Output 3

Training Programme for Recognized Researchers

CORE Project Team

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CORE PROJECT TEAM

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PROJECT CYCLE MANAGEMENT

1 ABOUT PROJECTS: INTRODUCTION

1.1 What is Project Cycle Management?

Project Cycle Management (PCM) is a systematic approach used to plan, implement, monitor, and evaluate projects. It provides a structured framework for managing projects from their inception to completion, ensuring that they are effectively and efficiently executed to achieve their intended objectives. PCM is commonly used in various sectors, including development, business, and public administration, to ensure that projects are well-organized, resources are utilized optimally, and outcomes are realized (Dearden and Kowalski, 2003).

The project cycle is typically divided into several phases, each with its own set of activities and processes. These phases generally include (Vasiljević et al., 2013):

- **Identification:** In this phase, potential projects are identified based on a thorough analysis of needs, opportunities, and problems. This is where the project's feasibility and relevance are assessed, and the objectives and goals of the project are defined.
- **Formulation and Design:** Once a project idea is approved, the formulation and design phase begins. This involves detailed planning of project activities, defining roles and responsibilities, estimating resources and costs, and developing a comprehensive project plan. This phase lays out the blueprint for how the project will be executed.
- **Implementation:** The project activities are carried out according to the plan developed in the previous phase. Resources are allocated, tasks are assigned, and stakeholders are engaged in executing the project. Effective communication, coordination, and monitoring are essential during this phase to ensure that the project stays on track.
- **Monitoring and Evaluation:** Regular monitoring and evaluation are critical to track the progress of the project and assess whether it is achieving its objectives. Key performance indicators (KPIs) are used to measure progress, and any deviations from the plan are identified. This phase helps in making informed decisions, identifying challenges, and making necessary adjustments to keep the project on course.
- **Completion and Closure:** Once all project activities are completed, the project is formally closed. This involves a final review of the project's outcomes and achievements against its initial goals. Documentation of lessons learned, successes, challenges, and best practices is an important part of this phase.
- **Follow-Up and Sustainability:** After the project is completed, efforts are made to ensure the sustainability of its outcomes. This may involve transferring ownership of the project to relevant stakeholders, ensuring that the benefits are long-lasting, and addressing any ongoing issues that may arise.

PCM emphasizes a participatory and iterative approach, involving stakeholders at various stages of the project cycle (Svoboda et al., 2018, p. 21). It promotes continuous learning, adaptability, and improvement throughout the project's lifecycle. Effective project cycle management contributes to successful project outcomes, increased accountability, and the efficient utilization of resources.

Project Cycle Management is a systematic framework that guides the planning, execution, monitoring, and evaluation of projects to achieve their intended objectives while ensuring

efficient resource utilization and stakeholder involvement. It is a dynamic process that facilitates effective project management and decision-making.

EU-funded projects and Project Cycle Management (PCM) share a close and symbiotic relationship. PCM is a structured approach to managing projects from their inception to completion, and it is particularly relevant in the context of EU-funded projects due to the unique requirements and characteristics of these projects.

History of PCM Approach: The roots of the Project Cycle Management approach can be traced back to the development sector and international organizations. In the mid-20th century, as development efforts expanded globally, there arose a need for more effective ways to plan, implement, and evaluate projects aimed at improving living conditions in developing countries (Kabeyi, 2019, p.73). The United Nations, World Bank, and other international institutions pioneered project management methodologies that emphasized systematic planning, participatory approaches, and continuous evaluation.

In the 1970s and 1980s, the European Commission (EC) adopted and adapted these principles into what we now recognize as Project Cycle Management. The EC's integration of PCM into its project funding and implementation processes was a response to the growing complexity of projects and the desire to ensure that funds were used efficiently and results were achieved. PCM became a cornerstone of the EC's project management practices, guiding the way projects were conceived, executed, and monitored.

1.2 Relationship Between EU-Funded Projects and PCM

Proposal and Planning (Identification and Formulation): When organizations or entities apply for EU funding, they are essentially proposing a project. The process of identifying potential projects and formulating proposals aligns with the identification and formulation phases of PCM. Project proponents need to clearly outline the project's objectives, activities, expected outcomes, and budget. The alignment of the project proposal with the EU's funding criteria and guidelines is crucial at this stage.

Implementation: Once EU funding is secured and the project is approved, the implementation phase begins. PCM provides the structured approach for executing the project according to the defined plan. Activities are carried out, resources are allocated, and stakeholders are engaged to achieve the project's objectives. The adherence to the project plan and effective coordination among partners and stakeholders are central to successful implementation.

Monitoring and Evaluation: PCM emphasizes continuous monitoring and evaluation throughout the project lifecycle. Similarly, EU-funded projects are subject to ongoing scrutiny to ensure they are on track, effectively utilizing resources, and achieving the intended outcomes. Regular reporting, assessment of Key Performance Indicators (KPIs), and identification of deviations from the plan are common practices in both PCM and EU-funded projects.

Reporting and Compliance: EU-funded projects often require regular reporting to the EU authorities to demonstrate progress and compliance with established guidelines. This reporting process corresponds to the monitoring and evaluation phase of PCM, where project managers

assess achievements, challenges, and necessary adjustments. Accurate and transparent reporting is essential to maintain the EU's confidence in the project's implementation.

Closure and Sustainability: As EU-funded projects near completion, PCM supports the closure phase, involving final reviews, documentation of lessons learned, and preparation for the project's sustainability. This phase aligns with the principles of PCM by ensuring that project outcomes are sustained beyond the project's lifespan and that long-term benefits are realized. (Arcidiacono, 2014, p. 4-5)

1.3 Why is PCM important?

The Project Cycle Management (PCM) approach holds significant importance in the context of grants and calls for proposals, particularly when organizations are seeking funding from various sources, including government agencies, foundations, and international bodies. PCM provides a structured and comprehensive framework that aligns well with the requirements and expectations of grantors and funding agencies. Here's why the PCM approach is crucial for grants and call for proposals (Minelle et al., 2022):

Effective Resource Utilization: Grants and calls for proposals often come with specific budget constraints and requirements. PCM ensures that resources, both financial and non-financial, are used efficiently and effectively throughout the project lifecycle. By following PCM principles, organizations can better allocate funds, materials, and personnel to achieve maximum impact.

Clear Project Planning: PCM requires organizations to thoroughly plan their projects before implementation. This planning includes defining project objectives, activities, timelines, and expected outcomes. Clear project planning is essential to convince grantors that the proposed project is well thought out and has a high likelihood of success.

Alignment with Funding Criteria: Many grants and calls for proposals have specific criteria and guidelines that applicants must adhere to. PCM's structured approach helps organizations align their proposals with these criteria, increasing the chances of their projects being considered for funding.

Measurable Results and Accountability: PCM emphasizes setting measurable objectives and Key Performance Indicators (KPIs) to evaluate project progress and success. This aligns well with the expectations of grantors who seek clear evidence of impact and accountability. Demonstrating how PCM will be used to track and report on project outcomes can enhance the credibility of grant applications.

Risk Management: Grantors are often interested in projects that are well-prepared to address potential risks and challenges. PCM's emphasis on risk assessment and management allows organizations to identify and mitigate potential issues, providing assurance to funders that projects are being implemented with foresight and diligence.

Stakeholder Engagement: Many grantors require evidence of stakeholder involvement and collaboration. PCM's participatory approach involves stakeholders at various stages of the project cycle, ensuring that their input is considered and integrated. This can strengthen the credibility of grant applications and proposals.

Evaluation and Learning: Grantors value projects that incorporate a learning and improvement mindset. PCM's continuous monitoring and evaluation process enable organizations to track progress, identify areas for improvement, and make necessary adjustments. This commitment to learning aligns with funders' interests in maximizing the impact of their investments.

Sustainability: Grantors often seek projects that have a lasting impact beyond the funding period. PCM's focus on project closure and sustainability ensures that organizations plan for the continuation of project outcomes even after the grant has ended.

In essence, the Project Cycle Management approach provides a robust and systematic methodology that enhances the quality, credibility, and competitiveness of grant proposals and applications. By incorporating PCM principles into their submissions, organizations demonstrate their commitment to effective project management, results-oriented planning, and transparent accountability—qualities that are highly valued by grantors and funding agencies.

1.4 How to interpret guidelines and/or call for proposals?

A "call for proposals" (CFP) is a formal invitation or announcement made by a funding organization, such as a government agency, foundation, non-governmental organization (NGO), or international institution, to solicit project ideas, initiatives, or solutions from individuals, groups, or organizations. The purpose of a call for proposals is to identify and select projects or programs that align with the funding organization's priorities, goals, and objectives (EUCalls, 2023).

A call for proposals typically outlines the specific areas of interest, themes, or topics for which the funding is being made available. It provides detailed instructions, guidelines, and eligibility criteria for interested parties to submit their project proposals. The submission process usually involves preparing and submitting a comprehensive proposal that outlines the project's concept, objectives, activities, budget, timeline, expected outcomes, and a plan for implementation and evaluation.

Key elements of a call for proposals include:

- **Thematic Focus:** The call for proposals specifies the subject areas or themes for which funding is available. This could range from health, education, and environment to social development, technology, and arts, depending on the priorities of the funding organization.
- **Eligibility Criteria:** The call defines who is eligible to apply for the funding. This may include criteria such as the type of organizations (e.g., NGOs, academic institutions, private companies), geographic locations, and target beneficiaries.
- **Project Requirements:** Details about the type of projects sought, their scope, and expected outcomes are outlined in the call. This helps potential applicants understand what kind of projects the funding organization is interested in supporting.
- **Budget and Funding:** The call provides information on the available budget, funding limits, and financial requirements. It may specify whether the funding is partial or full, and if matching funds are required from the applicants.

- **Submission Guidelines:** The call lays out the process for submitting proposals. This includes information about submission deadlines, required documentation, format of the proposal, and any specific templates or forms that need to be used.
- **Review and Selection Process:** The call may outline the evaluation criteria that will be used to assess proposals. It might also provide details about the review process, including who will be reviewing the proposals and how the selection decisions will be made.
- **Timeline:** The call typically includes important dates, such as the opening and closing dates for proposal submissions, the expected announcement of selected proposals, and the projected start and end dates for funded projects.
- **Contact Information:** The call provides contact details for inquiries and clarifications, allowing potential applicants to seek additional information if needed.

A call for proposals is a competitive process, and organizations or individuals interested in securing funding must carefully adhere to the requirements and guidelines specified in the call. Successful proposals are those that effectively demonstrate alignment with the funding organization's priorities, a well-defined project plan, and a clear potential for positive impact or outcomes.

Various institutions at different levels publish call for proposals to provide funding for specific objectives. These objectives are related with their agenda and usually have a background analysis and/or based on policy documents. This call for proposals usually include a guideline, a template document for the Project proposal and supporting documents. Before preparing a project, it is crucial to examine the guideline document properly.

What you need to do first is to check the objectives of the programme and activities that can be supported. If you have a project idea that doesn't match with the call for proposals, it is hard to justify your activities, so even though your proposal is prepared perfectly, the chances about receiving a fund would be slim.

The next thing you need check is eligibility criteria. This means who/which actor can apply for the programme. Although, there are programmes those support individuals, most of the programmes opt to fund legal entities. These entities can be public / private institutions, non-governmental organizations, schools, universities, unions, umbrella organizations etc. Usually, political parties are not supported. In some programmes, such as Erasmus+, some actions can include non-formal youth groups that have no legal entity. So, before you apply, you need to be careful about this exemptions and exclusions as well.

Call for proposals can also include certain financial and organizational capacity criteria as well. So, if you are planning to apply a Project from the organization that you are working for, make sure to read and understand this part as well. If the call for proposals state that your organization shouldn't have any debts due to social security payments and tax and your organization cannot comply this, it is better for you to know this before you prepare the proposal.

Call for proposals generally ask applicants to create a consortium. The rules for establishing the consortium (such as minimum/maximum number, location, capacity of partners) are stated in the guide. The international programmes usually require for you to establish a consortium with

partners abroad. Therefore, it is important to understand the required partnership structure and analyze whether you can have suitable partners with necessary qualifications.

Budget is also another important part you need to check. If you already have a Project in mind, you need to adjust the scope of the activities in line with the budget of the programme. If you have a consortium, you need to consider the finance of their activities as well. It is also imporant to check what kind of activities and/or components can be financed from the programme. Ineligible activities can be financed from outside sources. Some programmes may require from you to contribute the proposal financially up to certain degree. This process called co-finance. While some programmes may require you to finance certain part of the Project directly via bank account, some other programmes may accept in-kind contributions (such as use of Office supplies, fixed equipments, Office rent, payment of bills etc.) and/or appointment of workers of your organization. It is possible for you to co-finance the Project from your consortium partners.

Deadline and application method is also important part of a call for proposals. You need to make sure that you sent your proposal via proper channels. Some programmes require for you and/or your organization to register to digital and/or offline platforms. Therefore, you need to make sure that you can complete these processes before application. If programme requires physical application, you need to examine the acceptance details. Some programmes may accept the proposals by checking time stamp of the post Office, some programmes don't. So, if the programme that you will apply requires for application to reach the address/destination in a given time, you may need to send the application 3-4 days or even 1 week prior to deadline.

A general examination of a project application template and evaluation criteria is important because it gives you a general idea regarding the time and resources that you are going to use in the preparation process of the Project application. The guiding questions and character limitations will provide you a general idea about the degree of details required in application.

1.5 Which programmes should I look for?

1.5.1 Erasmus+

Erasmus+ is the EU's programme to support education, training, youth and sport in Europe.

It has an estimated budget of €26.2 billion. This is nearly double the funding compared to its predecessor programme (2014-2020).

The 2021-2027 programme places a strong focus on social inclusion, the green and digital transitions, and promoting young people's participation in democratic life.

It supports priorities and activities set out in the European Education Area, Digital Education Action Plan and the European Skills Agenda. The programme also

- Supports the European Pillar of Social Rights
- İmplements the EU Youth Strategy 2019-2027
- Develops the European dimension in sport

Erasmus+ offers mobility and cooperation opportunities in

- Higher education
- Vocational education and training
- School education (including early childhood education and care)
- Adult education
- Youth
- Sport

Source: https://erasmus-plus.ec.europa.eu/about-erasmus/what-is-erasmus

1.5.2 Horizon Europe

Horizon Europe is the EU's research and innovation programme for 2021-2027 with a budget of €95.5 billion.

It tackles climate change, helps to achieve the UN's Sustainable Development Goals and boosts the EU's competitiveness and growth.

The programme facilitates collaboration and strengthens the impact of research and innovation in developing, supporting and implementing EU policies while tackling global challenges. It supports creating and better dispersing of excellent knowledge and technologies.

It creates jobs, fully engages the EU's talent pool, boosts economic growth, promotes industrial competitiveness and optimises investment impact within a strengthened European Research Area.

Open and upcoming calls for Horizon Europe

The previous programmes (Horizon 2020 and FP7)

Horizon 2020

Research and Innovation funding 2007- 2013 (Archived site)

1.5.3 Health Programme

The third EU Health Programme with a budget of € 449.4 million is the main European Commission instrument to implement the EU health strategy.
Open and upcoming calls for the Health Programme

1.5.4 Cohesion Fund

The Cohesion Fund is aimed at EU countries whose gross national income (GNI) per inhabitant is less than 90% of the EU average. It aims to reduce economic and social disparities and to promote sustainable development.
Open and upcoming calls for the Cohesion Fund

1.5.5 Environment and climate action (LIFE)

The LIFE programme is the EU's financial instrument supporting environmental, nature conservation and climate action projects throughout the EU. Since 1992, LIFE has co-financed more than 4500 projects.
2021 LIFE programme calls

1.5.6 European Regional Development Fund (ERDF)

The European Regional Development Fund aims to strengthen economic and social cohesion in the European Union by correcting imbalances between its regions. The ERDF focuses its investments on several key priority areas, including innovation and research.
DG REGIO open calls

1.5.7 Structural Reform Support Programme (SRSP)

The Structural Reform Support Programme (SRSP) is an EU programme that provides tailor-made support to all EU countries for their institutional, administrative and growth-enhancing reforms.
Open calls for proposal can be found on the programme's website.

1.5.8 European Structural and Investment Funds (ESIF)

Over half of EU funding is channelled through the 5 European structural and investment funds (ESIF). They are jointly managed by the European Commission and the EU countries. The purpose of all these funds is to invest in job creation and a sustainable and healthy European economy and environment.
Open calls for proposal related to research and innovation can be found on the websites of the 5 individual funding programmes:
European regional development fund (ERDF)
European social fund (ESF)
Cohesion fund (CF)
European agricultural fund for rural development (EAFRD)
European maritime and fisheries fund (EMFF)

1.5.9 Research Fund for Coal and Steel (RFCS)

The Research Fund for Coal and Steel supports research projects in coal and steel sectors. Every year around €55 million (€47.7 million for 2015) is made available to universities, research centres and private companies to fund projects.
Open and upcoming calls for RFCS
Source: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls_en

Project cycle management is adopted by the European Commission in 1992 as primary tool for designing and managing projects. Project cycle management is based on the logical framework approach. (EU Commission, 2004, p.1)

In this work, we will aim to have an overall practical approach for preparation and implementation of the Projects.

2 PROJECT PLANNING

2.1 Problem Analysis

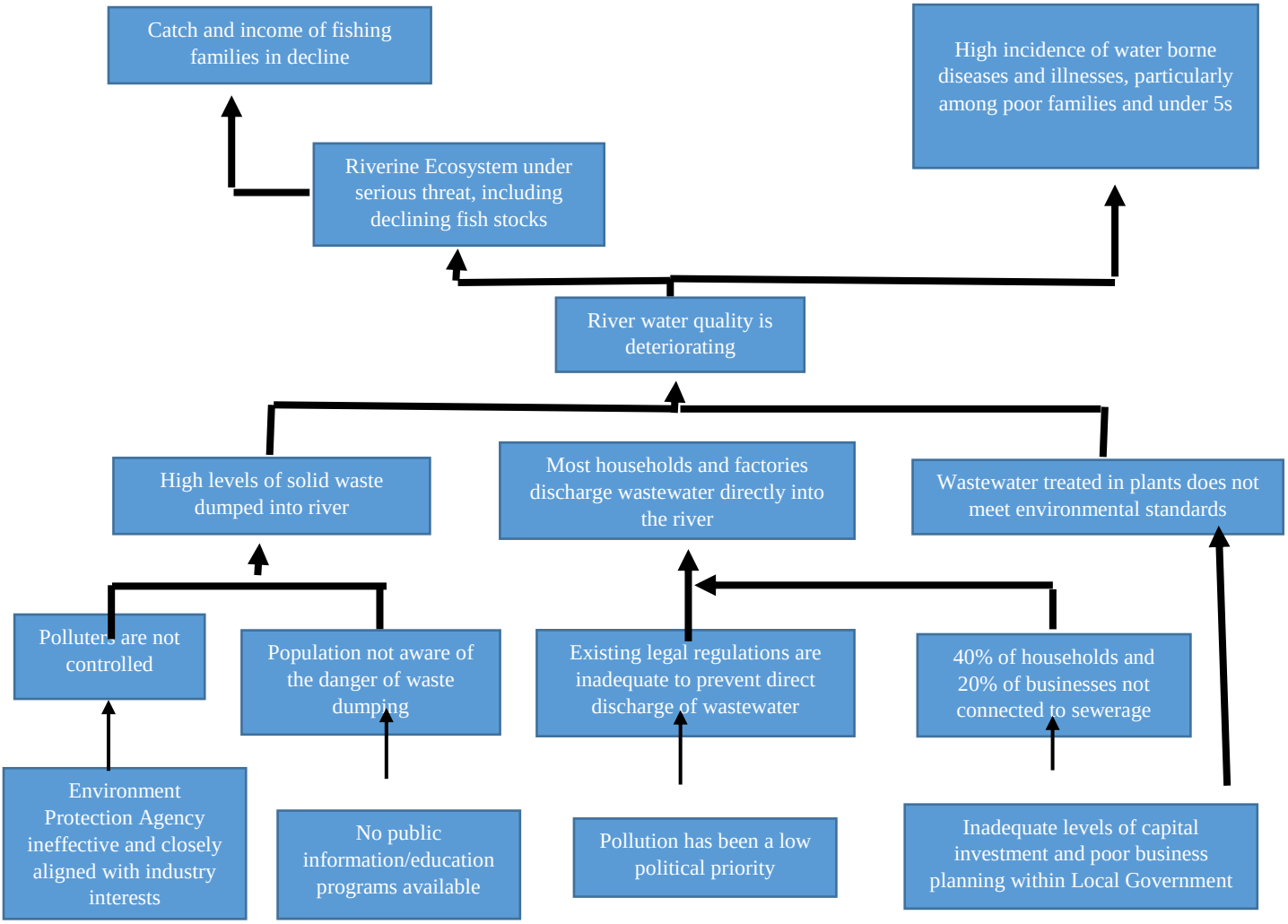

Figure 1: *Problem Analysis – River Pollution* (EU Commission, 2004, p.78).

Problem tree analysis (also known as causes-and-effect diagram) is a useful method to see the root causes and effects of a problem together and to create goals and strategies accordingly (Mahto and Kumar, 2008, p. 22-23). It also allows for teamwork and creation of hierarchical order of problems and effects. In the middle of the problem tree is the main problem to which the project aims to intervene. Your main problem in the project, if solved, should contribute to the overall purpose of the project. In other words, the general purpose of the project will not directly include a problem that you will completely overcome during the project but will express a general situation targeting a negative situation resulting from the effects of this problem. For example, if you have identified youth unemployment as the main problem in your project, all of the goals and activities to combat this situation will contribute to the achievement of the overall goal. Therefore, your project will contribute to overall objective to a certain extent by addressing this problem.

Table 1. ***Nested objectives (policy, programme and project)***

Policy (Of the National Agricultural Research Council)	**Programme (Of the Research Stations)**	**Project (Of the Research Teams)**
Overall objective: To contribute to the improved livelihood of hill farming families		
Purpose: Increased agricultural production, productivity and incomes among hill farming households	Overall objective: To contribute to increasing agricultural production, productivity and incomes among hill farming households	Overall objective: To contribute to increased use of recommended improved technologies
Result: The use of improved agricultural technologies increased among targeted farmers	Purpose: Increased use of improved agricultural technologies by hill farmers (e.g. rice)	Purpose: Recommendations provided for improved technologies suitable for targeted farmers
	Result: Recommendations for targeted farmers provided/disseminated	
		Results (e.g.): 1. Technologies identified based on farmer priorities 2. Technologies generated and adapted 3. Technologies verified in farmers fields

Source: EU Commission (2004, p. 94).

You can also use a grant guide or call for proposals if you find it difficult to relate your main problem with the overall objective. Grant institutions and programs have their own priorities and objectives. You can use the sub-purposes of these programs while determining your general purpose. Thus, by referencing these goals, you also demonstrate the relevance of your project to the program. In this case, you can use these programme sub-objectives as they are, or you can use original sentences. On the other hand, you can define a unique overall objective using the tree you have created. In this case, you will need to briefly summarize the effects at the top of the hierarchy in a unique and comprehensive sentence. When we consider a grant program related to young people, an overall objective can be determined as follows: "to contribute to reduction of the social and economic disadvantage of young people and to improvement of their psychological well-being".

Once you have identified your main problem, you need to identify the factors that cause it. You should arrange which element causes which problem hierarchically by putting them in an order. If we take the example of youth unemployment in a region, lack of working experience may be

one of the main reasons for youth unemployment. The reason for the lack of working experience can be listed as the lack of internship opportunities, the low number and capacity of companies in the field where young people graduate, the lack of basic communication skills among young people, the lack of career planning, support, and guidance for young people, etc.. Among these sub-problems, it is possible to make a deeper analysis. If we take the sub-problem of the lack of basic communication skills in young people as an example, the lack of adequate training in basic communication skills in schools, the lack of sufficient knowledge, skills, and capacity of families about basic communication skills, the limited spaces and activities for socialization and communication can be listed as root problems. This sequencing can be performed and detailed until root causes are reached.

To the extent that the main problem is detailed, it will be able to be analyzed well, and targets and strategies can be determined. Planning the necessary activities for these goals and strategies is also related to a good analysis at this stage. The sub-problems you have identified will turn into activities that will be organized in order to reach the goals and objectives in the following stages (Vesely, 2008).

At the top of your main problem in the problem tree, there are the effects of this main problem. The effects you will detect should be detailed in the "impact" section of your project proposal form. For this reason, it is important to consider all effects and stakeholders while analyzing the problem at the first stage. Like the problem analysis, the more detailed the impact analysis, the more successful and comprehensive intervention logic will be put forward. This will enable you to detail the indicators you will determine in measuring the effects of your project and to measure the success in a more comprehensive and objective way. Again, if we were to give an example from the main problem of youth unemployment, this problem can lead to an increase in depression, in crime, in the use of harmful substances, cigarettes and alcohol, in social idle capacity, social exclusion of young people, and in jobs that require low qualifications rather than value-added jobs in the fields where young people are educated. These effects can be further deepened and detailed. For example, the emergence of depression in young people may cause an increase in suicide rates, a decrease in young people's expectations from life and hopelessness, an increase in depression drug use, an increase in psychologist / psychiatry services, etc..

The causes and effects of the main problem may also be related to more than one sub-cause and effect. In this case, connecting the items in your problem tree with arrows and lines will prevent confusion.

Steps for Problem Tree
1. Step: Identify the core problem
2. Step: Look for related problems to the starter problem.
3. Step: Begin to establish a hierarchy of cause and effects:
- Problems which are directly causing the starter problem are put below.
- Problems which are direct effects of the starter problem are put above.
4. Step: All other problems are then sorted in the same way – the guiding question being ‘What causes that?’
If there are two or more causes combining to produce an effect, place them at the same level in the diagram.
5. Step: Connect the problems with cause-effect arrows – clearly showing key links

6. Step: Review the diagram and verify its validity and completeness.
Ask yourself/the group – 'are there important problems that have not been mentioned yet?'
If so, specify the problems and include them at an appropriate place in the diagram.

Source: Summarized from EU Commission (2004, p.67).

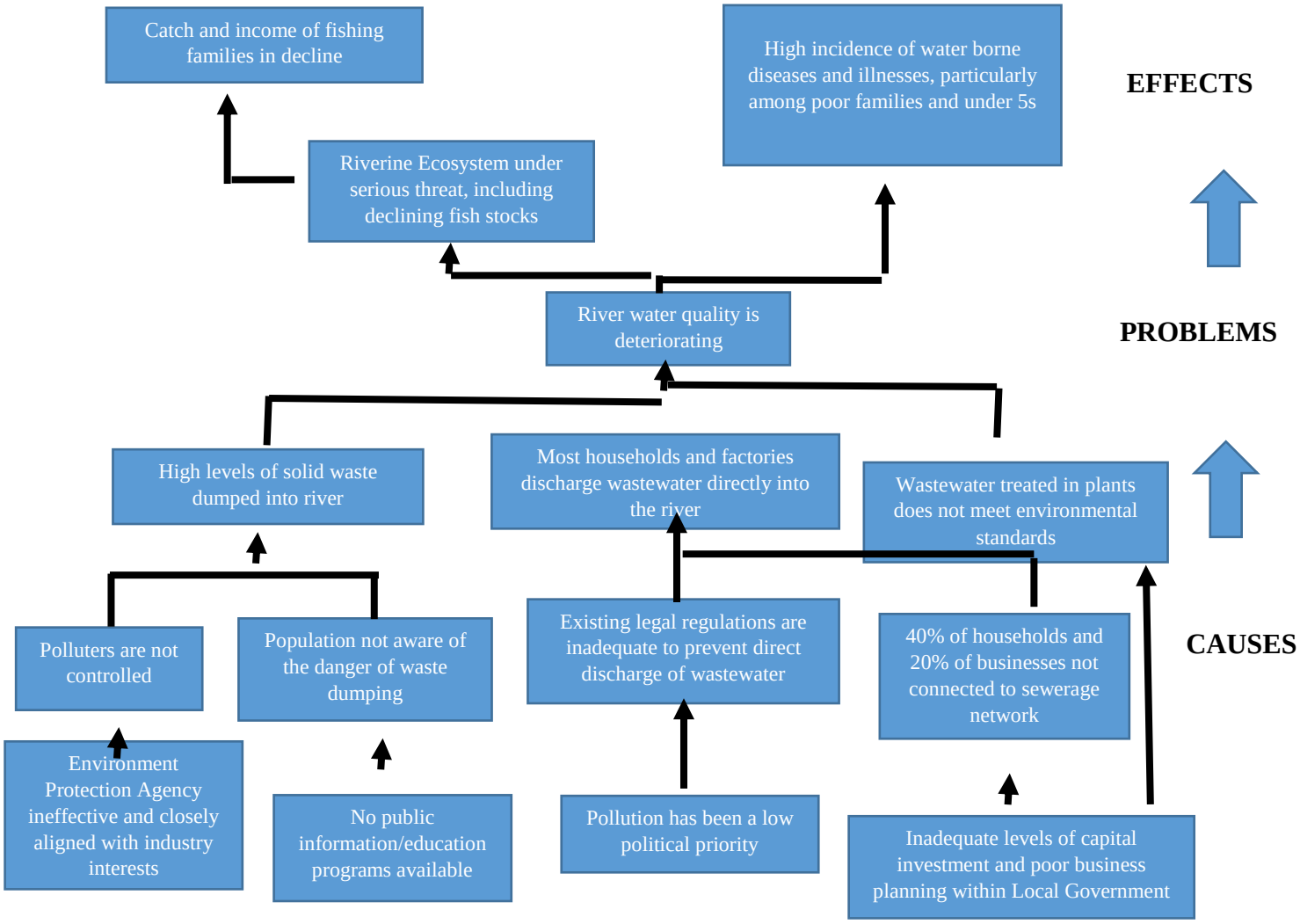

Figure 2. *Problem Tree Analysis with Effect and Causes Nexus* (EU Commission, 2004, p.78).

Problem Tree Analysis Examples

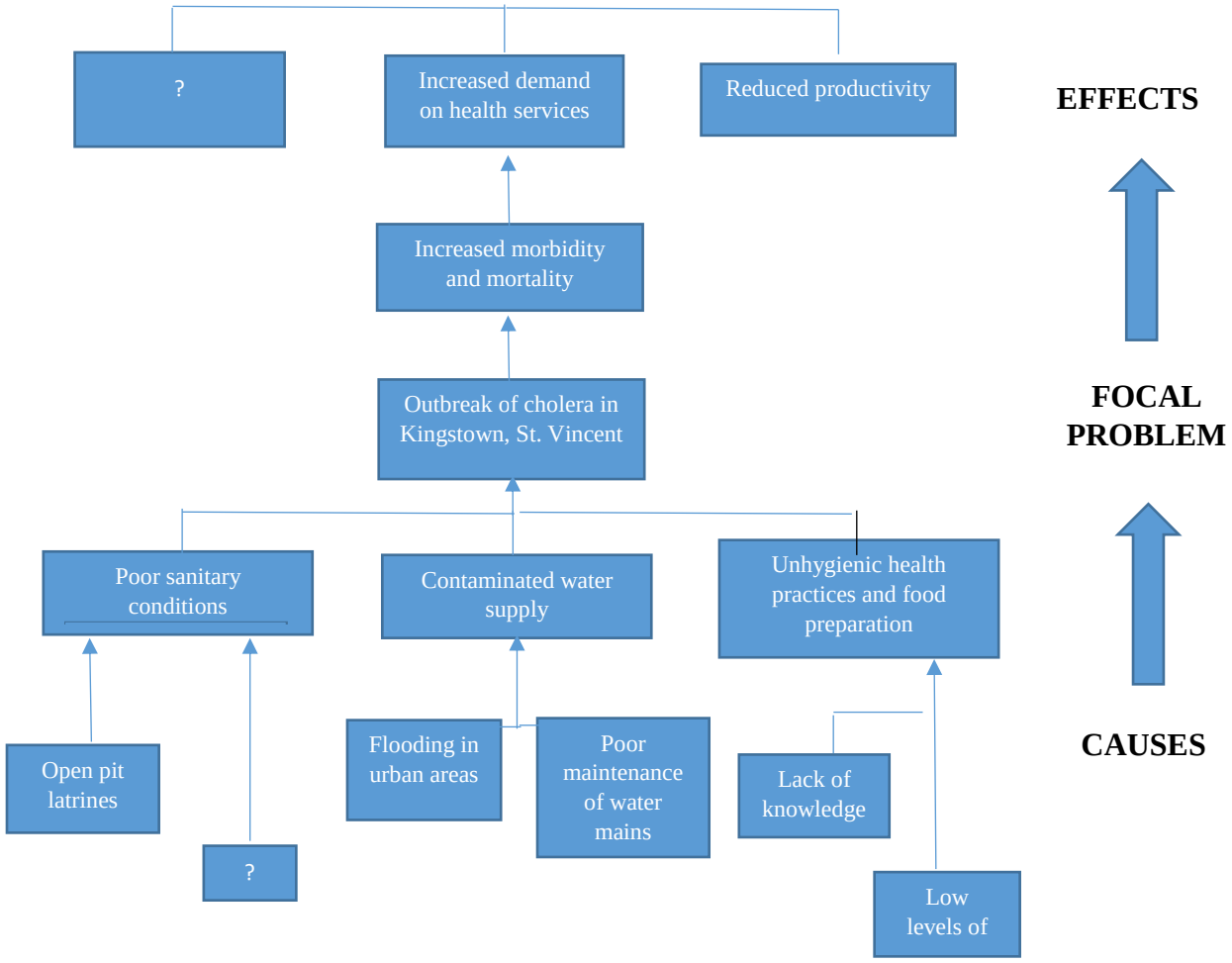

Figure 3. *Problem Tree Analysis Example* (Ammani et al., 2011).

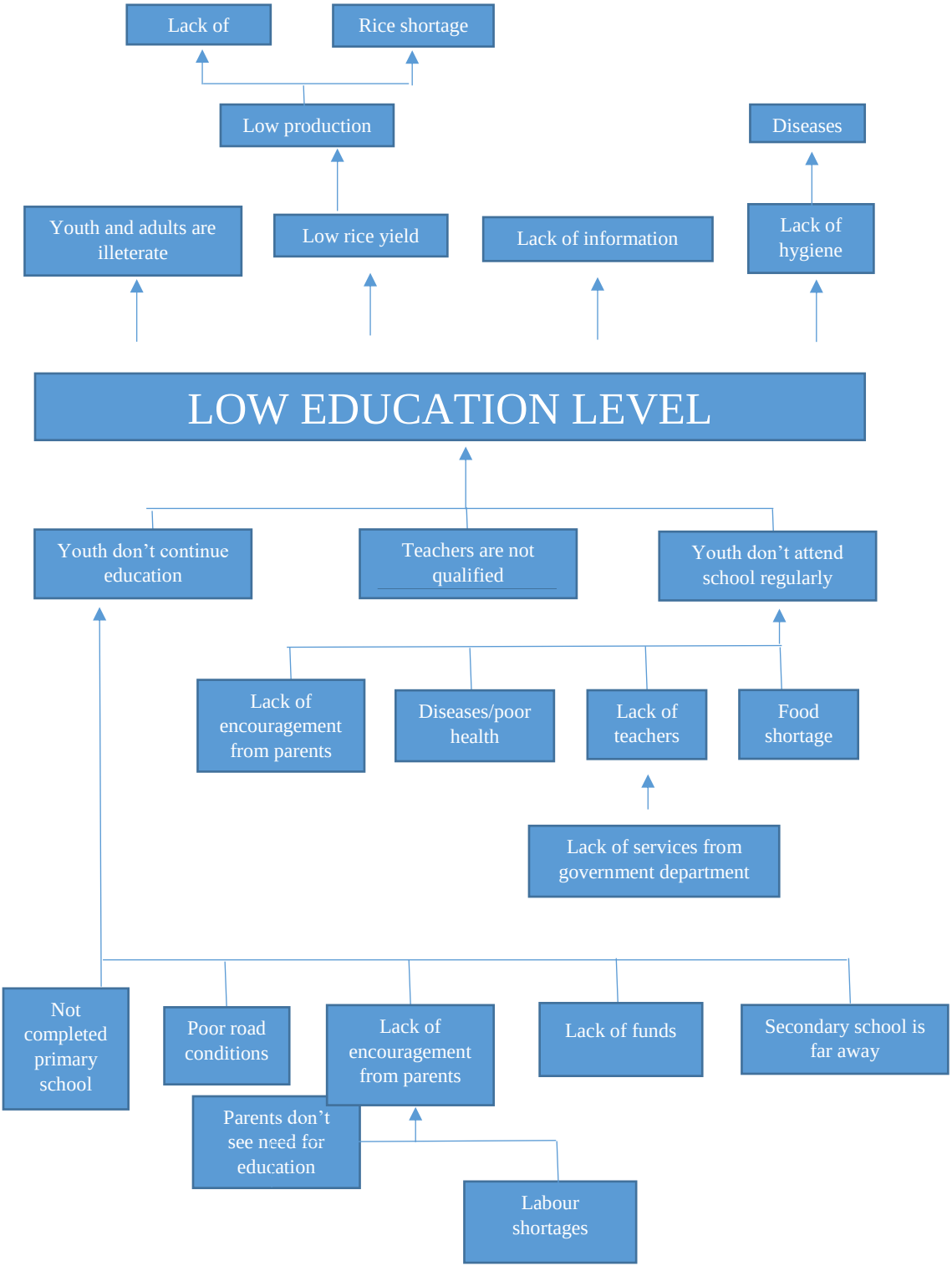

Figure 4. *Problem Tree Analysis Example*

Source: https://www.fao.org/3/ag106e/AG106E17.htm

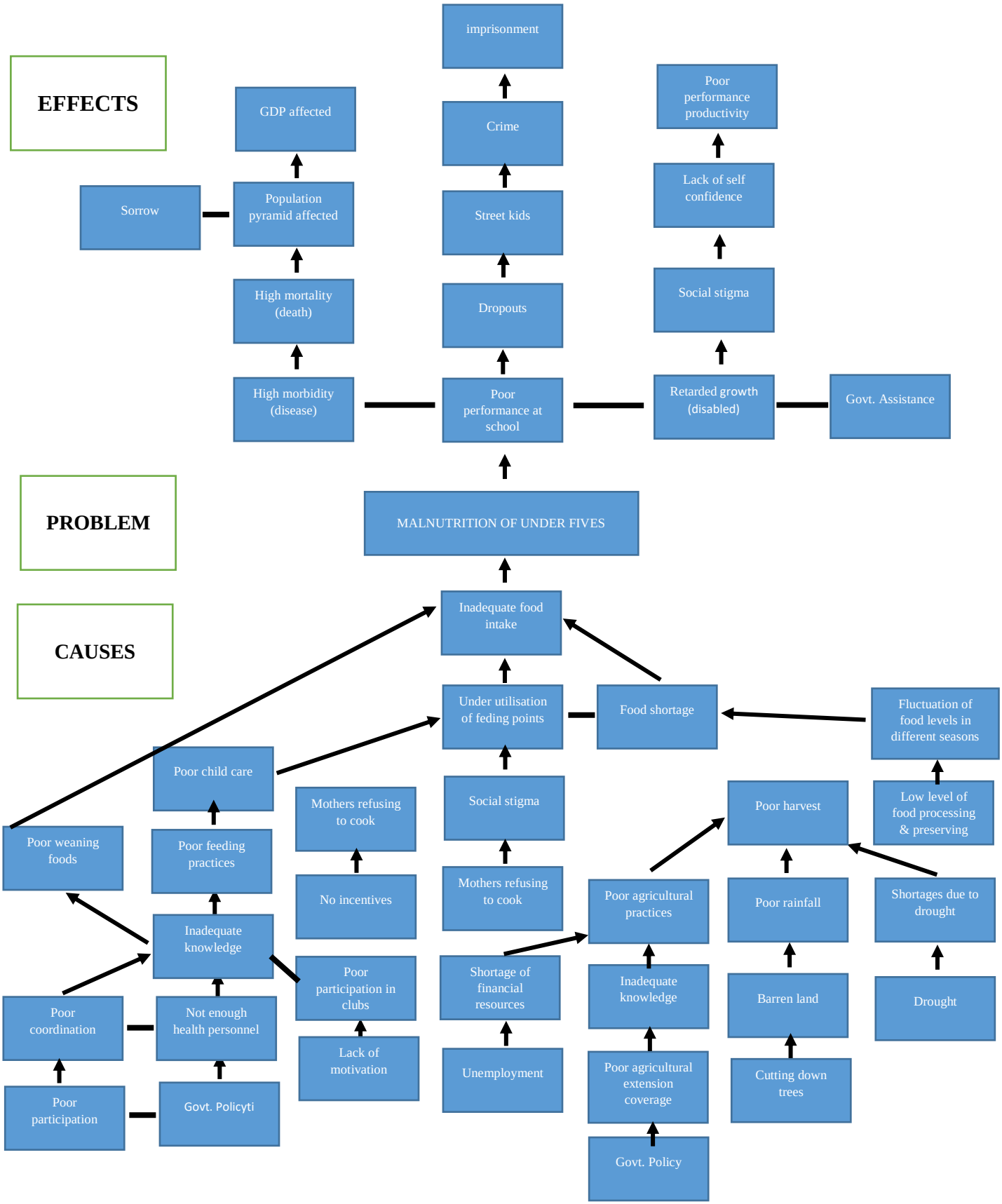

Figure 5. *Problem Tree Analysis Example*

Source: https://www.fao.org/3/y5793e/y5793e04.htm

Figure 6. *Problem Tree Analysis Exapmle*

Source: https://www.thegrassrootscollective.org/problem-objective-tree-development

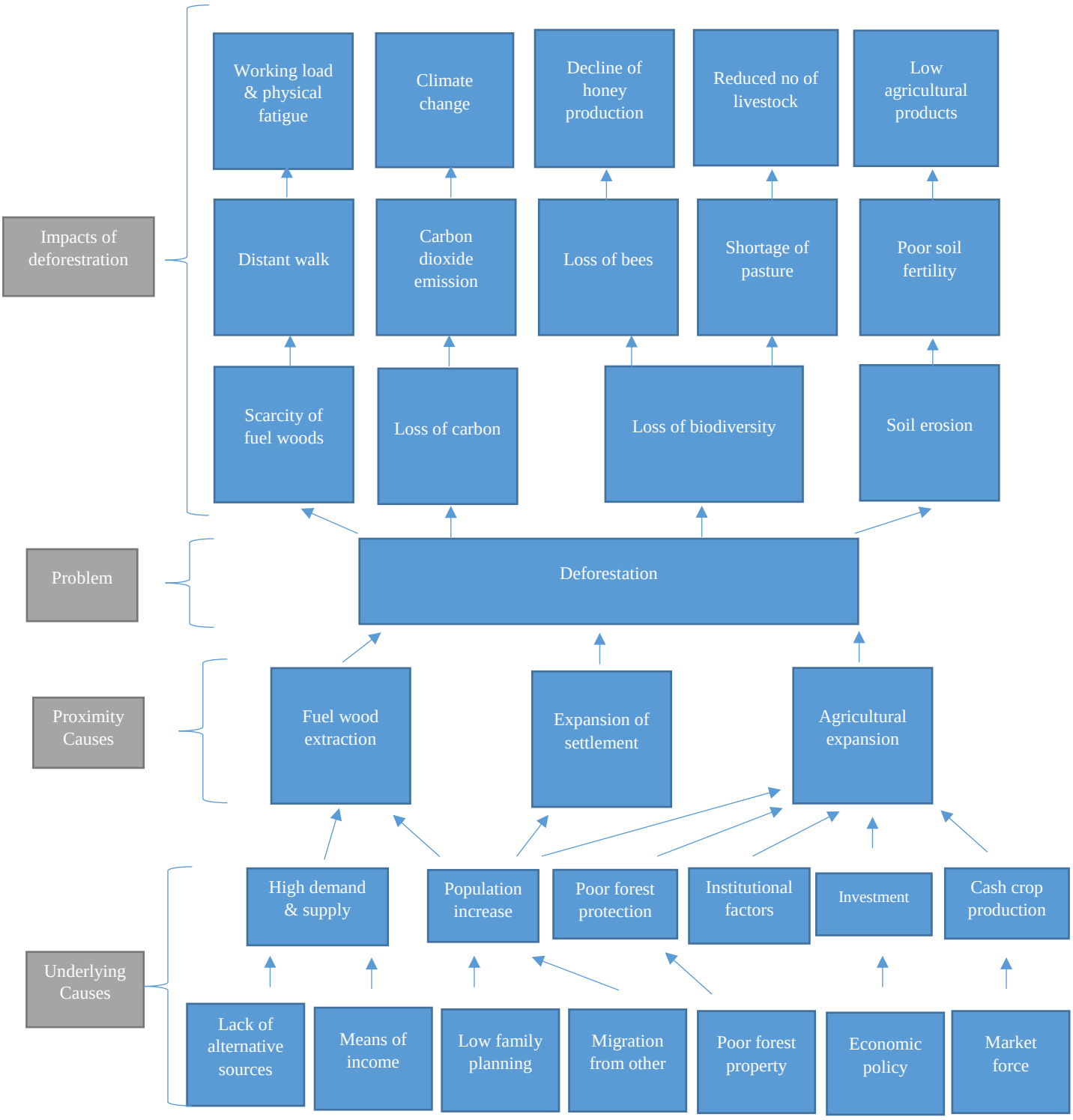

Figure 7. *Problem Tree Analysis Exapmle* (Ayele et al., 2019).

2.2 Objective Analysis

Another step after problem tree analysis is goal analysis. The success and extent of the goal analysis is related to how well and correctly the problem analysis is done. Goal analysis is performed by transforming the problems identified in your problem tree into goals.

If we give an example through the problem of youth unemployment, our goal will be defined with positive sentences such as reducing youth unemployment or increasing youth employment. However, as mentioned in the problem analysis, your project will provide the solution to the main problem, but will not be at a level to solve the overall problem alone. Therefore, if you turn the general problem into a goal, your overall goal/objective in your project proposal will be "To reduce the social and economic disadvantage of young people and to contribute to their psychological well-being.". Your purpose should be defined in a more specific framework that includes the stakeholders of the project. For this, stakeholder analysis is required.

Once you have determined your project goals, the activities you will perform while achieving these goals will have results. These results are related to root causes at the bottom of your problem tree analysis. Similarly, you need to transform your sub-problems and root causes into results with positive and desirable sentences (Usha Rani et al, 2022, p. 32).

After converting all the statements in your problem tree into goals, a draft version of your goal analysis will be prepared. However, to complete the analysis, it is helpful to double-check the hierarchical connection of the targets and add new targets as needed. After these revisions, your target analysis will be complete.

Steps for Analysis of Objectives

1. Step: Reformulate all negative situations of the problems analysis into positive situations that are: • desirable • realistically achievable

2. Step: Check the means-ends relationships to ensure validity and completeness of the hierarchy (cause-effect relationships are turned into means-ends linkages)

3. Step: If necessary:

- revise statements
- add new objectives if these seem to be relevant and necessary to achieve the objective at the next higher level
- delete objectives which do not seem suitable or necessary

Source: EU Commission (2004, p. 69)

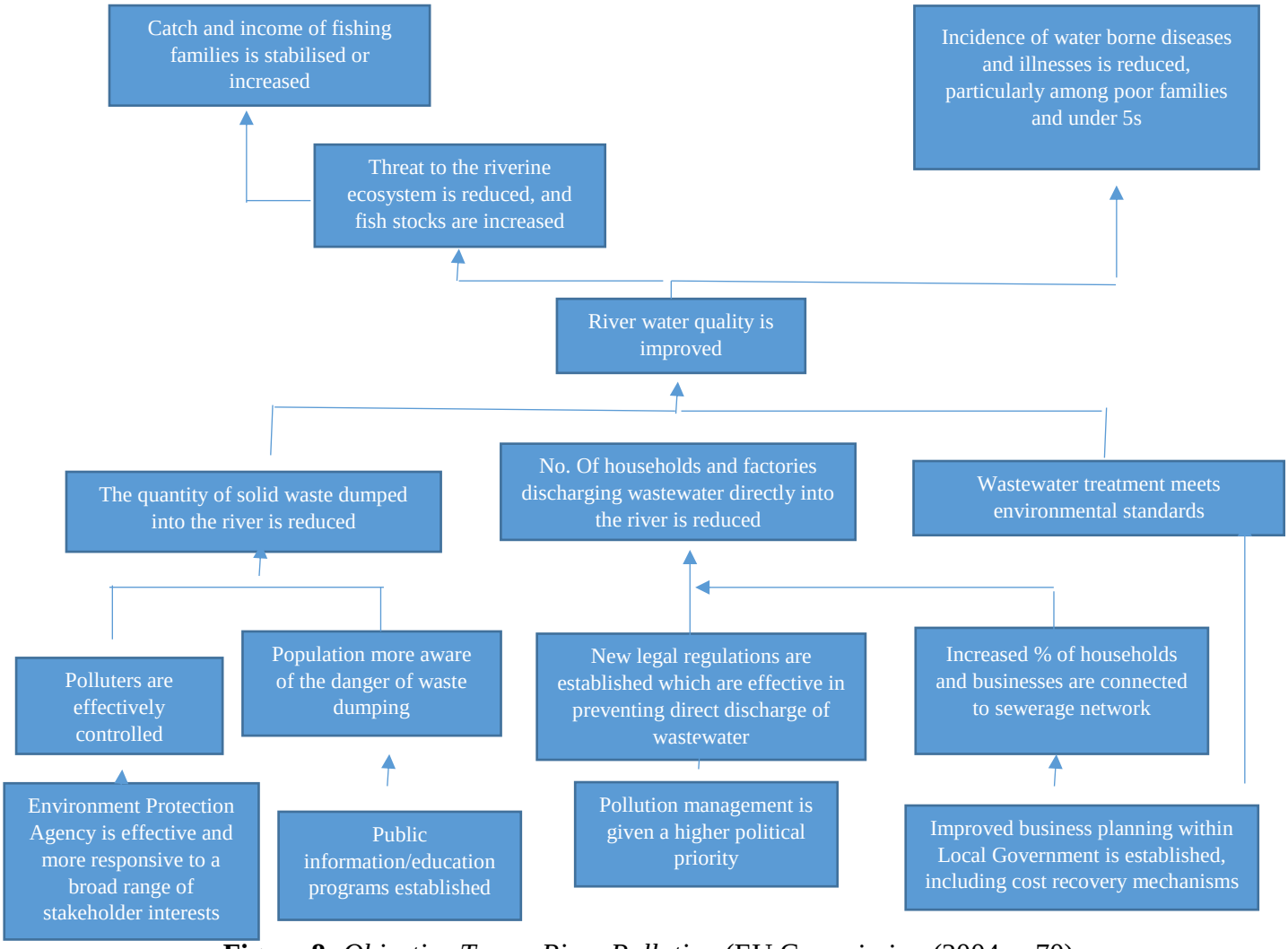

Figure 8: *Objective Tree – River Pollution* (EU Commission (2004, p.70).

2.3 Strategy Analysis

Strategy analysis is the final stage in creating the main scheme of the project. As mentioned in the previous stages, project resources are limited, so only a contribution can be made to the solution of the main problem. On the other hand, while providing this contribution, it will not be possible to fulfill all of the sub-goals. For this reason, one or more of the sub-targets will have to be excluded from the target analysis.

When determining your strategy, you need to analyze which goals you can achieve effectively, efficiently and accurately. Identifying the methodology with the lowest risk will result in fewer problems in the implementation phase.

Other additional issues that you should pay attention to may vary depending on the content of the grant program. It is important to determine the strategy that will maximize the sustainability of the objectives and the activities determined accordingly, promote green economy and climate change awareness, gender equality, positive impact on the disadvantaged, synergy and capacity development that can be created among the stakeholders.

In the strategy analysis

- You have limited resources.

- Therefore, you need to choose a strategy to determine the problem that you want to tackle.
- Choose 1 or more than 1 objectives as you see fit.

You can tackle with the remaining problems in other projects.

- Analysis the identified (potential) objectives in relation to a set of 'feasibility' criteria
- Selects an appropriate strategy for project implementation,
- Decision is based on policy priorities, budget, human resources, urgency, social acceptability, etc.

Part of the objective tree is possibly not a part of the project but should be considered in the analysis of assumptions and risk.

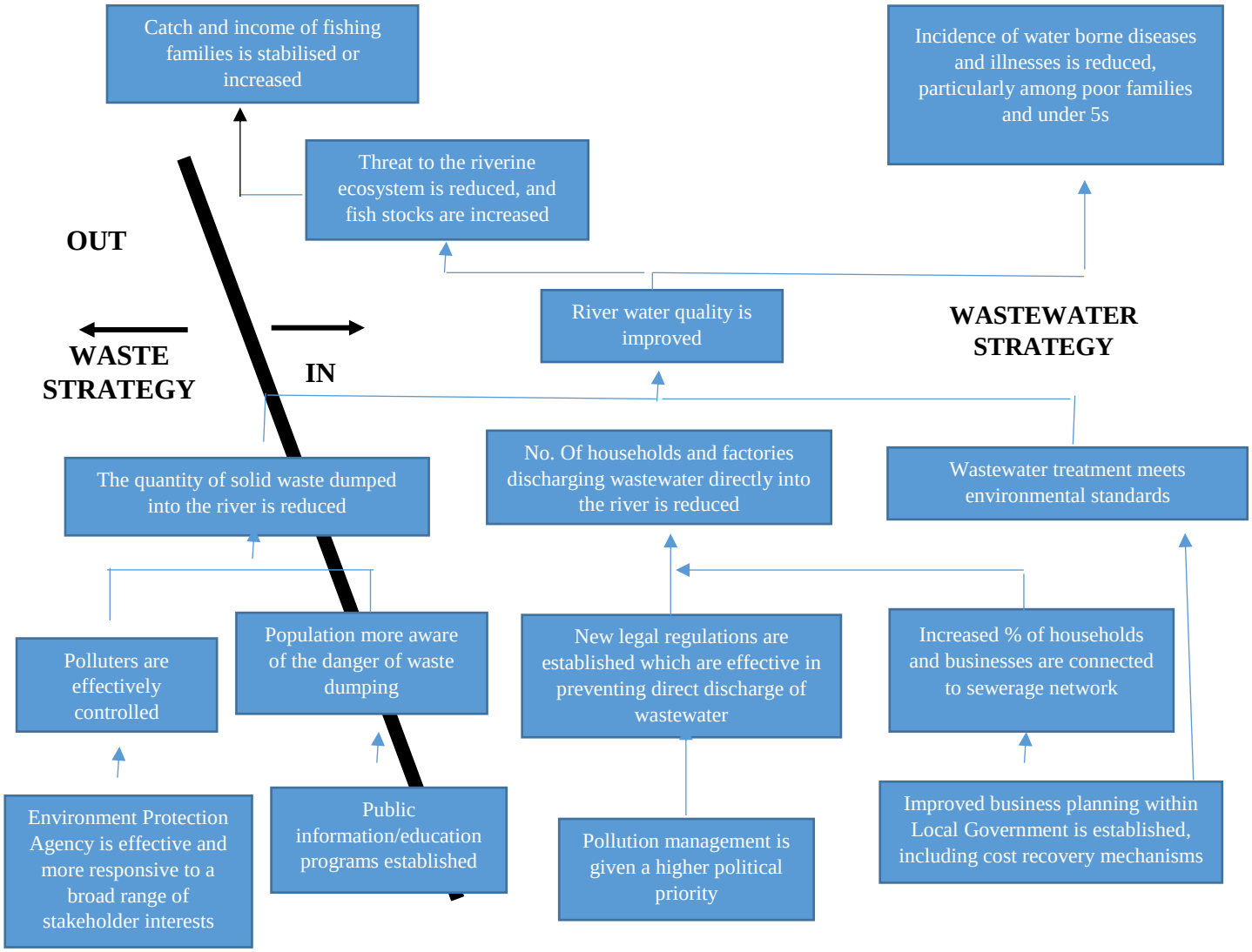

Figure 9: *Strategy Selection – River Pollution* (EU Commission (2004, p.72).

2.4 Stakeholder Analysis

Stakeholders in the projects are actors, individuals (target group), organizations, institutions at local, regional, national, international levels directly or indirectly affected by the activities that you will carry out (Aaltonen, K., & Sivonen, R. 2009, p.132). Stakeholders are essential part of a Project. Therefore, it is important to make a proper analysis before preparing your proposal. It is important to identify your stakeholders and partners while you are preparing the rationale

part of the proposal. The most effective, important and key actors/institutions/organizations should be identified.

You can split stakeholder analysis into two components: Beneficiaries and Consortium Partners

Beneficiaries can be examined under two categories:

Target Group(s): Project target group(s) is (are) directly and positively affected by activities at Project purpose level. Workers from consortium partners can be also included to target group(s). (EU Commission, 2004, p.62)

Final Beneficiaries: Final beneficiaries are also people that will benefit from the Project activities. However, the difference from the target group(s) is that they will be affected in the long term. For example, if you implement a Project aiming for promoting social entrepreneurship in an area and you are directly supporting 50 potential entrepreneurs, those 50 potential entrepreneurs are in your target group. Once the Project activities ended and those entrepreneurs started their businesses, unemployment in the area will be started to reduce, economy will flourish to a certain degree, social problems will be reduced.

While you are identifying your final beneficiaries, it is important to be realistic and objective. You should make a good analysis with tangible and specific objectives. If you expect an impact in a specific area and time, you should state it in your proposal elaborately. You should justify your estimation / expectation by stating your methodology and the way of thinking. The impact on the final beneficiaries should be verified from objective sources. For example, if your Project activities reduce the employment in a specific area and time, this result can be verified from local statistics.

Consortium Partners: Proposal writers should contact with them and held meetings. Since these organizations are involved with the Project thematic area, they may provide a better perspective and approach to the Project. They can significantly contribute the activity design, methodology, implementation parts of the Project. They also are in contact with the target group, so it is possible to create a more comperehensive needs analysis by benefiting from their deeper understanding with the target group. Also, it can be easier and more effective to reach the target group(s) via these organizations.

In line with the call for proposals document, your partners can be (the list is not exhausted):

- Non-formal youth groups,
- Municipalities, local administrations, public administrations,
- Universities, schools, education centers,
- Non-governmental organizations, associations, foundations, unions,
- Private institutions, companies,
- Umberella organizations, national/international networks.

Most of the call for proposals restrict the number of partners in a Project. This makes sense, because the more partners you have the more management load you will have. Usually, the

number of partners is in line with the scope (therefore budget) of the programme. So, it is important for proposal writers to select most effective and suitable partners for the Project.

- Financial and organizational capacity,
- Ability to reach the target group effectively,
- Willingness to undertake the tasks, activities and the Project,
- Relevance of the partner with the Project topic and the target group are important factors for selecting partners.

One of the most common mistakes is selecting a partner due to having a good relationship with it. While knowing and having a good cooperation with an institution/actor ensure a stable functioning of the Project, it may reduce the potential / impact of the activities.

Guiding Questions can be summarized as follows:
Which organizations/people are affected from the problem?
Which organizations/people can be affected positively from the solution of this problem?
Who gets the benefit, who gets harm?
Who can be against the solution, who can support the solution?
Which partners can we collaborate?

Table 2. ***Stakeholder Analysis Template***

Stakeholders	**Their Interest/Relation/Connection to Your Activities**	**How can they participate to the project**
Primary Stakeholders		
1. Municipality	One of the aims of a local administration is to reduce social inequalities. If your project is related with this area, it will be their area of interest as well.	In line with your activities, they can give you various financial or in-kind contribution.
2.		
3.		
4.		
5.		
Secondary Stakeholders		
1.		
2.		
3.		
4.		
5.		

Identify all people or organizations affected by a project, to analyze stakeholder expectations, and to effectively engage stakeholders.
You can categorize your stakeholders in two: Primary & Secondary Stakeholders.
- Primary stakeholders are the ones that affected from your Project activities *directly* (negative or positive).
- Secondary stakeholders are the ones that affected from your Project activities *indirectly* (negative or positive).
Also, organizations that you can undertake the Project should be considered and noted. These partners will be your Primary stakeholders.

2.5 Relationship Between Analysis and Objectives

It is also helpful to standardize the way the hierarchy of project objectives is defined.

In this regard, the following method can be followed:

(i) Express the Overall Objective as "contributing to…..";

(ii) Express the purpose of the project in terms of the benefits provided to the target group such as 'Increased/improved/etc…….',

(iii) Express the results tangibly and concretely in past tense as 'Delivered/produced/executed etc.', and

(iv) Express the activities in the present tense, starting with an active verb such as 'Prepare, design, build, research....'. (EU Commission, 2004, p.77)

2.6 Relevance

An integral part of project proposal forms is relevance. In the Relevance section, you will be asked to associate your main purpose, sub-goals, activities and outputs in your project with the priorities in the program guide (Henriksen & Traynor, 1999, p.163). For this reason, it is recommended that you read the program guide well and think about which priorities you will refer to and how before preparing the proposal.

You are also expected to make a needs analysis in the proposal form. This needs analysis is not limited to just converting your problem tree to text. You should well justify your methodology with statistical data, research studies, reports, policy documents, scientific articles, etc. related to your project topic for solving problems, that you identified, with high added value activities. While doing this work, if the project text does not exceed the character limit, you can also specify references to articles and sources. If you are applying for a project with national or international stakeholders, you should address the entire consortium, not just your institution and region, when making these references. In this context, it is recommended that you get some feedback and data from your stakeholders. With this information, you can strengthen the relevance of your project.

For example, if you are going to make an application at European level and your project partners will be from European countries, you are expected to include local, regional, national and European levels in your project form. If you have a Project with an environmental aspect, you will also need to refer to European policy documents in this area. In addition, you will need to make an analysis of the situations in Europe and the applicant countries and support this

analysis with concrete data and reports as much as possible. You can also justify using these data and analysis when choosing your project partners. Make sure that your justification is realistic, objective, concrete, understandable and based on data. On the other hand, many grant programs limit characters in the proposal text. This will require you to do your analysis as concisely as possible.

2.7 Activity Planning

After the situation analysis, you need to plan some activities in order to achieve the overall objective, purpose and results you have determined. These activities should be structured as simply and uncomplicatedly as possible. Some grant programs and/or organizations require activities to be disclosed in the format they have determined. For this reason, it is recommended that you carefully review the application guide and form. For example, the Erasmus+ program demands the creation of Workpackages in Cooperation Partnerships projects (and if possible, no more than 5 of these WPs) and has adjusted their application systems accordingly.

When organizing work packages or activities, it is important that you specify the activities that are related to each other under a main heading and explain them in chronological order (Esteves & Pastor, 2002) While determining your activities, you can start from the results you have determined at the bottom of the situation analysis. If you set up the necessary activities to achieve these results, you will achieve your project goal and contribute to the overall objective. This will ensure the success of your project.

You can specify sub-activities under each activity you have determined and write sub-items as much as your application form allows. However, it is recommended that you do not create a number of items that would make it difficult to evaluate the project form. Sub-activities may directly influence the main activity or include supporting and complementary activities. Activities that do not contribute to the achievement of the project purpose should not be included in the project. Such and poorly justified activities may be subject to criticism by evaluators and result in a low score.

It is recommended that you match each activity you undertake to your purposes and, if possible, explain its relevance. While organizing your activities, you should also specify the outputs and the effects that will occur as a result of the relevant activity. Information on outputs and effects may be requested in the same part of the application form or in different parts. It is important for the consistency of the project that you specify this information in the relevant sections according to the format requirements of your application form.

You need to determine how long each of your activities will take and be realistic when determining this duration (Dawson & Dawson, 1998, p.300). Any activity that you cannot perform on time will lead to shifts and deviations in your project goals and plans. In addition, if you keep the time span large, less time may be allocated to other activities of the project than necessary. This is one of the factors affecting the overall performance of the project during the implementation phase. It is important that activity times are well-designed, consistent, measured and realistic, as evaluators will score with these considerations in mind while working on the project proposal.

In the project proposal, you must also specify all needs and resources required to realize each activity, to be met from the project budget and/or to be provided as in-kind contribution (Chen & Zhu, 2011). These issues are especially important when creating the budget. In some programs, a separate template may be requested for the budget. You will need to consider these issues together in the document that you worked for preparing for the activities and specify them in different parts of the project proposal form if requested. When creating the activities, taking notes of these issues in the working document will prevent you from going back to the beginning if information is requested at different points in the proposal form.

When creating your activities, remember that the project is a team effort. This team work includes the coordinating organization's work teams as well as the stakeholders and their employees (Usadolo & Caldwel, 2016). You need to specify which partner(s) will undertake each activity or whether they will take place simultaneously in different venues. In addition to this, it is important to explain the duties of the employees in the project, the qualifications of those who will take charge and the employment processes if additional employment is required.

- In order to realize the objectives of your Project, you need to plan proporational and impactful activities.
- You need to use the lower part of the objective tree and devise activities to achieve these objectives.
- Once you designed the activities, you can split them into smaller ones.
- i.e. Activity 1. Design of the training programme.
- Activity 1.1 Literature review
- Activity 1.2 Survey and Survey Analysis

Activity 1.3 Needs Analysis (Based on the results of the 1.1 and 1.2)

Table 3. ***Objective, Activities, Indicators and Stakeholders Relationship Template***

Objective(s)/ Solution(s)	Main & Sub Activities	Results/ Indicators	Stakeholder
Objective 1: Directions: State clearly the solution(s) you propose to implement to address the problem as identified in your situation assessment.	Directions: Name the key actions to be implemented to achieve your proposed solution. You need to list your main activities and elaborate it by dividing it into subactivities.	Directions: List the results you expect to achieve which directly contribute to the solution to the problem identified. You need to use SMART indicators.	Who is going to be responsible to undertake the task?
Objective 2: (If you have)			

2.8 Activity Plan Design Example

Suppose you are preparing a project proposal for a 12-month grant program. In the first months of the project, the necessary coordination, assignment, procurement, recruitment processes, and the establishment of a project office are carried out for the smooth functioning of the rest of the project.

1. Realization of Project Coordination Procedures

1.1 Meeting of the Project Executive Board

1.2 Establishment of the Project Team and the Meetings

1.3 Realization of Project Orientation Training and Meetings

1.4 Establishment of a Project Office

2. Making Transactions for Purchases

2.1 Creating Technical Specification Files for Purchasing

2.2 Market Research, Receiving Bids and Offers from Firms

2.3 Initiation, Follow-up and Finalization of Tender Processes

3. Project Kick-Off Meeting, Project Promotion, Visibility and Dissemination Activities

3.1 Project Kick-off Meeting

3.2 Activities Regarding the Promotion and Visibility of the Project and Professional Development Center

3.3 Creating the Project Web Page

4. Opening and Operation of the Professional Development Center

4.1 Realization of the Center Opening Ceremony

4.2: Directing the Target Audience to the Professional Development Center

4.3: Creating Career Plans and Personalized Education Curriculum for Young People in the Target Group

4.4: Realization of Training Activities

4.5: Conducting Vocational Guidance and Counselling Studies

5. Bi-Monthly Reporting

6. Organizing the Project Final Meeting

7. Interim and Final Reporting

When planning your project activities, do not only consider the applications you will make and the areas/centers/offices you will establish and/or maintain. You also need to plan the preparatory work required to perform these activities. As can be seen in the example above, the 1st and 2nd activities cover the processes necessary for the progress of the project to be carried out smoothly and in accordance with the legislation, regulation and programme rules.

Visibility, promotion and dissemination activities specified as the 3rd activity include the activities that should be included in each project. In this example, you can specify these activities, which are elaborated in row 3, in different orders. On the other hand, it is important that the activities are planned and carried out to cover the whole or a significant part of the project. In the first months, you can provide visibility and promotion without making a purchase. Social media, statements to press, interviews, briefings, kick off meeting can be done free of charge or without the need for a purchase process. Apart from the ones given in the example here, you can make additions or make explanations by making the titles more detailed.

For example, in the 4th row, the main activities of the project are presented. Depending on the size or methodology of your project, you can also define more than one of your main activities. You can also plan your main activities simultaneously.

For example, it is foreseen that in the 5th activity, interim and final reports will be prepared every 2 months, and in the 7th activity. In line with your project program guide and call for proposals, you should include your work on reporting, auditing and quality work in your activity calendar and provide the necessary level of explanation.

In the example, the closing meeting is given in the 6th activity. It is possible to consider this activity as the sub-activity of the 3rd activity. On the other hand, if you want to explain the kick-off and closing meetings in more detail, or if the project activities foresee large and detailed promotional meetings, it would be useful to examine these activities under a separate heading. In this context, you can explain and justify the preparation process of your kick-off and/or closing meetings in detail.

2.9 Gantt Chart

The chart developed by Henry Gantt, called the Gantt chart, is used in almost all project proposals (Wilson, 2003). This schedule can be generated automatically in programs that allow application through a web platform or system such as Erasmus+.

While the Gantt chart enables the coordinators and partners to easily monitor all activities and processes during the project planning and management stages, it also provides the independent evaluators to make an overall review and evaluation.

Table 4. ***Gannt Chart Example***

Year 1													
	First Year						Second Year						
Activity	1	2	3	4	5	6	7	8	9	10	11	12	Stakeholder
1. Realization of Project Coordination Procedures													
1.1 Meeting of the Project Executive Board													
1.2 Establishment of the Project Team and the Meetings													

1.3 Realization of Project Orientation Training and Meetings													
1.4 Establishment of a Project Office													
2. Making Transactions for Purchases													
2.1 Creating Technical Specification Files for Purchasing													
2.2 Market Research, Receiving Bids and Offers from Firms													
2.3 Initiation, Follow-up and Finalization of Tender Processes													
3. Project Kick-Off Meeting, Project Promotion, Visibility and Dissemination Activities													
3.1 Project Kick-off Meeting													
3.2 Activities Regarding the Promotion and Visibility of the Project and Professional Development Center													
3.3 Creating the Project Web Page													
4. Opening and Operation of the Professional Development Center													
4.1 Realization of the Center Opening Ceremony													
4.2: Directing the Target Audience to the Professional Development Center													
4.3: Creating Career Plans and Personalized Education Curriculum for Young People in the Target Group													
4.4: Realization of Training Activities													
4.5: Conducting Vocational Guidance and Counselling Studies													

5. Bi-Monthly Reporting													
6. Organizing the Project Final Meeting													
7. Interim and Final Reporting													

As can be seen in the chart, activities and all sub-activities are located in the left column. The columns on the right show the months of the project. If you anticipate the months in which each activity will take place, you will need to color or mark the relevant parts. In the far right part, you should state who your stakeholders are and who will carry out the activity.

2.10 Results and Indicators

Indicators are important for coordinators, managers and evaluators to follow up and examine the success and completion of the project and its tasks (Parmenter, 2015). Therefore, it is important for proposal writers to identify objective and verifiable indicators. Each indicator should be related with the activities, tasks and/or outputs of the Project.

In order to follow up the activities and tasks, SMART indicators should be identified (Shahin & Mahbod, 2007, p.27-29). SMART means:

- Specific
- Measurable
- Achievable
- Realistic
- Time-Bound

Examples:

  - 2 surveys conducted to 500 young people (age range: 18-25) by the end of the 3rd month of the Project.
  - 10 training session were organized to 250 disadvantaged people between 8th and 10th month of the Project.
  - 1 website is created for the dissemination and valorization of the Project, its viewcount is 300.000 by the end of the Project.

- Well defined indicators will allow you to check the quality of the Project results and to determine the potential risks and deviations from the objectives.

It is good to use quantitative statements. Also you can support it with qualitative statements as well.

Additionally, you can refer target groups and geographic location in your indicators, if it is requested or deemed necessary.

Table 5. ***Objective, Activities, Indicators and Stakeholders Relationship Template with Time and Budget***

Objective(s)/Solution(s)	**Main & Sub Activities**	**Results/Indicators**	**Stakeholder**	**Months…**			**Budget**
				1	**2**	**3**	
Objective 1: Directions: State clearly the solution(s) you propose to implement to address the problem as identified in your situation assessment.	Directions: Name the key actions to be implemented to achieve your proposed solution. You need to list your main activities and elaborate it by dividing it into subactivities.	Directions: List the results you expect to achieve which directly contribute to the solution to the problem identified. You need to use SMART indicators.	Who is going to be responsible to undertake the task?				
Objective 2: (If you have)							

2.11 Sustainability

- There can be 4 aspects in this case:
    - Financial sustainability
    - Political sustainability
    - Institutional sustainability
    - Environmental sustainability

2.11.1 Financial Sustainability

Financial sustainability refers the ability of a proposal to continue its activities after Project lifetime. In the recent years, most of the grant programmes started to give more importance to having an impact of their programme even after the funded projects are ended. Financial sustainability can be achieved through different ways (Bell etal., 2010).

Your project can receive support from the government, local administration, a private company, a NGO with resources etc.. So, when you are creating your consortium, it may be beneficial to choose partners which can support your project and/or its activities even after the end of the Project.

Another way that you can continue the Project activities may be creating, designing a sustainable structure during the implementation. This structure may include development and sale of a product / service / membership, creation of a social enterprise / initiative, a continuous campaign to collect donations (or establishing a NGO for this matter).

You need to state clearly in your proposal how you are going to finance the core aspects of your Project. So, you can have necessary partners to fund the activities and/or you can create a structure for sustainability in terms of finance. While you are stating the methodology in your proposal, it should be realistic and convincing. If you are going to take a support from a partner or one of your stakeholders outside your consortium, it can be convincing that you made a meeting and reached an agreement. If it is possible you can annex this agreement to your proposal, if not you can state how, when and what kind of resources will be provided by which party.

In the same manner, it is important to elaborate what kind of income structure you will create to maintain funding for the Project activities. You need to provide detail about how you generate, collect and manage funds. The most important aspect here is to be realistic. You can made some comparisons with the similar projects. You can justify the needs that you are going to meet and demand to the services / products that you will generate.

So the main guiding question for the financial sustainability and possible answers are summarized as follows (Bell etal., 2010):

- What will be your main source of income?
    - A product / service
    - Additional support from other institutions
    - Donations

- Membership fees (If you created an NGO, club, GYM, website etc.)

2.11.2 Political Sustainability

Political sustainability is important to ensure the publicity, public ownership, lobbying, securing funds/resources, reducing bureaucracy for the Project processes and activities. Political sustainability is important both for the implementation and post-implementation. Because it affects other types of sustainability (Scoones, 2016, 297).

In the implementation process, receiving political support can increase the publicity of the Project to relevant public institutions.

You can affect legislation and policy making processes related with your Project topic to achieve a desired goal or facilitate processes in a specific area which you need to address.

You can reduce the bureaucracy in any part of your Project. This will ensure that your activities can be carried out in time and properly.

You may get additional resources to carry out your activities. Public institutions may provide training rooms, office areas, supplies, funds etc.

You may reach your target group more easily and efficiently by using the network and channels.

In order to ensure political sustainability, you can include one or more active policy maker actors as partners. Local administrations can be an optimal choice since it is easy to reach them. Central government organizations can be challanging. However, if you or your partners have a network or connection with the central government organizations, you can increase your projects' impact substantially. In that manner, you can also take an important NGO or lobbying/think-tank institutions as partners to establish a connection with the central government body related with your Project topic.

Another way to reach / affect the policy makers, public institutions in the area is to conduct dissemination, visibility, valorization, promotion activities. These can be listed as contact making seminars, workshops, networking events, conferences, focus meetings, establishing connections with the head of the relevant institution (Smucker, 2005). Official letters with information documents can be another way to reach the institutions via official channels. Since the public institutions should provide an answer to your letters, it would create an opportunity to introduce and promote the Project. Also, it is possible to reach these institutions via social media or digital platforms, however the chances of success would be significantly lower.

In the end, you need to clearly state in the proposal that the measures you will take to receive the political support and thus ensure the sustainability. You need to incorporate these actions in the relevant parts of the Project proposal. It would be more effective for you to held meetings with the institutions that can provide political sustainability before the submission of the proposal. So you can justify your actions easily. It can be even better if you have an agreement with the policy maker / public institution, so you can annex it to your proposal.

Guiding questions can be summarized as follows:

What are the most important policy making actors / public institutions to your Project? How can you get their support to your activities? Are your actions relevant and realistic?

Important points:

Local and central government agencies are important.

If your Project is complementary and in line with the local / central government, you can get additional financial aids and in-kind contributions.

Also bureaucracy can be significantly reduced.

2.11.3 Institutional Sustainability

Corporate sustainability refers to the internalization and support of your project by the coordinator, partners and other relevant stakeholders' institutions. It cannot be expected that all employees of the institutions involved in a project will be working on it or have knowledge about it. On the other hand, as a result of visibility, promotion and dissemination activities, it can be ensured that all employees are aware of the project, activities and outputs. This strengthens the sense of corporate ownership and plays an important role in the sustainability of the project.

In addition, your project must match the corporate goals of your institution and your partners. For this reason, it will be expected that not only your target group but also the consortium will own and maintain the outputs you will produce in your project. In your project proposal, it is important to specify which activities and outputs you will continue after the project ends and in what way.

After the end of the project, you can also mention the issues related to updating these outputs and activities to be carried out, which will continue to be used, since you will ensure corporate sustainability. For example, let's say you have developed a training output within the scope of your project. In this case, these trainings will continue to be given by your institution and/or your partners after your project ends. After the project, you can update these training outputs according to your institution's needs and continue to use them. Your partners can carry out a similar process or the consortium can continue to develop these and similar outputs through the network they have established among themselves.

- This sustainability is actually related with your and partner organizations.
- Project outcomes should be in line with your interest. So you can use these outcomes after the Project ends.
- For example, if you created a new training module, your organization can use this after the Project. Therefore, you generate further income for your cause.

2.11.4 Environmental Sustainability

Environmental sustainability has become a sought-after issue in almost all grant programs, especially in recent years. The Paris Climate Agreement, the 2030 Climate Target Plan, the 2030 Agenda for Sustainable Development and similar policy goals and strategies prioritize

combating global warming, climate change and environmental problems. Therefore, it will be expected that your activities and outputs will be in line with these policies and strategies, contribute and/or refer to them in the project call for proposals.

Examples of including environmental sustainability in your activities and outputs can be listed as:

Putting recycling bins in a training or event you will hold,

Informing the participants in terms of environmental sustainability before a training program you will carry out,

The use of electric vehicles in a student exchange activity you will carry out, including other methods with low carbon gas emissions,

Taking care that the materials you use are recyclable or recycled,

Intensive use of digital tools in your visibility, promotion and dissemination efforts and avoidance of paper waste and use as much as possible.

2.12 Horizontal Issues

2.12.1 Participation and Inclusion

Participation practices involve striving to boost public involvement focused mainly on the substance of programs and policies. Inclusion practices involve consistently fostering a community engaged in collaboratively shaping processes, policies, and programs to identify and tackle public concerns (Quick and Felman, 2011, p.272). Participation and inclusion are among the concepts that have been given importance in many grant and funding programs in recent years. Therefore, the concepts of participation and inclusion should also be considered when designing your goals, activities and outputs. If there is a section for this in the project proposal template form, you can include the concepts of participation and inclusion from different perspectives. If a specific section is not reserved for this in the project proposal form, you can mention these issues in different sections.

Different perspectives on participation and inclusion can be listed as follows:

2.12.2 Participation to governance mechanisms

The relationship between participation and governance underscores that good governance necessitates governance rooted among the people, representative democracy lacking participation is weak, development devoid of public involvement lacks genuine popular support, and public participation in development enhances the prospects of good governance (Davids et al., 2005, p.64). The concept of governance has gained a lot of importance in recent decades. Many grants and funding institutions and programs require relevant stakeholders, especially the youth and disadvantaged, to contribute to the projects and activities. In order to ensure the participation of stakeholders in governance, first of all, they should be aware of the project and its activities. Afterwards, it is important to share information about the project regularly and accurately in line with transparency and accountability. Finally, the methods, tools and procedures for participants' participation in decision-making must be clearly defined, explained and non-discriminatory.

In addition, today, social media platforms are very popular and virtual structures that allow interactive interaction in terms of receiving and presenting feedback, requests, complaints and suggestions. You can specify that you can also benefit from these virtual tools in your project.

2.12.3 Participation to Project activities and outputs:

People in your target audience(s) profile should not only take part in the project activities as a target, but should also participate in their realization. This participation includes not only participating in an activity, but also the process of realizing that activity. Active participation or involvement of the target audience at any stage of the project will ensure their ownership and internalization of the project.

How can you ensure this participation? You need to consider different methods for each activity. If you are going to organize a training course, you must inform the participants about the announcement of this training, its benefits, the contribution that will be made to them, whether they will be given certificates. You also need to pre-register and get reserve participants as much as the number of quotas. If the grant program allows, participants can be paid daily wages, transportation and food/beverage expenses can be covered. In addition, if any intellectual output (educational material, booklet, etc.) is foreseen to be prepared in your project, the participation of target audiences can be ensured for certain parts of this output. For example, a preliminary stage can be implemented for a booklet / material. In this preliminary stage, needs analyzes can be carried out with surveys and interviews to be applied to the target audience. Feedbacks can be also received online through digital channels. If a conference with wide participation is to be held, high-profile speakers who are in the interest of the target audience can be announced by inviting them.

The most crucial element at this stage is to increase both quantitative and qualitative participation in activities.

2.12.4 Participation to evaluation activities

It is very important to receive feedback from the target audience within the scope of evaluation activities. These feedbacks will be more critical and objective than self-assessments in the project consortium. It is important to provide information about each stage of the project and to receive the opinions, suggestions, requests and demands of the participants regarding these stages. This process should be carried out not only by receiving the feedback, but also by evaluating them and reflecting them on the activities, processes and outputs, and providing information by returning to the feedback provider. The feeling of ownership towards the project of those whose ideas are taken into consideration and to whom feedback is received, will increase. On the other hand, improvements made with the ideas and suggestions presented by the target audience will be more effective and efficient and will increase satisfaction. While this will contribute to the achievement of the project's goals, there will be an increase in the quality and quantity of outputs and activities.

2.12.5 Participation to visibility, promotion and dissemination activities

The participation of those in the target audience in visibility, promotion and dissemination activities will enable the project to reach more people with the target group profile. It is expected that a target group with similar characteristics will have a high level of

communication with each other. For this reason, when a person in the target audience introduces the project to their peers and colleagues, more people are reached. In extreme cases, this creates a snowball effect, reaching far more people than intended (Pescher etal, 2014). For example, some of the challenges produced create a viral effect (See: Ice Bucket Challenge).

Contests: In addition to contests that may have a viral effect, prize-winning contests can be organized at the local level. For example, you can use the budget allocated for the project logo design (if the grant program allows) by organizing a competition. In addition, You can organize a contest related to the subject of the project such as painting, poetry, literature, design, project. In this case, you will not only be able to carry out an activity required in your project with your target audience, but also ensure that the project will spread and be promoted to the target audience. The target audience that will participate in your contest will have also examined your project, so it would be useful to provide information about your project in your contest announcement.

Digital Communities / Web Pages: Social media, digital communities and web platforms, which are widely used and popular today, are online places where different target audiences come together. You can ensure the dissemination and visibility of your project by creating digital platforms and communities, or by finding a platform or community that is already suitable for your target audience. As a result of the information sharing and visibility activities you will carry out, you can receive feedback and contributions from the wider community.

Social media: Today, politics, sports, public and private institutions and organizations actively use social media platforms to receive interaction and feedback and thus to increase the quality of their services and products. In order to benefit from these opportunities within the scope of your project, you should use your social media accounts actively and interactively. For this reason, it would be appropriate to specify your measures and activities regarding social media in your project proposal.

Inclusion of target group and disadvantaged people: Inclusion of the disadvantaged has gained importance especially in recent years. Disadvantaged people cannot adequately participate in social decision-making mechanisms, activities, projects, and cannot express their opinions due to their situation. In your project proposal, it is important that you design activities that will reach these people and ensure their participation and take precautions. While some grant programs directly target disadvantaged groups, some programs can provide extra funding for disadvantaged people. Disadvantage may arise due to concepts such as geographical, cultural, economic, social, educational, disability, immigration, discrimination, gender inequality. If you think which disadvantageous situations can be seen predominantly in your target group, you are expected to give your justification for this.

For example, when you organize a conference, you can offer a translation service for the hearing impaired. Similarly, you can receive facilitator services for the disabled in trainings. If your project envisages the establishment of a center, you can also indicate in the proposal your measures to facilitate the access of the disabled to this center. If your project envisages a mobility abroad, you can put budget for the travel materials of your disadvantaged participants.

Perspectives and approaches to participation and inclusion are not limited to these. If a different approach to these concepts is requested in the project call for proposals, program priorities and evaluation criteria, you should also make an evaluation and justification in this respect.

2.13 Methodology

You may need to specify the methods you will use while implementing your project in the project proposal form. The methods you will use may differ according to the activities you will apply. As a matter of fact, your project methodology covers the methods and techniques you will follow while performing the activities. You can refer to issues such as inclusion, participatory management, environmental and climate change mentioned in the sustainability section, which are mentioned in horizontal topics, in the method section.

Apart from these, you can specify some of the methods you can use while performing your activities as follows:

Needs analysis: It is expected that you have prepared your project proposal based on the needs of the target audience. As a matter of fact, you need to create the framework of your project by performing your problem, target and strategy analyzes within this framework. However, you may need to conduct an objective needs analysis to determine the specific and detailed needs of your target audience. For example, within the framework of your project, you determined that your target audience had a training need and you designed your activities accordingly. However, the impact of a general education method on your target audience will be limited. Considering the needs of your target audience, a tailor-made training program that you will prepare for them will have more impact and permanence (Long, 2005).

Surveys: Surveys are one of the most objective and effective ways to obtain and analyze feedback from your target audience and those involved in your activities. You can include survey studies in your project in order to analyze needs, improve your activities and provide better service.

Focus meetings: You can hold focus meetings as an alternative or complementary to the feedback you get from surveys. While specific questions are included in surveys, you can get new ideas, structured/unstructured feedback and results in focus meetings. You can hold focus meetings with your target audience or with different people and communities to improve your activities.

Maximum use of internet, social media and technology: In recent years, parallel to technological developments, education, production, management etc. and other sectors are in rapid change and transformation. On the other hand, employees and/or those in the target group may not be able to adapt to these changes quickly and may contribute to the development of new methods in a limited way. For this reason, it is important to include technology, internet and social media in the activities of the project and to encourage the participants to use these new tools. On the other hand, the use of social media has increased considerably today. You can actively use social media in your project for the purpose of reaching your target audience and for visibility, promotion and dissemination.

3 ACTIVITY PLANNING

Activity planning and its implementation is the core part of a Project. Without the proper implementation of activities and actions, you simply cannot realize a Project successfully, thus you cannot reach your goals.

3.1 Management

Planning and management of activities go hand by hand. Successfully planned activities cannot be undertaken with a weak management structure and vice versa (Groenendijk & Dopheide, 2003). Therefore, management is an essential part of any proposal.

For a proper management structure, you need to make sure that your partners and stakeholders will be involved and included equally. Therefore, creation of a top management structure is advisable. This top management should be consist of representatives of organizations in the consortium who can directly take a decision regarding the Project. This approach would eliminate any internal bureaucracy among the consortium. This top management structure should convene regularly. These meetings should be reported and minutes should be archived and distributed to Project staff. This will ensure that any decision is agreed on, documented and should be followed up.

Top management will be responsible of general administration of the Project. Any deviation, problems, risks, important issues will be discussed, examined and decided. However, there will be also a need for management structure for the Workpackage and specific actions. Therefore, Project teams should be created to undertake specific activity and actions. Workers and appointed personnels in the Project will be natural members of these teams. These teams will have meetings and communication among themselves more often than the top management. Each team can have a local leader and international team will have a general coordinator/leader. This coordinator/leader can be Workpackage leaders as well.

A Workpackage (WP) consists of set of activities and actions to achieve a certain part of the Project objectives. Erasmus+ Programme Guide (2023, p.435) defines Workpackage as "*A component of the project work breakdown. It represents a group of project activities targeting common specific objectives*". *Workpackages may required for the easier implementation of the Project. Some programmes have requirement for the creation of these Workpackages. Each workpackage have a leader, but this leader doesn't necessary be a worker from Project Coordinator organization. Workpackages can be delegated partners who have necessary qualifications and capacity. If a partner has a specific expertize and/or network & connections in the area of WP actions/activity, It would be better to appoint such role.*

3.2 Communication and Collaboration Management

Communication among partners and different stakeholders are important. A well functioning communication leads to successful collaboration (Martin et al., 2016). Miscommunication and/or misunderstandings would hinder the Project progress and its potential. Due to miscommunication, Project activities can be implemented differently or incorrectly by each partner. This would lead quality and quantity drop in activities which will cause that the Project objectives are not met.

In order to ensure a good communication among partners and stakeholders, different medias, channels and frequency of use of these channels should be identified in the planning phase and incorporated into the proposal. Since quality and use of the digital channels are improved in recent years, most of the communication can be done virtually. One of the most important aspect that you need to do is documentation of each communication. Decisions and topics discussed should be documented and circulated to related persons, so everyone can be on the same page.

In the proposal, you can either categorize the meetings/communication by media or its objectives. If you want to make a categorization by media, you can split the communication in two main groups: virtual/online and physical/face-to-face. Then you can create sub-categories (such as written, verbal, video-conference for virtual/online communication).

It is possible to categorize the meetings/communication by objectives. Examples for this categorization are top management meetings, workpackage meetings, quality meetings, risk handling/management meetings, procurement meetings.

In either way, under each categorization you need to specify objectives, media/channels, frequency of use, participants, locations.

3.3 Time and Budget Management

Time and budget management is a crucial aspect of Project management (Jaselskis & Ashley, 1991). Rules and regulation regarding this management aspect should be also referred in your proposal. These rules and internal regulation should be decided unanimously among partners. When the Project is granted, these rules and other important topics should be turned into an agreement document and signed by each party.

It is advisible that you include a clause detailing frequency of financial installments. This means that you can make payments to your partners in line with the work completed. You can link your payments to completion of tasks or Workpackages. For example, you can make advance payment as %20 of the total budget allocated to partner at the start of the Project. You can make additional %20 payment (or more/less) when your Workpackage-2 is done, and so on. Grant programmes also don't pay you all of the budget in one installment. In line with the programme rules, you can adjust your payment distribution. The main aim here is to ensure that the tasks are done in time and correctly, if not you can cut the payments or not to make any. So you can delegate tasks to other partner sor you can find new partners in case of a non-responsive partner by getting into contact and approval of your programme agency.

An important methodology to follow up the human resources in terms of work and budget is utilization of staff timesheet documents. You can track up the work of all staff employed in the Project by each organization. It is advisible that you collect these documents at the end of the each month. By this methodology, you can control and have a proof that the number of workers, days, hours allocated to an activity by your partners employing staff under different categories.

Since you will have meetings with your partners regularly, it is possible for you to justify your time and budget management in the proposal. You will naturally follow-up your activities in the Project via these meetings and correspondances among partners. These communication

and collaboration efforts will provide you necessary information about the activities, so you and your consortium can analyze whether there is a deviation from Project time table and/or objectives. If there is a substantive deviation, you can identify the problem and take necessary measures to tackle it. So, you can start risk/issue/change/crisis management process.

Table 6. ***Staff Timesheet Example***

Project	**Competence Oriented Methodologies for R&D in Social and Educational Sciences**
Partner institution	***i.e. Istanbul Sabahattin Zaim University***
Contact person	***i.e. John Smith***
Staff member	***i.e. Jane Brown***
Reporting period	***i.e. 01.06.2022-30.06.2022***

2. Timesheet

Date (ddmmyy)	No. of Output	Activities related to the project	Staff Category	No. of days
01.06.2022	O1	Survey Design – Identification of Target Groups	Trainer/Teacher/Researcher	1
02.06.2022	O1	Survey Design – Scale Development	Trainer/Teacher/Researcher	1
06.06.2022	O1	Survey Design – Scale Development	Trainer/Teacher/Researcher	1
07.06.2022	O1	Survey Implementation	Trainer/Teacher/Researcher	1
08.06.2022	O1	Survey Implementation	Trainer/Teacher/Researcher	1
09.06.2022	O1	Survey Analysis	Trainer/Teacher/Researcher	1
13.06.2022	O1	Creation of Survey Report	Trainer/Teacher/Researcher	1
			TOTAL	7

Date	Stamp of institution	Signature of member of staff

Above is an example of a staff timesheet. As can be seen, the table includes the date, output, a brief description of the output-related activities, the category under which the employee works, and the number of days. This staff timesheet example has been prepared specifically for Erasmus+ cooperation partnerships. It is possible to revise the form for different projects. You can add different titles to the Employee category section and write differentiating the wages to be paid on the side. The coordinator/manager can control and manage how the related employee spends his/her time through this table. If there is any deviation from the targets, one of the most efficient ways to find the source is to follow these tables. In this way, it can be determined whether the deviation in the targets is caused by the personnel or for a different reason, and interventions can be made accordingly. At the same time, the stage of outputs and activities and the amount of human resources allocated to them can be followed through these charts. In case of a change in the human resources of the project, staff timesheets can be used to integrate new recruited people into the activity and related stages.

Staff timesheet documents are an important tool in terms of supervising, monitoring and tracking not only the coordinator's own employees, but also the employees and work of the project partners. Through staff timesheet documents, the coordinator can check the stage of the tasks given to other partners and whether the necessary resources have been spent on them, and can make their payments in line with this information (Brown, 2001).

3.4 Risk/Issue/Change/Crisis Management

It is impossible for anyone to foresee the future event completely correct. What you can do best is to analyze the events, activities, environment under certain assumptions. Some grant programmes ask you to state this assumptions and risks at the proposal phase. Some general assumption examples are stated below:

- Economic environment will be stable for procurement of goods and services that will be used in the Project.
- There will not be any bureaucratic and/or regulative change affecting the Project activities.
- Key personnels defined in the proposal will be available during the Project.
- Project partners will be able to continue their activities during the Project.

You can also include more specific assumptions related with your Project and activities. Since your Project proposal will be an integral part of the contract that you will sign with the Grant Provider / Agency, it is important to leave an open door to risks. In case of your assumptions are violated due to external causes (or force majeure), your Project activities may be at risk in terms of quality and/or quantity. In that case, you need to contact with your Grant provider / Agency and ask for a way out. In that case, you can state that one or more of your assumptions are failed and there can be reduction quality and/or quality of your outputs and activities.

Even though some risks cannot be foreseen, some can be dealt with throughout the Project processes. In order to deal with these risks, a risk, issue or change process should be defined. You can define certain categories to group risks, issues or changes. It can be easier to manage these categories if you delegate responsibilities in line with the significance level. So, if an issue can be resolved at local level, you or your partner tackle with the issue and inform

consortium about it. If this issue cannot be resolved solely by one partner, consortium would be informed and tries to find a way out. If, It cannot be resolved by this level either, you can contact with the Grant provider / Agency to ask guidance and an escalation path.

3.5 Risk Analysis

It is possible to find solutions by rating your risks. Measures to eliminate, prevent, reduce and mitigate the effects of external threats to the project are carried out with a good risk analysis (Borghesi & Gaudenzi, 2012).

Personnel responsible for risk assessment may refer to the table below for each risk they have identified.

Table 7. ***Risk Assessment Example***

Likelihood		Very Likely	Likely	Unlikely	Highly Unlikely
Severity	Fatality	High	High	High	Medium
	Major	High	High	Medium	Medium
	Minor	High	Medium	Medium	Low
	Negligible	Medium	Medium	Low	Low

On the other hand, the identified risks can also be tabulated on the basis of purpose, result and activity according to probability, impact and risk value:

Table 8. ***Risk Assessment Based on Purpose, Results and Activities***

Purpose/Result/Activity	Risks	Probability	Impact	Risk Value
Purpose	Obstacles to achieving this goal are written here.	3	4	12
1. Result	Obstacles to achieving this goal are written here.	2	5	10
2. Result	Obstacles to achieving this goal are written here.	4	1	4
3. Result	Obstacles to achieving this goal are written here.	3	4	12
4. Result	Obstacles to achieving this goal are written here.	-	-	-
5. Result	Obstacles to achieving this goal are written here.	-	-	-
1. Activity	Obstacles to realizing this activity are written here.	-	-	-

2.	Activity	Obstacles to realizing this activity are written here.	-	-	-
3.	Activity	Obstacles to realizing this activity are written here.	-	-	-
4.	Activity	Obstacles to realizing this activity are written here.	-	-	-
5.	Activity	Obstacles to realizing this activity are written here.	-	-	-

Source: Yentürk and Aksakoğlu (2006, p.88).

In the table above, it is possible to rank the risks on the basis of purpose, result and activity. In calculating the risk value, the product of probability and effect value is taken into account. Probability and effect values are set from 1 to 5. In this case, the minimum value that the risk value will take is 1, while the maximum value is 25. The determination of probability and impact values depends on the person or people who analyze the risk. Risk value ranges can be determined according to the project methodology.

For example, 1-5 can be defined as very low, 6-10 low, 11-15 moderate, 16-20 high, 21-25 very high. Different processes can be carried out according to the degree of risk. These risks can also be decomposed according to solution levels. In this framework, the risks that can be solved at the local level can be eliminated by the team of the partner in the relevant country, if there is an international risk, the relevant partners can minimize it with their own measures, or if a risk that will completely affect the project is detected, the fund provider can be contacted and request support and/or revision.

Table 9. ***Risk Assessment Template***

Risk		Impact Level	Probability	Impact	Risk Value	Solution / Precaution Mechanism

3.6 Visibility, promotion, dissemination, valorization Activities

Visibility, promotion, dissemination, valorization activities are important for any Project to achieve its goals. Any Project has at least 1 target group and needs to get into contract with them at some point. Also, Project sustainability can be ensured via proper visibility, promotion, dissemination activities for certain stakeholders, policy makers, institutions and organizations.

It is important to develop visibility, promotion, dissemination and valorization strategies for the target group(s) you have determined in parallel with your stakeholder analysis, and/or for individuals and institutions that can reach these target groups. Impact levels should also be taken into account when developing these strategies. These individuals and institutions can be reached through activities at the local, regional, national or international levels. Different strategies can be developed in line with the objectives of the project, the size of its budget, and the potential impact on target groups.

If a proposal is being made for a project with a relatively large budget, tools that appeal to large audiences such as radio and television can be used. However, most grant programs provide relatively low levels of grant resources. In this case, activities and channels that will target the target audience in the most effective and efficient way should be used. Technological tools, digital platforms and social media, which are frequently used today and which can be used for dissemination and visibility in accordance with the audience profile, have an important place among these channels. These tools allow dissemination and visibility activities for free or at low cost. When the promotional budget is allocated for social media tools such as facebook, twitter, instagram, visibility can be provided directly according to the characteristics of the target audience. These budgets will remain quite low compared to the cost of using the mass media and will also allow direct access to the desired audience. In mass media, on the other hand, although the costs are high, access to the target audience may be limited. Therefore, it would be more logical to turn to niche areas for visibility.

It was mentioned that you can follow a strategy according to the impact levels in your project. The costs of traditional visibility and dissemination activities that you will carry out at the local level will remain at a lower level. Activities at this level can be focus meetings, institution visits, flash mob events, information activities to be held at schools, competitions for students and youth, interviews with the local press, press releases, and official letters to local institutions. Similarly, it is possible to carry out these activities at the regional level.

At national and international levels, as it was mentioned, dissemination, visibility and promotion activities due to traditional and mass media will be very costly, so social media and digital platforms, which are very effective at these levels, can be used. In this framework, it would be appropriate to include social media and digital memberships and channels in your project proposal.

It is also important to determine the frequency of use of the channels and tools you have chosen according to the levels you have determined and their place in the activity calendar. For these visibility, promotion and dissemination activities, you need to assign and define tasks not only to the coordinator but also to the project partners.

3.7 Corporate Identity

In addition to the channels and tools you will use, the message you convey to your target audience is also important. Content creation and corporate identity are the factors that affect the effectiveness of the message you will convey. The point you need to pay attention to when creating content is not to include unnecessary and incorrect information. You can make necessary referrals by creating a web page with detailed and up-to-date information and by

including this page in the messages and images you will send. Activities for realization of corporate identity, on the other hand, include activities aimed at ensuring the same dissemination order and thus increasing the memorability and impact. Creating the project logo, choosing the colors to be used in the images, standardizing the footer and header notes to be used in official correspondence, establishing a web page and obtaining e-mail address, and regularly sharing current content are among these works. Managing social media accounts, sharing properly, and responding quickly to incoming interactions and comments can also be counted among the factors that increase institutionalism. You can use brochures, posters, business cards, presentations, information notes, promotional materials (note papers with logo and web page, post-it, agenda, mug, etc.) in the message you send. While making use of printed materials, keeping them to a minimum and using recyclable/recycled materials will also be an important contribution to environmental sustainability.

Another important point to consider when creating your messages is the rules of the granting program and/or institution. These rules may sometimes restrict your dissemination and visibility activities. Apart from this, some programs (for example Erasmus+) also impose an obligation to include the waiver text in the texts and images. In addition, it may be obligatory to indicate the logo, visual and grant support of these programs, funding institutions and, if any, other organizations mentioned in the program guide. Some programs may have separate guidebooks for visibility and promotion. It is important for a successful project proposal to examine these during the project preparation phase and to state that they will be taken into account in the implementation.

3.8 Volunteering And Volunteer Management

Volunteering takes place in the form of active participation of the target groups and the 3rd parties in the project processes. Volunteers are a useful human resource, especially for nonprofits. Volunteers can take part in volunteering activities for reasons such as personal satisfaction, career, gaining experience, benefiting from abroad opportunities, necessity arising from the education curriculum and so on.

If your project is based on volunteerism or includes activities that involve the participation of volunteers, you should also describe how this process will be carried out. Volunteers should be seen as a temporary human resource and the duties, authorities and responsibilities to be assigned should be distributed to this extent. A person's voluntary service and work for an institution or project should not be seen as completely free of charge. Travel and food expenses of these people should be covered and, if possible, some pocket money should be given. For this reason, it is recommended to allocate daily in the project budget for volunteers.

In order for the volunteers to take part in the project, the necessary information must be announced. Digital portals used by project announcements and non-profit organizations can be used for these announcements. In addition, advertisements can be placed on social media groups. In the advertisements, it would be useful to mention your project, activities and work that will take place in the volunteer position, the place and duration of the volunteering, the contribution it will make to the participants (certificate, reference, etc.), and participation fees that will be provided to them, if any. Collecting the participants' information on a standard

form and creating a database will be useful in the follow-up of the applications and the recruitment process of the volunteer.

Necessary training should be given to the volunteer about the job (s)he will do after the selection process. Therefore, if your project is going to be about volunteering, it is important that you specify the training to be given to these people. Volunteers will be able to use these trainings on their resumes, so stating these trainings in the advertisement can be used to attract volunteers.

Table 10. ***Volunteer Information Database Template***

Name	Lastname	Birthdate	Gender	Language Level	Contact Number	Applied Position	Expectations from the Project and Position	Previous Experience Related with the Position	Skills Related with the Position	School Graduation Status / Name of the School

In order for the volunteers to take the work process seriously, you can prepare and sign contracts. This will also increase job engagement. As a matter of fact, since the concept of volunteering is not fully understood in Balkan countries, Türkiye and some other countries, people who work voluntarily will think that they can leave their jobs whenever they want. In such case, your project activities will be interrupted. In order to prevent this, you need to generate incentives specific to your project and activity and increase the commitment of the volunteer. For example, if you need to find local, volunteer participants for a youth project that you will carry out in the country, it can be an important incentive to state that these volunteers will have priority in taking part in projects abroad.

It is also important to follow the activities of your volunteers. You can carry out this follow-up activities with the Project staff (not with the volunteers). Such an assignment would be ideal for controlling and monitoring volunteers and would allow unexpected events to be prevented early on.

4 FOLLOWING UP / MONITORING

Follow-up and monitoring processes are planned and implemented to ensure that the project activities are carried out on time and under the conditions specified in the proposal. Follow-up and monitoring processes are carried out not only by the coordinator, but also by the partners. In this context, the coordinating institution has to follow up and monitor both its own duties and works and those of its partners. In addition, third parties who do not take part in the project as coordinators or partners may also have duties, and the follow-up of these studies should be considered in the project proposal.

The methods to be used in the follow-up of the activities, the frequency and by whom and how they will be documented are important. All these issues may vary depending on the size and content of the project. In a project with a large budget and machine production, a quality control specialist will be required for the quality of the product, an industrial engineer or employees with similar qualifications will be required for the optimization of the performance of the machinery and workers. In this case, on-site observation will be in question and reports can be made on a daily, weekly or monthly basis.

On the other hand, in projects with a social content and a relatively low budget, services may be offered instead of products, and some of the activities in the project may be carried out at the desk. In this case, measurement methods and verification sources include surveys, signature lists, minutes, photos, images, videos, invoices, etc. supporting documents. If the budget of the project is small, the frequency of activities will be less, and the frequency of inspection may decrease accordingly. In addition, less budget will be allocated for monitoring and evaluation. Since there will not be daily monitoring and evaluations in service as in production, the frequency of these studies may vary according to the time the service is provided. In addition, some of the activities to be monitored and evaluated can also be carried out at the desk through document control.

The most objective and useful method used for the quality assessment of service-based activities is the survey and the analysis of these surveys. Surveys to be made before and after

a training or service and their appropriate comparison will inform you about the success of your activity and will guide you in improving your activities in future processes and projects.

Verification Methods

Primary Sources: The sources from which you can directly obtain information on your activities within the framework of monitoring and evaluation activities can be defined as primary sources. These resources include surveys, participant lists, interviews and results, research reports, focus group meetings, in-depth interviews, evidence of activities, news, images, visuals, outputs, etc..

Secondary Resources: Researches, reports, statistical records, official documents, annual reports, plans, etc. prepared by parties other than the project activities and the consortium can be defined as secondary sources. The most important feature that distinguishes the primary source from the secondary source is that it was created by a person or institution that is not directly related to the project.

It is important that the persons and processes that will carry out the monitoring and evaluation studies are also identified in the proposal and acted accordingly. Assignments can be made from within the consortium for monitoring and evaluation studies, as well as service procurement from an outside company. However, it is recommended that you review the program guide and the rules in the call for proposals for outsourcing. In large-scale project proposals, the involvement of an external, independent person or firm as an auditor may provide professionalism, while such an application in small-scale projects may be perceived as an extra cost. In both cases, the audit processes need to be well justified.

In the assignments to be made from within the consortium, it is generally not required to give the names of the people who will make the monitoring and evaluation at the proposal stage. In this case, it will be sufficient to provide information about the position and qualification of these people. Monitoring and evaluation may not be the only task of the people you will assign, but they will also be able to work at different stages of the project. In this case, it may be useful to indicate how much of their time they will devote to these tasks.

You may need to set a hierarchy according to the number of people you will assign. For example, monitoring and evaluation personnel can carry out their work in accordance with the specified activity calendar and report to the coordinator assigned as the monitoring and evaluation manager. The Manager can review these reports and request corrections or approve the report and submit it to the Project Executive Board. A similar process can be established for the monitoring and evaluation relationship between the partners and the coordinator. In this case, the monitoring and evaluation managers of the partners can send their reports to the director of the coordinating institution. As a result of the process, these reports are revised or accepted. If there is any deviation from the targeted time and quality, this situation is separately presented to the information of the top management and decided in the next meeting.

Steps for Following Up Process
Step 1 – Determine who is going to follow up/monitor your activities.
Step 2 – Identify the information collection methods.
Step 3 – Place a sub-activity regarding the follow-up.
Check List for Following Up Process
Do activities be realized as they stated in the Time Table?
Do the outcomes meet your expectations?
How does the target group response to the Project activities?
What are the differences between the expectations and reality?

Table 11. ***Output Follow-up Template Example***

Name of the Output	**Name of the Activity**	**Start Date**	**Termin Date**	**KPI**	**Initial State**	**Target**	**Current**	**Completion (%)**	**Explanation (If any)**
Needs Analysis Report	Survey Design	01.06.2022	30.06.2022	Survey will be designed on time	-	Be finished on termin date	Finished before termin date	%100	-
	Survey Implementation	01.07.2022	31.07.2022	Surveys will be applied to minimum 450 people in the target group.	0	450	375	%83,33	The activity is ongoing.
	Survey Analysis	01.08.2022	31.08.2022	Surveys will be analyzed on time.	-	Be finished on termin date	Activity has not started yet.	-	-
	Finalization of Needs Analysis Report	01.09.2022	30.09.2022	Needs analysis report will be generated on time.	-	Be finished on termin date	Activity has not started yet.	-	-
Date: 25.07.2022		Name of the Evaluator: John Doe			Signature:		Remarks:		

EVALUATION

Step 1 – Identify the information collection methods. (Surveys, statistics etc.)

Step 2 – Frequency of these information collection methods. (every two months, Daily etc.)

Step 3 – Determine the responsible person/team for data collection. (Project team, 3rd parties-subcontractor, or both)

Step 4 – Decide that how are you going to use the feedback from the evaluation.

4.1 Quality Plan

Quality studies play an important role in determining the extent to which the objectives and outputs of the project have been achieved and in intervening when necessary. Quality requires examining goals and outputs not only quantitatively but also qualitatively. Quality studies in your project are carried out by regular monitoring and evaluation of Key Performance Indicators (KPI). Monitoring and evaluation of management processes as well as objectives and outputs are also included in the quality issue. As a matter of fact, a good management process is required for the project to reach its goals and outputs at the desired level. Problems experienced in management processes will directly affect the quality of the target and output. In addition, the image of a poorly managed project that achieves the desired goals and outputs and the institutions involved in the project may also be adversely affected. For this reason, while preparing and implementing your project, you need to consider both objectives and outputs and management processes. It is also important to include items related to management processes when determining your KPIs. In order to minimize management risks, you need to define a Risk/issue/change/crisis Management methodology and strategy at the proposal stage.

As quality management is directly related to monitoring and evaluation processes, it can be specified in this part of the proposal form. You also need to define how the quality management processes will operate. You can divide your quality management process into quality assurance and quality control.

The quality assurance technique and process are the set quality objectives and the preventive steps taken to eliminate any differences in the quality of the output produced. In this process, the frequency and quality of the steps followed in the coordination and cooperation of the output, service or activity to be produced are evaluated. Meeting minutes, correspondence, decisions taken, practices made, internal correspondence, survey results to be applied to project employees can be used within the framework of quality assurance mechanism.

Quality control technique and process can be defined as the quality objectives set and the remedial steps taken to eliminate any difference in the quality of the output produced. If there is a deviation from the targets, related problems are identified and necessary measures are taken and improvements are made. Surveys for beneficiaries, feedback, visuals, images, notes, invoice / waybill information, peer / expert evaluations, work package / output review meetings can be used within the scope of quality control mechanism.

In the evaluations to be made, a commission within the consortium will be appointed, or an external evaluator may be hired. If the grant program allows, you can justify the external evaluation service in this context. It is important that you specify how often, by whom, and

for what purpose your quality studies will be carried out, in the relevant sections of the project proposal form. At this stage, you can specify the qualifications and profile of the person or people who will carry out the quality studies. When presenting the profile of these people, you do not need to give their names unless otherwise requested. It is recommended that you pay attention to proportionality in the budget you will allocate for quality studies. In this context, quality work should not constitute a large part of the project budget. If you are developing a production-related project where quality is very important, you can justify this situation, but this budget will naturally be more limited in projects where the physical product is scarce and for services and activities.

5 CREATING A DRAFT BUDGET

Budgeting is one of the most important part of a Project proposal. Costs that you will determine should be in line with the activities which have to produce benefits, good quality and lead your Project to its goals.

Below is a budget template used by the European Union:

Table 12. ***Budget Template***

1. Budget for the Action	**All Years**			
Costs	**Unit**	**# of units**	**Unit value (in EUR)**	**Total Cost (in EUR)**
1. Human Resources				
1.1 Salaries (gross salaries including social security charges and other related costs, local staff)				
1.1.1 Technical	Per month			
1.1.2 Administrative/ support staff	Per month			
1.2 Salaries (gross salaries including social security charges and other related costs, expat/int. staff)	Per month			
1.3 Per diems for missions/travel				
1.3.1 Abroad (staff assigned to the Action)	Per diem			
1.3.2 Local (staff assigned to the Action)	Per diem			
1.3.3 Seminar/conference participants	Per diem			
Subtotal Human Resources				
2. Travel				
2.1. International travel	Per flight			
2.2 Local transportation	Per travel			
Subtotal Travel				
3. Equipment and supplies				
3.1 Purchase or rent of vehicles	Per vehicle			
3.2 Furniture, computer equipment				
3.3 Machines, tools…				
3.4 Spare parts/equipment for machines, tools				
3.5 Other (please specify)				
Subtotal Equipment and supplies				
4. Local office				
4.1 Vehicle costs	Per month			
4.2 Office rent	Per month			
4.3 Consumables - office supplies	Per month			
4.4 Other services (tel/fax, electricity/heating, maintenance)	Per month			
Subtotal Local office				
5. Other costs, services				

5.1 Publications				
5.2 Studies, research				
5.3 Evaluation costs				
5.4 Translation, interpreters				
5.5 Financial services (bank guarantee costs etc.)				
5.6 Costs of conferences/seminars				
5.7 Visibility actions				
Subtotal Other costs, services				
6. Other				
Subtotal Other				
7. Subtotal direct eligible costs of the Action (1-6)				
8. Indirect costs (maximum 7% of 7, subtotal of direct eligible costs of the Action)				
9. Total eligible costs of the Action, excluding reserve (7+ 8)				
10. Provision for contingency reserve (maximum 5% of 7 'Subtotal of direct eligible costs of the Action')				
11. Total eligible costs (9+10)				

In the previous sections, it was mentioned that you should note the necessary resources and equipment for each activity either in the project proposal form or in a draft document that you are working on. When you examine the notes you take for each activity, you will notice that some of the resources, equipment or services required for the activities may be shared or included in the same budget item. For example, if you foresee the design and distribution of brochures in your two different activities, you should specify them in a single budget item, not separately. On the other hand, if two different training services are foreseen for two different activities, you can specify that you will purchase two different training services under the 6. Other. In this case, you will need to number, name, budget and justify the different education service purchases such as 6.1, 6.2. However, if the same type of training is foreseen in both activities, then it would be beneficial to enter a single budget item under the heading 6.1.

If we examine the cost sections one by one, Human Resources takes the first place. Sections 1.1 and 1.2 are designated as the place where the wages of national or international employees will be written. In part 1.3, if any domestic or international mobility of the personnel is foreseen within the framework of your activities, it is requested to include the per diems related to this.

You can elaborate on sections 1.1 and 1.2 if necessary. For example, such as 1.1.1 Technician, 1.1.2 Psychologist, 1.1.3 Guidance Teacher, 1.1.4 English teacher… When determining and budgeting the wages of these employees, remember that these are gross. In addition to the gross wage, it is recommended to add the taxes that employers have to pay to these costs. Otherwise, your institution will have to cover these fees or the employee salaries will be lower than you set. On the other hand, you need to take into account the inflation problem seen all over the world in recent years. You need to calculate inflation for the year or years in which the project will be carried out and reflect the rate you find as a result of this calculation to your budget. For example, for a position where you set a gross wage of 1000 Euros, if you have estimated the inflation rate of 10% in the year the project will be implemented, it will be

necessary to write an amount such as 1,100 Euros in the budget. It is important that you explain the reason for this redundancy in the justification section.

As mentioned, you are requested to include personnel duty allowances in section 1.3. It is recommended that you pay attention to the upper limits determined by the grant program when determining these per diems. If no cap is set, you can price the task to determine an average daily and justify that way. Remember, in this section you will only set the per diem for the attendant, for transportation you are requested to specify the costs in section 2.

In section 2, you are expected to include local and international travel. These trips must be related to the given task and project. If your project includes participation in an international meeting, you can calculate the average travel costs and add your estimated changes for inflation and budget it. You have to do these calculations for each activity one by one. Similarly, you are expected to put budget for local mobilities and meetings. On the other hand, the payments to be made for the staff to come to work should not be included in this section, but should be specified in the Human Resources section (it should be included to wages).

In the 3. Equipment and Supplies section, you can specify the fixtures, consumables, goods, machinery and tools you need to carry out the project activities. In this section, you can buy these equipments as well as rent them. Some programs do not allow or limit rentals. Unless you have an important reason, it is recommended not to rent and buy equipment. As a matter of fact, after the completion of the project, it is necessary to ensure the sustainability of the activities. Therefore, it will be easier and more sustainable to use the purchased equipment instead of finding financing again to rent the needed equipment.

On the other hand, when purchasing equipment, some grant programs may require you to set a budget equal to the depreciation rate of the product you will receive. For example, if you are going to use a computer with a depreciation of 5 years in a project of 3 years, you may be asked to write down 3/5 of the cost of this computer and justify it as such.

It is possible to make your main headings detailed as in other sections. For example, if you are going to create a training office, You can write items under 3.2 Furniture, Computer equipment part such as 3.2.1 Desk, 3.2.2 Working chair, 3.2.3 Coffee table, 3.2.4 Working chair, 3.2.5 Smart Board, 3.2.6 Computer, 3.2.7 Projection tool, 3.2.8 Cabinet, 3.2.9 Hanger, 3.2.10 Chair etc..

While budgeting, you can write your needs under the relevant section or under the headings in other sections. The important thing here is that the budget item is not stated in irrelevant parts and that it allows the independent evaluator to examine the budget in a consistent and logical framework.

In the 4th part, you can budget your project office expenses. Office rent, monthly costs of tools required to carry out the works related to the project, office supply costs are included in this section. The important thing here is to be objective and consistent when justifying these costs. The budget you will allocate for the project office rent should not be used for an office rent you normally pay. Or in a project where you have allocated an apartment of your own, if the project office is designated as a single room, you only need to include the expenses of that part in the budget. On the other hand, if you already have an office, you can specify that you

will allocate this office to the project as co-financing instead of writing it down as a cost. Some grant programs also consider such co-financing as a contribution to the project budget. In projects that do not consider such in-kind supports as a contribution to the budget, these contributions are still seen as positive. For this reason, it is recommended that you budget office supplies and, if necessary, vehicle expenses, and show the parts such as office rent and payment of bills as co-financing in this section. However, this is only a recommendation. If you are well justified and the costs are determined realistically, it is possible to receive grant support for office rent and bills and similar expenses.

Part 5 covers other costs and services:

5. Other costs, services

5.1 Publications: In this section, you can allocate a budget for the printing and design expenses of the books and intellectual outputs you will produce within the framework of the project. In order to create the contents of these products, you can allocate a budget in different parts in parallel with the activities of the project. On the other hand, if a detailed activity is not foreseen to create content, you can budget in this section. For example, if you have planned to design an instructor training booklet on facilitating the participation of people with disabilities in society within the scope of your project and you have allocated a human resource for this, you can only include printing and design expenses in this section. However, if you want to design and prepare a comic book series on the participation of people with disabilities in society, you can justify it in this title.

5.2 Studies, research: As mentioned in 5.1, if no research or study is foreseen to be carried out in a different activity of your project, you can cost a needs analysis or any research work in this part.

5.3 Evaluation costs: Some grant schemes require external auditor services. In such a case, you can budget the purchase of an external audit service under this heading. On the other hand, although there is no such obligation, you can allocate a budget for this service with good justification. If you are not going to purchase such a service, you can do an internal audit using the project's human resources, but it is recommended that you justify it well in the project.

5.4 Translation, interpreters: If your project requires translation or interpreter services, you can put a cost in this section. On the other hand, if your human resources in the project have the knowledge, skills and equipment to do these works, you can state that you will benefit from these resources in the project proposal and you may not allocate a budget for this part.

5.5 Financial services (bank guarantee costs etc.): Some programs may require a bank guarantee letter from the grant beneficiary. In addition, bank transfer expenses and costs arising from exchange rate changes may arise. If the grant program allows these to be met, you can specify an estimated budget in this section.

5.6 Costs of conferences/seminars: If you are going to organize seminars and conferences, you can include the relevant costs in this section. It is important that you detail the costs of each seminar and conference in headings. For example, under the heading of 5.6.3 Project Closing Conference, 5.6.3.1 Catering expenses, 5.6.3.2 Conference hall rental fee, 5.6.3.3 Key Note Speaker Cost, 5.6.3.4 Simultaneous Interpreter and Equipment Expenses.

5.7 Visibility actions: In this section, you can create budget items for your visibility, promotion and dissemination activities that you plan to carry out within the scope of the project and/or the materials you will use in your activities.

6. Other

You can put budget of the products and services that are not included in the other sections under this heading. Generally, project-specific service procurements are included under this heading. For example, you can specify a limited-time training, guidance or consultancy service under this heading.

Service Procurement vs. Human Resources

It is necessary to mention one issue regarding service procurement. While designing your project, you may have human resource-based activities such as training, consultancy and guidance. You can follow two different methods to perform these activities. The first of these is to employ people who meet the necessary criteria in the relevant field in your project. The second method is service procurement. Especially in projects with a duration of one year or less, you can choose service instead of employment. When deciding between service recruitment and human resource employment, you may consider pros/cons:

Human Resources Employment

- Recruitment process, interviews, interviews,

- Recruitment procedures, accounting procedures and other bureaucratic processes,

- The termination of employment of the person at the end of the project and the related compensation payments,

- The necessity of repeating the aforementioned transactions as a result of the person leaving the job and the possibility of disruption of services and activities in this process.

- The necessity of employing an accountant, if there is no accountant who can do the mentioned transactions or if the workload does not handle this or paying overtime to your staff (not specifically working in the Project) within the scope of the project.

+ At the end of long-term projects, the employment of the personnel who know the projects and processes continues so that the work and processes are not interrupted,

+ The probability of personnel to have a greater sense of belonging to the project.

+ Possibility of providing more services than targeted / determined during working hours and duration (not exceeding the legal period).

Service Procurement

+ The processes related to bureaucratic and human resource management are carried out by the company providing the service.

+ When payments are made through progress payment by fund provider, this part can be tolerated by the company providing the service for a certain period of time, if the payments made to the beneficiary within the scope of the grant program are delayed.

+ As long as the desired quantity and quality of service is provided, leaving the company or Project of workers in the Project is not a problem. In this part, the organizational and financial capacity of the company is important.

- Since the service is received through the company, it is difficult for the employee to develop a sense of belonging to the project and the purchasing company.

- There are time, place and job definition limitations in service delivery. Personnel with corporate affiliation may intervene in unforeseen situations, but this will not be the case in service procurement.

-/+ The service provider will be looking for profits not for wages if it is not a sole proprietorship and the service provider does not work on its own behalf. Therefore, the service it will provide will be more expensive than the direct employment of human resources. On the other hand, since it may be difficult to provide direct employment in short-term projects, it may be necessary to keep wages high. In these cases, the costs may be lower since the companies that provide services assign their employees to different institutions and projects. For this reason, it is important to conduct market research and get price offers at the project proposal stage.

Hybrid method: You can directly employ the administrative staff of your project, choosing from people who will take ownership of the project and activities and can continue it when the project is completed, and can provide the institutional memory. On the other hand, you can obtain the services to be provided by people whose technical knowledge and expertise you will benefit from for a certain period of time, through the service procurement method. In this way, you will reduce the disadvantages of both methods.

Section 7 contains the sum of the subtotals of all your activities.

8. Indirect costs, in this example, can be up to 7% of your direct expenses (i.e. the total amount included in Section 7.). In different programs, the rate of indirect expenses may vary, in some of them this budget item may not be exist.

In the 9th part, the sum of the costs in the 7th and 8th parts is given.

10. In this example, the sum of all the activities in section 7 can be reserved for a maximum of 5% of the direct expenditures. In different programs, this rate may change, in some this budget item may not be exist.

11. Total costs in sections 9 and 10 will give the total budget of the project. These costs include the subtotals of the parts in the project budget (direct expenses), indirect expenses (maximum 7% of direct expenses), reserve funds (maximum 5% of direct expenses).

Table 13. ***Budget Justification for Activities***

	All Years	
Costs	**Clarification of the budget items** *Provide a narrative clarification of each budget item demonstrating the necessity of the costs and how they relate to the action (e.g. through references to the activities and/or results in the Description of the Action).*	**Justification of the estimated costs** *Provide a justification of the calculation of the estimated costs. Note that the estimation should be based on real costs or on simplified cost options if allowed, as described in section 2.1.5 of the Guidelines for Grants Applicants*
1. Human Resources		
1.1 Salaries (gross salaries including social security charges and other related costs, local staff)		
1.1.1 Technical		
1.1.2 Administrative/ support staff		
1.2 Salaries (gross salaries including social security charges and other related costs, expat/int. staff)		
1.3 Per diems for missions/travel		
1.3.1 Abroad (staff assigned to the Action)		
1.3.2 Local (staff assigned to the Action)		
1.3.3 Seminar/conference participants		
Subtotal Human Resources		
2. Travel		
2.1. International travel		
2.2 Local transportation		
Subtotal Travel		
3. Equipment and supplies		
3.1 Purchase or rent of vehicles		
3.2 Furniture, computer equipment		
3.3 Machines, tools…		
3.4 Spare parts/equipment for machines, tools		
3.5 Other (please specify)		
Subtotal Equipment and supplies		
4. Local office		
4.1 Vehicle costs		
4.2 Office rent		

4.3 Consumables - office supplies		
4.4 Other services (tel/fax, electricity/heating, maintenance)		
Subtotal Local office		
5. Other costs, services		
5.1 Publications		
5.2 Studies, research		
5.3 Evaluation costs		
5.4 Translation, interpreters		
5.5 Financial services (bank guarantee costs etc.)		
5.6 Costs of conferences/seminars		
5.7. Visibility actions		
Subtotal Other costs, services		
6. Other		
Subtotal Other		

You are expected to justify and explain the budget items and their costs that you have identified in the 2. Justification of the Budget for the Action section.

5.1 Clarification of the Budget Items

In the proposal you need to provide a narrative clarification of each budget item demonstrating the necessity of the costs and show how they relate to the action (e.g. through references to the activities and/or results in the Description of the Action).

In this section you need to justify the necessity of the budget item. You should specify in which activities you will use the budget item. You can also reference the abbreviations and numbers you have given to the activities. While justifying the activities, you should not forget to indicate how much of each unit is used in the relevant product / service item.

In the column on the right, you will need to justify the costs. While justifying the costs, you can state that some costs related to the employer are calculated as well as the inflation, the changes caused by the supply / demand that you foresee, tax and social security deductions for human resources. In addition, in some programs, they may request you to get a price quote for product / service items above a certain budget limit. In this context, you can state that you have received price offers from companies. For standard goods, products and services, unless otherwise stated, you can do your market research on the internet and state this in the justification section.

3.

Table 14. ***Estimated Budget Sources, Revenue and Costs***

Expected sources of funding & summary of estimated costs			
		Amount/ EUR	**Percentage %**
Expected sources of funding			
EU contribution sought in this application **(A)**			
CO-FINANCING (1+2) **(B)**			
1. Other contributions (Applicant, other Donors etc)			
Name	*Conditions*		
2. Revenue from the Action [4]			
Expected TOTAL CONTRIBUTIONS **(A)+(B)**		0,00	
Estimated Costs			
Estimated TOTAL ELIGIBLE COSTS [2] **(C)**		0,00	
EU contribution expressed as a percentage of total eligible costs [3] **(A/C x 100)**			0,00

Table 15. ***Budget Distribution Table Among the Applicants***

Name of the Entity[4]	Amount EUR	Percentage %
Lead applicant		0,00
Co-applicant -1		0,00
Co-applicant-2		0,00
TOTAL BUDGET	**0,00**	**0,00**

1. Expected sources of funding and estimated costs must be in balance.
2. as per heading 11 of the Budget of the Action
3. do not round, enter percentage with 2 decimals (e.g. 74,38%),
4. with reference to art.17.4 (b) of the General Conditions

In the 3. Expected sources of funding & summary of estimated costs section, you are expected to detail how the co-financing will be provided. As mentioned, some grant programs expect beneficiaries to contribute a certain amount to the project. The amount of this contribution may differ from program to program. Generally, programs do not accept in-kind contributions as co-financing, but show the use of human resources as an exception. In other words, if you assign the person or people you employ in your institution during your project, you will not have to allocate any financial installments for co-financing the project. This may apply to your partners as well as to the coordinator. On the other hand, making extra contributions to the project and providing financing opportunities can have a positive effect on the evaluator (even though it is not included in the written evaluation criteria).

If we go through the 3. Expected sources of funding & summary of estimated costs one by one:

In the EU contribution sought in this application (A) section, you must specify the amount and rate of support to be received from the granting institution (you can calculate the rate part by writing a formula in excel or after entering all the total amounts).

As can be seen in the CO-FINANCING (1+2) (B) part, there are 2 subsections. The first of these is the 1. Other contributions (Applicant, other Donors etc) section. In this section, you must write down the cash contributions of your institution, partners and 3rd parties to the project, and the value of the human resources contributions in terms of the relevant currency. In addition, in this section, you must specify the names of your institution, each of your partners and/or the donors and the conditions, if any. When calculating the contributions to be made through human resources, you should consider and specify the gross wage payments, not the net wage payments you make to the personnel. During the execution phase of your project, you will be asked for the assignment letter and payrolls of the relevant person(s) to prove these contributions. The gross amount on the payrolls will show your contribution. If the amount on the payrolls of the persons in charge is below the amount of co-financing requested by the program, the difference will have to be covered in cash. On the other hand, assigning more people than necessary to meet this co-financing with human resources may result in a score being deducted from the relevance part of the project by the independent evaluator.

In the second subsection, the estimated amount of the revenues obtained from the project is requested. If your project does not generate income from the production of any product and/or service, you can leave this section blank, otherwise you have to specify your estimated income

amount. It can be said that there is an unwarranted perception that project calls for proposals or grant programs are not expected to generate income or value because they generally have social purposes. In fact, it is very important for your project to create financing by generating value, in terms of strengthening its sustainability. Explaining how you will create a structure that will generate income and value in the sustainability part of your proposal form and presenting it with a realistic analysis will ensure that your proposal receives a very high score in these parts as a result of the evaluation. However, in short-term projects, it may be difficult to establish and operate a structure that can generate income, value and profit. In this case, you can specify that the structure / model you have installed can be fully implemented after your project is completed. Since your project will not generate income during the execution phase, you do not have to make any income estimates in this section. You can also mention about your model that will generate income in the sustainability section.

It is important that you determine the amount you expect to earn in the estimated income section realistically, taking all risks into account. As a matter of fact, when you state the amount you expect to receive as excessive, but this expectation is not fulfilled, you may have to complete the amount of co-financing in question from other sources. This can put your institution, your partners and your project in a difficult position.

In the Estimated Costs section, you are expected to specify your estimated costs.

Estimated TOTAL ELIGIBLE COSTS shows the total cost in section 11 of Table 1 of the budget. When you compare the amount of support in the EU contribution sought in this application (A) to the total cost (A/C x 100), it will give you EU contribution expressed as a percentage of total eligible costs.

In the last part, the Budget Distribution Table Among the Applicants, the budget distributions of the coordinators and partners are specified. When specifying these budget allocations, you must include not only the grant received, but also the co-financing amounts (per institution, if any). The ratio of each partner's budget to the total project budget will give you the percentage distribution of the partners.

RESOURCE AND BUDGET PLANNING & MANAGEMENT

A Project can be split into different Workpackages and each Workpackage consists of activities and tasks. In order to undertake tasks and carry out activities, resources are needed and should be properly distributed and followed up. While allocating the resources, you need to consider several things:

- Are the resources enough to carry out the activity?

- Are the resources directly related with the tasks and activities? How are they related?

- Is it cost effective?

- Did you carry out a market research?

- Did you analyze the general situation of the national and/or international economy or the specific situation related with the sector?

- If you foresee a problem for the future activities, state its reason in the proposal and allocate your resources and determine your budget accordingly. For example, if you foresee that there will be inflation in prices for the next year (let’s say %10), you need to increase the costs %10 than the originally planned.

- If you are planning to hire personnel, consider the gross salary not the net salary. You need to make a research about how your national regulations are regarding the additional payments (such as stamp taxes, fees for documentation requested by the authorities) for the hired personnel.

- Did you set your budget in line with the Grant Programme Guidelines? Some grant programmes (especially EU funds) require coordinator and/or partners to co-finance the Project activities. The rules for co-finance varies for each programme. Some programmes put special rules that you can co-finance the Project by allocating your personnel (who is already working in your institution) for the Project for a specific amount of time. Therefore, you don't have to directly make financial installments to the Project. While some programmes count in-kind contributions as co-finance, while some don't. Therefore, it is important for you to read and understand the guidelines properly.

- Purchasing vs. Renting. Some grant progammes may not allow for you to purchase a product, so you need to rent it instead. However, in order to ensure the sustainability, you may provide justification for the purchase of the product. If you think the product/service is not essential and doesn't provide necessary impact for sustainability, it would be better for you to focus on renting it. Also, if it is not necessary, do not put budget the things you would like to purchase for your regular Office work (such as new computers, screen etc.). Unnecessary purchases and rents can be criticized by the evaluators. This may result a lower score in the evaluation process which can cause elimination of the proposal.

It would be easier and more accurate if you prepare your budget and identify the resources you need for each activity. When you design the activity, visualize yourself that you are carrying out the activity in the future. Think about the activity step by step, and take note all the required resources to carry it out. Once you do this for each activity, you almost complete your draft budget.

6. LOGFRAME APPROACH

The logframe approach can be considered as part of project cycle management. Some funding institutions and programs may require a logframe form to be completed in their application annexes. Even if the program you are applying to does not require such a form, in any case, the logframe approach is an important tool for you to see the consistency of your project proposal and organize your project accordingly.

If you complete the situation analysis correctly and successfully, you can fill the first column very easily.

Overall Objective / Impact is in the first row of the Results chain column. As you may remember, at the top of the situation analysis were the effects of the problem and the solution of this problem. These effects represent an ideal situation where you can only contribute with your project.

The second row of the same column contains Outcome (s) / (Specific objective(s)). In this part, you can use the main purpose of your project; In the *Other Outcomes (*where relevant) section, you can use items that are hierarchically one level below the main purpose in your problem/target tree.

In the Outputs section, you must specify the concrete outputs and products as a result of your project's activities. In this section, you can specify both the items at the bottom of your problem-target tree and the issues you have stated in your activity plan regarding these items.

In the Indicator column, you must specify quantitative and qualitative indicators of the goals and outputs in the first column. These indicators should show the results that will emerge as a result of the project. You can use the Key Performance Indicators (KPIs) that you have determined in the project form in this column. If you are acting on the logic frame approach,

you can include the indicators you will determine in these sections in the project form. As mentioned, you need to make sure that the indicators in this section are SMART (Specific, measurable, achievable, realistic, time-bound).

In the 3 columns next to the Indicator column, information about the indicators is requested:

Baseline: This section includes basically the situation before Project was carried out. Determining the situation before the project is important in terms of both a good handling and justification of the issue and a good design of the project. For this reason, you need to determine the pre-project situation by making use of the online environment, institutions, face-to-face interviews, research reports, statistical databases and similar objective sources.

Target: The target value represents the situation at the end of the project. In this context, you need to specify your goals for the end of the project, both qualitatively and quantitatively. Baseline and target values are necessary values to measure your success at the end of the project.

Current value: This part has the same value as the baseline at your project start. However, if you are preparing your interim report using the logic of the logical framework within the scope of the program, you must specify the current situation before the interim report is presented in this section. In other words, this part will be updated during the project implementation, you can use the same expressions as the baseline at the beginning of the project.

The Source and mean of verification column contains information on how to measure the targets and outputs mentioned in the first column in terms of quality and quantity.

a. Assumptions

Logframe approach also requires the identification of assumptions for each row except the first one. While determining your assumptions, it is also important to identify your risks and the mechanisms and methods to combat them. The goals and indicators you set in the logframe approach will be realized under these assumptions. Your goals and indicators include qualitative and quantitative descriptions. In cases where your assumptions differ, there may be a qualitative and quantitative decrease in your project outputs and activities. In such a case, the success rate of your project will decrease, as you will not be able to fully achieve your goals during the project execution phase. In this case, you will need to make a statement to the institution or program authorities from which you receive funds / grants. Since your project proposal will also be a part of the grant agreement you will sign, the assumptions you make here will serve as a basis and reference point for your explanations and justifications.

The assumptions you write for each line will go from general to specific as you get down to the lines below. On the other hand, it is possible that the assumptions and risks you set for different lines are common. For example, when you have a specific goal related to reducing youth unemployment, one of your assumptions to meet the target(s) is that the economy is stable. If the economic situation deteriorates during the period you implement your project, both the employment opportunity of young people will decrease and the price / value of the resources you will use in the project activities will increase, so the activities and outputs will be lower than the target in terms of quality and / or quantity. In this case, you can also use your assumption regarding the economic situation in the lines below.

b. Activity Matrix

The activity matrix may also be included in the logframe matrix in some project proposal forms. It is seen that the activity matrix is requested separately in the grant programs published by the European Union recently.

The logframe approach envisages a hierarchical order. In this context, the General purpose, the specific goals necessary to achieve this general goal, and the outputs necessary to achieve the specific goals are specified in conjunction with each other. In order to realize the outputs in the last stage of this hierarchical order, activities should be organized. It is recommended to enumerate appropriately to show how all these specific goals, outputs and activities are related. For example, you can sort the outputs of the 1st specific objective as 1.1, 1.2, 1.3 …. Similarly, you can use similar logic in activities. Thus, both you and the independent evaluators will not have to repeat or make mistakes while reviewing the project proposal.

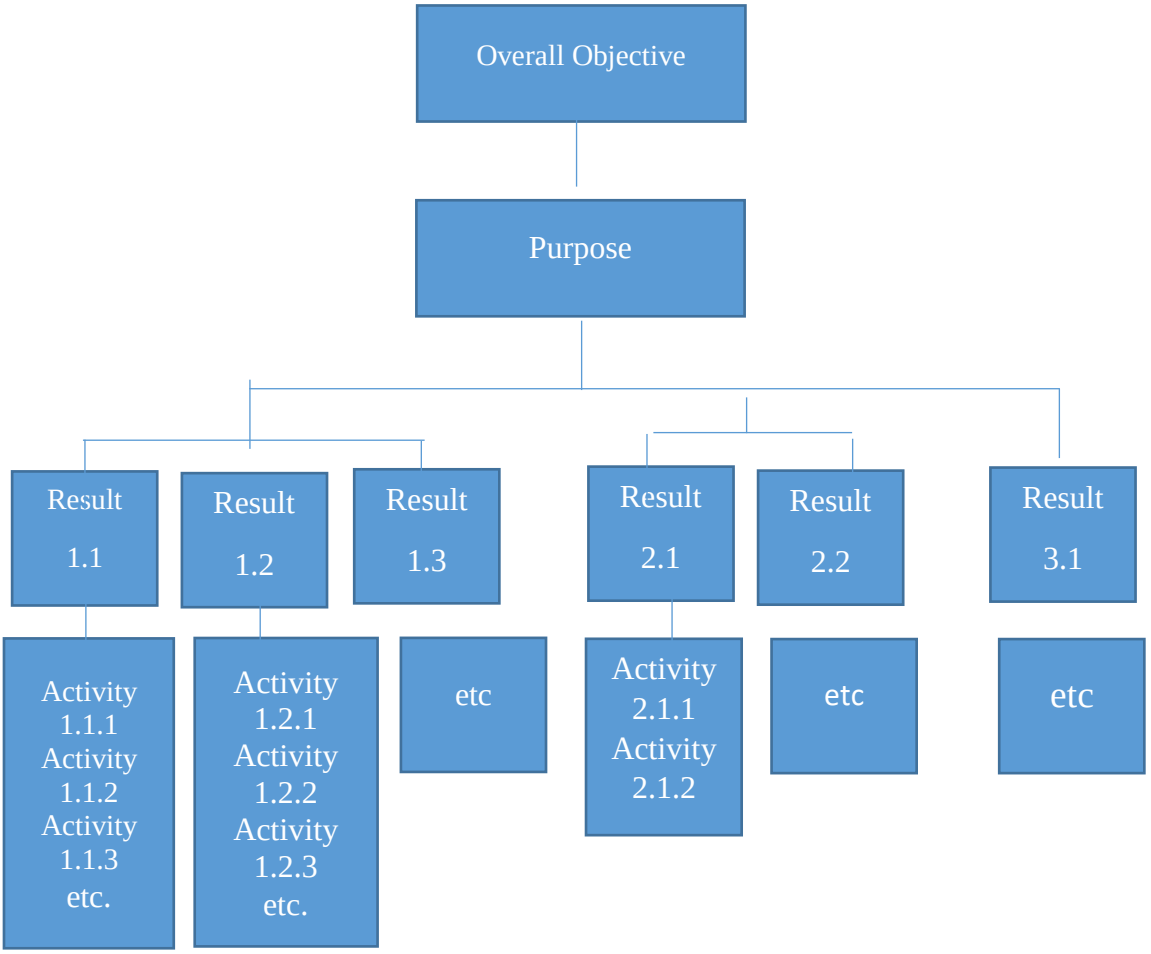

Figure 10: *Objective Tree with References Numbering* (EU Commision, 2004, p. 76).

Table 16. ***Objective Hierarchy with Statements***

Objective hierarchy	Example of how to write statements
Overall objectives	To contribute to improved family health, particularly of under 5s, and the general health of the riverine eco-system
Purpose	1. Improved river water quality
Results	1.1 Reduced volume of waste-water directly discharged into the river system by households and factories 1.2 Waste-water treatment standards and effectively enforced.
Activities **(may not be included in the matrix itself, but rather presented in an activity schedule format)**	1.1.1 Conduct baseline survey of households and businesses. 1.1.2 Complete engineering specifications for expanded sewerage network 1.1.3 Prepare tender documents, tender and select contractor 1.1.4 Identify appropriate incentives for factories to use clean Technologies 1.1.5 Prepare and deliver public information and awareness program 1.1.6 etc

Source: EU Commision (2004, p. 77).

c. If-Then Causality

You can test and revised the statements in the Logframe matrix in line with the if-then causality logic.

IF adequate inputs/resources are provided, **THEN** activities can be undertaken;

IF the activities are undertaken, **THEN** results can be produced;

IF results are produced, **THEN** the purpose will be achieved; and

IF the purpose is achieved, **THEN** this should contribute towards the overall objective

IF we wish to contribute to the overall objective, **THEN** we must achieve the purpose

IF we wish to achieve the purpose, **THEN** we must deliver the specified results

IF we wish to deliver the results, **THEN** the specified activities must be implemented; and

IF we wish to implement the specified activities, **THEN** we must apply identified inputs/resources.

Source: EU Commision (2004, p. 74).

Table 17. ***Logical Framework Analysis Template***

	Results chain	***Indicator***	***Baseline (Value & reference year)***	***Target (Value & reference year)***	***Current value* (Reference year)***	***Source and mean of verification***	***Assumptions***
Impact (Overall objective)	*The broader, long-term change to which the action contributes at country, regional or sector level, in the political, social, economic and environmental global context which will stem from interventions of all relevant actors and stakeholders.*	*Quantitative and/or qualitative variable that provides a simple and reliable mean to measure the achievement of the corresponding result* *To be presented, when relevant, disaggregated by sex, age, urban/rural, disability, etc.*	*The value of the indicator(s) prior to the intervention against which progress can be assessed or comparisons made.* *(Ideally, to be drawn from the partner's strategy)*	*The intended final value of the indicator(s).* *(Ideally, to be drawn from the partner's strategy)*	*The latest available value of the indicator(s) at the time of reporting* *(* to be updated in interim and final reports)*	*Ideally to be drawn from the partner's strategy.*	*Not applicable*
Outcome (s) (Specific objective(s))	*The main medium-term effect of the intervention focusing on behavioural and institutional changes resulting <u>from the intervention</u> (It is good practice to have one specific objective only, however for large Actions, other short-term outcomes can be included here)*	*(see definition above)*	*The value of the indicator(s) prior to the intervention against which progress can be assessed or comparisons made.*	*The intended final value of the indicator(s).*	*(same as above)*	*Sources of information and methods used to collect and report (including who and when/how frequently).*	*Factors outside project management's control that may influence on the impact-outcome(s).*
****Other Outcomes (*where relevant)***	*Where relevant other short-term effect(s) of the intervention focusing on behavioural and institutional changes resulting <u>from the intervention (e.g.</u> intermediate outcomes can be accommodated here)*	*(same as above)*	*(same as above)*	*(same as above)*	*(same as above)*	*(same as above)*	*Factors outside project management's control that may impact on the SO/other outcomes linkage.*

Outputs	*The direct/tangible products (infrastructure, goods and services) delivered/generated by the intervention (*Outputs should in principle be linked to corresponding outcomes through clear numbering)*	*(same as above)*	*(same as above)*	*(same as above)*	*(same as above)*	*(same as above)*	*Factors outside project management's control that may influence on the other outcome(s) / output linkage.*

Activity Matrix

What are the key activities to be carried out to produce the intended outputs? *(*activities should in principle be linked to corresponding output(s) through clear numbering)*	***Means*** *What are the political, technical, financial, human and material resources required to implement these activities, e. g. staff, equipment, supplies, operational facilities, etc.* ***Costs*** *What are the action costs? How are they classified? (Breakdown in the Budget for the Action)*	***Assumptions*** *Factors outside project management's control that may impact on the activities-outputs linkage.*

Source: https://europa.eu/capacity4dev/file/103902/download?token=KJm7N1cQ

7. COMMUNICATION AND COLLABORATION AMONG ACADEMICIANS

Communications management is a crucial aspect of organizational functioning, encompassing the planning, implementation, monitoring, and adjustment of communication channels within and between organizations. It involves developing strategies for corporate communication, designing internal and external communication guidelines, and effectively managing the flow of information, including online communication. This process helps organizations establish a systematic approach to communication, ensuring that information is disseminated efficiently and effectively.

Communication and management are inherently intertwined. Communication involves the exchange of information between individuals or groups, while management entails the dissemination of information by managers to their teams. Effective communication is essential for successful management, as it enables control, coordination, and collaboration within projects. Without a well-designed communications management system, the various stages of a project may encounter significant limitations. It also serves as a vital tool for maintaining project integrity and facilitating information exchange among team members. Communication should flow vertically, horizontally, and diagonally within the organization. Additionally, it plays a dual role in project management, serving as both a facilitator and an enabler of project control. It is the dynamic element that integrates the various processes involved in project execution. As project management is both an art and a science, the project manager assumes the role of leading and coordinating the multidisciplinary team responsible for project planning and execution.

a. The Role Of Communication in Management

Communication plays a crucial role in management at all levels of an organization. Here are some key aspects of the role of communication in management:

Information Exchange: Communication enables the exchange of information between managers, employees, and various stakeholders. It allows managers to convey expectations, goals, and instructions to their teams, while employees can provide feedback, share ideas, and report progress. Effective communication ensures that everyone has the necessary information to perform their roles effectively.

Coordination and Collaboration: Communication is essential for coordinating and collaborating within and across teams and departments. It helps align efforts, synchronize activities, and ensure that everyone is working towards common objectives. Clear and timely communication facilitates teamwork, minimizes misunderstandings, and promotes synergy among team members.

Decision Making: Communication provides the information and data needed for effective decision making. Managers rely on accurate and timely communication to gather facts, analyze options, and make informed decisions. Communication also involves sharing decisions with relevant stakeholders and explaining the rationale behind them, which enhances transparency and understanding.

Leadership and Motivation: Effective communication is a vital tool for leadership. Managers who communicate clearly, openly, and consistently inspire trust and confidence among their teams. Communication helps managers motivate employees by providing feedback, recognition, and guidance. It also facilitates the alignment of individual and team goals with organizational objectives.

Conflict Resolution: Communication plays a crucial role in resolving conflicts and addressing issues within the organization. It allows parties involved in a conflict to express their concerns, understand different perspectives, and work towards a mutually acceptable resolution. Open and constructive communication promotes a positive work environment and fosters healthy relationships.

Organizational Culture and Climate: Communication shapes the organizational culture and climate. The way communication occurs within an organization influences the overall work environment, employee engagement, and the level of trust and openness. Effective communication practices encourage a culture of transparency, collaboration, and innovation.

External Relations: Communication is not limited to internal interactions within an organization. It also extends to external stakeholders, such as customers, suppliers, partners, and the broader community. Effective external communication helps build and maintain relationships, manage reputation, and meet the needs and expectations of external stakeholders.

In summary, communication is a fundamental aspect of management, enabling information exchange, coordination, decision making, leadership, conflict resolution, and shaping organizational culture. Effective communication practices contribute to organizational success and create a positive work environment.

b. Importance of Communications Management

Communications management is of great importance in organizations for several reasons:

Efficient and Effective Communication: Communications management ensures that communication within the organization is planned, structured, and well-executed. It helps establish clear channels of communication, defines roles and responsibilities, and ensures that the right information reaches the right people at the right time. This leads to more efficient and effective communication, minimizing misunderstandings, errors, and delays.

Alignment and Consistency: Effective communications management ensures that messages are consistent and aligned with organizational goals, values, and strategies. It helps create a unified voice and image for the organization, both internally and externally. Consistent communication fosters trust, credibility, and a shared understanding among stakeholders.

Stakeholder Engagement: Communications management enables organizations to engage and build relationships with various stakeholders, including employees, customers, suppliers, investors, and the wider community. By understanding their communication needs, preferences, and expectations, organizations can tailor their messages and strategies to effectively engage and connect with different stakeholder groups.

Change Management: Communication plays a critical role in managing organizational change. During times of change, effective communications management helps manage resistance, reduce uncertainty, and gain buy-in from employees. It ensures that change initiatives are communicated clearly, transparently, and consistently, facilitating a smoother transition and increasing the likelihood of successful change implementation.

Crisis and Reputation Management: In times of crisis or reputational challenges, communications management is essential. It enables organizations to respond swiftly, transparently, and effectively to protect their reputation, manage public perception, and address stakeholder concerns. Well-managed communication during crises can help maintain trust, credibility, and mitigate potential damage to the organization's image.

Collaboration and Teamwork: Communications management promotes collaboration and teamwork within the organization. By providing clear guidelines and processes for communication, it encourages open dialogue, idea sharing, and knowledge transfer among teams and departments. Effective communication fosters a culture of collaboration, innovation, and continuous improvement.

Measurement and Evaluation: Communications management includes monitoring and evaluating communication activities to assess their effectiveness and impact. By measuring key communication metrics, such as message reach, engagement, and feedback, organizations can identify areas for improvement, make data-driven decisions, and continuously enhance their communication strategies.

Overall, communications management is crucial for organizations to establish effective communication practices, engage stakeholders, manage change, protect reputation, foster collaboration, and drive organizational success. It helps organizations build strong relationships, maintain trust, and ensure that communication is a strategic asset for achieving their goals.

Scholars working in universities can collaborate and communicate to write scientific articles:

Collaboration and effective communication play a crucial role in the process of writing scientific articles for scholars working in universities. By working together and sharing their expertise, scholars can produce high-quality research that contributes to the advancement of knowledge in their respective fields. Here are some key strategies for scholars to collaborate and communicate effectively during the article writing process:

Establish clear goals and roles: Before beginning the article writing process, it is important for scholars to establish clear goals and define each team member's roles and responsibilities. This ensures that everyone is aligned and working towards a common objective. Assign specific tasks, such as literature review, data analysis, or manuscript drafting, to individual team members based on their expertise and interests.

Foster open and regular communication: Regular communication is vital for effective collaboration. Scholars should schedule regular meetings, both in-person and virtually, to discuss the progress of the article, exchange ideas, and provide updates on individual tasks. These meetings offer an opportunity to brainstorm, address challenges, and make decisions collaboratively.

Utilize digital tools and platforms: Take advantage of digital tools and platforms that facilitate communication and document sharing. Platforms such as Google Docs or Microsoft Office 365 enable real-time collaboration on the manuscript, allowing multiple authors to work on it simultaneously. Use email, instant messaging apps, or project management tools to stay connected and share important updates or revisions.

Share resources and references: Scholars can enhance collaboration by sharing relevant resources, such as research papers, datasets, or software tools. This helps to broaden the knowledge base and ensures that all team members have access to the necessary information to support their writing and analysis.

Provide constructive feedback: Peer review is an integral part of the article writing process. Scholars should provide constructive feedback to their colleagues, focusing on areas such as the clarity of arguments, the logical flow of the manuscript, or the accuracy of data interpretation. Constructive criticism helps to improve the quality of the article and enhances the final output.

Acknowledge and respect diverse perspectives: Collaboration often involves scholars from different backgrounds and areas of expertise. Embrace this diversity and encourage open discussions that incorporate various perspectives. Engage in respectful debates, challenge assumptions, and consider alternative viewpoints, as this can lead to more comprehensive and robust scientific articles.

Plan and adhere to timelines: Establish a timeline for completing different stages of the article writing process, including literature review, data analysis, drafting, revisions, and submission. Adhering to the timeline ensures that all team members are aware of deadlines and can plan their work accordingly. Regularly assess progress and make adjustments if needed.

Give credit and authorship considerations: Discuss authorship order and contributions early in the collaboration. Ensure that all team members who have made significant contributions to the research are appropriately recognized as co-authors. Transparent discussions about authorship can help avoid conflicts and promote a fair and ethical approach to publishing.

By embracing collaboration and effective communication, scholars working in universities can leverage their collective expertise, insights, and resources to produce impactful scientific articles. Through ongoing collaboration and open communication channels, they can create research outputs that contribute to the advancement of their fields and promote knowledge dissemination.

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WRITING ARTICLES FOR SCIENTIFIC JOURNALS

1. INTRODUCTION

1.1. Importance of Publishing in Scientific Journals

Publishing in scientific journals serves multiple critical functions in the academic ecosystem. At its core, journal publication is the primary means by which scientific findings are disseminated, scrutinized, and built upon. According to Bourne (2005), published articles are a means of communicating findings and a form of "intellectual currency" in academia. Being published in a peer-reviewed journal offers an imprimatur of quality and rigour, giving researchers' work a platform for exposure and validation (Ware & Mabe, 2015). Therefore, it can be said that the publication of scientific studies also serves an important function in the researcher's self-improvement.

Publications also significantly impact a researcher's academic career. Van Noorden (2014) noted that publications are often the yardstick for promotions, funding, and institutional reputation. Beyond individual or institutional benefits, publications contribute to the broader advancement of knowledge and can potentially lead to significant societal impacts, including policy changes and technological innovations (Sutherland et al., 2014). In this way, it can be stated that the researcher fulfils her responsibility to contribute to the society in which s/he lives. Thus, we can explain the importance of academic publishing with the following points:

- Contributing to the scientific knowledge heritage of humanity
- Ensuring progress in scientific, technological, cultural, or social fields
- Solving real lifer problems with scientific methods
- Ensuring individual academic career development
- Providing social and economic impact

In summary, publishing in scientific journals fulfils many critical functions in the academic ecosystem. Essentially, the main way scientific findings are disseminated, studied and built upon, journal publication provides a platform for researchers to showcase and validate their work. Published articles communicate findings and are considered "intellectual currency" in academia. Additionally, publications significantly impact a researcher's academic career. Publications are often used as promotion, funding, and corporate reputation benchmarks. Beyond individual or institutional benefits, publications contribute to advancing knowledge and can lead to societal impacts such as policy changes and technological innovations. As a result, the importance of academic publishing can be summarized with points such as contributing to the scientific knowledge heritage, making progress in scientific, technological, cultural or social fields, solving real-life problems with scientific methods, ensuring individual academic career development and providing social and economic impact.

1.1.1. Contributing to the Scientific Knowledge Heritage of Humanity

Research publication in peer-reviewed scientific journals is a cornerstone of academic scholarship. These publications act as the repository for accumulated human knowledge, offering an avenue for sharing research findings with a global audience (Bornmann & Mutz, 2015). With the increasing complexity of academic disciplines, the role of scientific journals in distributing, validating, and archiving scholarly output has never been more vital. Therefore, academic journals should be seen as important actors that serve the principle of advancement of science through accumulation (Becker, 2013). Scholars who contribute to the

scientific knowledge heritage of humanity through academic studies leave permanent imprints on this common heritage by publishing their work in academic journals.

1.1.2. Ensuring Progress in Scientific, Technological, Cultural, or Social Fields

Scientists benefit from humanity's common scientific knowledge when they research. As a result, they make inventions and discoveries that lead to progress in the scientific, technological, cultural, or social fields in which they work. Scientific journals act as both repositories and launchpads for these kinds of new knowledge. They capture the state of the art in a particular field and catalyze future research. Articles often identify gaps in existing research and propose areas for further inquiry (Ioannidis, 2006). Thus, publishing on these platforms contributes to the collective progress of scientific, technological, cultural, and social understanding, bridging the known to the as-yet-unknown.

1.1.3. Solving Real Lifer Problem Situations with Scientific Methods

Scientific research should aim to solve a problem encountered in real life, meet a research need expressed in the literature by other researchers, or both. Therefore, in the introduction sections of academic studies, the research is justified by emphasizing the problem situations encountered in daily life and the research gaps expressed in the literature. Also, this emphasizes should be in the discussion and conclusion/implication sections. This way, the readers discover which problems are solved and which gaps in the literature are filled within the scope of the research.

1.1.4. Ensuring Individual Academic Career Development

Being published in a respected scientific journal lends a level of academic recognition that is indispensable for scholars. The peer-review process associated with journal publications validates the research quality, rigour, and contribution to existing literature (Lee et al., 2013). This recognition is often quantified in the form of citations, a common metric used in academia to measure the impact of one's work (Van Noorden, 2014). This function can enable researchers working on similar subjects to become aware of each other and conduct joint studies. For individual researchers, publishing in scientific journals can significantly influence career trajectories. Academic promotions, grants, and other forms of institutional support are often tied to a scholar's publishing record (Langfeldt, 2006). Furthermore, the prestige associated with publication can lead to invitations to speak at conferences, join editorial boards, or collaborate on research projects, providing more avenues for career advancement (Hazelkorn, 2015). In this way, strong relationships will be established between researchers, and new career opportunities will emerge for researchers through these relationships.

1.1.5. Providing Social and Economic Impact

Beyond academia, the significance of journal publications extends to broader societal and economic contexts. Scientific papers can inform policy decisions, drive innovation, and even shape public opinion (Sutherland et al., 2014). For example, research in medical journals can lead to new treatments and technologies, impacting healthcare globally. Similarly, studies in social sciences can shed light on complex societal issues, offering pathways to solutions that have both social and economic ramifications (Salager-Meyer, 2008). In this way, scientific studies' importance in providing social benefit will become much more visible. In summary, publishing in scientific journals serves as a multifaceted tool for academic recognition, career

advancement, and social impact. It is not merely an end but a means to disseminate knowledge, spark innovation, and address society's complex challenges.

1.2. Tips for Authors in the Scientific Paper Writing Process

1.2.1. Knowing Your Audience

Understanding the target audience is crucial in scientific writing. Knowing who will read your paper helps tailor the research's language, depth, and focus. Researchers often overlook this aspect, yet audience-oriented writing enhances comprehension and impact (Hyland, 2018). Therefore, for whom the researcher will write emerges as a factor that directly affects how he/she will write. Thus, as a writer you should always remember your audience because the authors academic publication aims to educate and persuade their intelligent readers (Lipson, 2005). From this perspective, you should give adequate information to educate your audience in your specific subject and show sufficient proof that you conducted proper research, used appropriate methodology, extract original findings and results, contribute literature, and give useful suggestions to the target audiences and new researchers. We can explain these two components as:

- **Giving enough information to your audience:** When you write an academic paper on a specific subject, you should give some information about your topic, main concepts, and background or history knowledge if necessary. In this point, giving too much information to educate your audience can prolong your writing process and product. This can make it hard to limit your study and write within the word limit of your target journal. Also, too much information can be understood as you were underestimating your audience. For example, you conducted an experiment on the effects of writing strategies usage in undergraduate-level writing lesson. What kind of informative introduction is proper for it?
- **Type 1:** What is language? → Definitions of language skills → Writing as a language skill → How writing was invented? → Writing's importance for the development of civilization → Education and writing relationship → What is writing education? → Writing problems in education → Strategy usage to deal with problems in education →Definitions of writing strategies → Types of writing strategies → Related studies → Defining the gap in the literature → Importance of the study → Aims and research questions.
- **Type 2:** Complexity of writing process → Main writing problems of the study group of the study → Writing strategies as a solution of writing problems → Definition of writing strategies → Types of writing strategies → Related studies → Defining the gap in the literature → Importance of the study → Aims and research questions.
- **Type 3:** Types of writing strategies → Related studies → Importance of the study → Aims and research questions.

As you can see, Type 1 contains too much information, and its theoretical framework is broader than it is needed. If an author writes that amount of information in his/her paper, it can be distracting and boring for the audience. For instance, in this example readers want to see whether writing strategies worked on undergraduate students' writings so reading the kind of information such as definitions of language and language skills are useless and distractive. On the other hand, less information also does not work too. In Type 3, there is not any

description of writing strategies, information about study groups' writing skills/problems and defining the gap in the literature. Thus, as an author you should give information about main concepts in your paper, draw a theoretical framework and define the literature gap that your study fills. Hence, the Type 2 seem better for that kind of study.

Persuade your audience: As an informative text, academic studies have argumentative and persuasive features. Due to these aspects, your academic studies should prove your argument and persuade your audience that your research is qualified as expected and that your findings and results make sense. In line with this purpose, there are some tips:

- In order to persuade your audience to your study's contribution to the literature, define the gap in the literature that your study fills in.
- Explain your aim and research questions certainly. Then design your results section in terms of it. Ambiguity in these elements can make your audience confused.
- Explain in detail why you chose the method and research design you used. This way, your readers will be able to see which path your study followed and how it generated original data.
- Explain how you collect and analyze data. It is important to persuade your audience that you implemented proper data collection and analysis process to your chosen aim and method.
- In order to ensure your audience that you presented dependable data, you should explain it in different ways in terms of your study method. If you write a quantitative research paper, you should explain your data's validity and reliability; if it is qualitative, you should explain your data's trustworthiness; and if it is mixed method research, you should explain all validity, reliability, and trustworthiness together in your method section.
- To convince your reader that no ethical violations occurred during your scientific study, you should explain in the methods section under the ethics heading how you obtained ethical approvals from the authorized institutions, how ethical procedures were followed in experiments using humans or other living beings, how verbal and written participant consents were obtained, and how you ensured the confidentiality of the participants' profiles.
- If you want your readers to understand your findings systematically, organize your results section to synchronize with your research questions.
- To convince your readers that your findings are original and contribute to the literature, compare the findings of your study with those of previous studies in the literature in the discussions section. In the discussions section, you will prepare in this way, especially revealing the results that differ from previous studies, which will persuade your readers about the originality of your study.

In conclusion, understanding the target audience is paramount in scientific writing. Tailoring the language, depth, and research focus to the intended readership enhances comprehension and impact. Neglecting this aspect can result in disengagement and reduced effectiveness. to remember their audience and aim to educate and persuade them effectively. Providing adequate information while avoiding overwhelming the audience is crucial. The balance lies in Type 2, which offers sufficient detail without being overly exhaustive. Additionally,

academic studies should possess persuasive features, substantiating arguments and findings while demonstrating their contribution to the literature. Clear articulation of aims, research questions, methodology, data collection, and analysis methods are vital to engender trust and credibility. Moreover, addressing ethical considerations and organizing findings in line with research questions aids in systematic understanding and enhances the persuasiveness of the study. Ultimately, effective scientific writing not only disseminates knowledge but also convinces and influences its audience, advancing scholarly discourse and contributing to the broader scientific community.

1.2.2. Setting Realistic Goals and Timelines

Publishing scientific research is a long-term commitment. Authors should set achievable goals and deadlines to manage the process efficiently. From data collection to final submission, establishing a realistic timeline prevents undue stress and enhances the quality of work (Boice, 2000). Certainly, one of the most important elements of successful work is correctly planning and acting according to this plan. Here is 12-week-long article writing plan example from Belcher's (2019) book. You can create your timeline regarding your goals and your academic study's deadline.

Table 1. *An Example of a Twelve-Week Calendar of Planning Article Writing*

Week	Task	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Total hours	Note
Example May 1-7	Example	8-9 a.m.	8-9 a.m.	0 minutes grad conf	0 minutes grad conf	8-9 a.m.	1-5 p.m.	1-2 p.m.	8 hours	
Week 1	Designing your plan for writing									
Week 2	Advancing your argument									
Week 3	Abstracting your article									
Week 4	Selecting a journal									
Week 5	Refining your works cited									
Week 6	Crafting your claims significance									
Week 7	Analyzing your evidence									
Week 8	Presenting your evidence									

Week 9	Strengthening your structure
Week 10	Opening and concluding your article
Week 11	Editing your sentences
Week 12	Sending your article

Source: Belcher (2019).

Determining realistic goals and timelines is an important stage in the publication process of scientific research. To effectively manage the process from data collection to final presentation, it is necessary to establish achievable goals and timelines. One of the most important elements of a successful work is to make correct planning and act in accordance with this plan. Proper planning encourages creating a personal timeline based on the goals of research and the deadline for academic work.

1.2.3. Associate with Others: Working as Collaborative vs. Cooperative

Two heads are often better than one, especially in academic research. Collaboration can lead to richer data sets, varied perspectives, and a more thorough analysis of findings (Katz & Martin, 1997). For this reason, it is considered valuable for researchers to construct and continue their studies with a collaborative approach. Peer reviews are an invaluable part of this collaborative spirit. They offer constructive criticism that could significantly elevate the quality of the paper (Lee et al., 2013). These criticisms will guide researchers both in their current studies and in their future studies. In this way, researchers will be able to include the experiences of different researchers in their studies. According to the literature, there are two types of teamwork styles: collaboration and cooperation. In cooperative work, the distribution of tasks is done according to the principle of individual specialization in tasks or subtasks. Here, tasks are distributed at the beginning of the work and each individual performs the part that is his/her responsibility, and at the end of the process, all parts come together. Whereas in collaborative work, each carries out all the work together from the beginning to the end of the work. Beau et.al. (2010) explain collaborative and cooperative working:

Table 2. *Differences Between Collaboration and Cooperation*

Collaboration	Cooperation
Skills	Skills
- Maturity-Experience,	- Mentoring/supervision
- Autonomy	- Pyramidal Hierarchy
- Self Control	- Control of top management
Modes of participation	Modes of participation
- Individual and Collective	- Division of tasks / sub-tasks
- Voluntary/ spontaneous	-Mandatory/ imposed

Realization of the tasks - Explore, create, communicate - global responsibility and support to peer	Realization of the tasks - process of a specialization - individual responsibility for the task/subtask assigned
Collaborative space - Network: interaction - Synergy between the cognitive and collective aspects	Cooperative space - Learning collaborative skills - Knowledge & information transfer

Table 2 explains the differences between cooperating and collaborating. Collaboration is based on skills such as maturity, experience, autonomy and self-control, while cooperating is based on skills such as mentoring/supervision, pyramidal hierarchy and control of top management. Modes of participation are individual and collective, voluntary/spontaneous for collaboration, where division of tasks and subtasks are mandatory/mandatory for cooperation, and the accomplishment of tasks is about exploring, creating, communicating, and providing global responsibility and peer support in collaboration. At the same time, the process of cooperating is a process of specialization, and it involves responsibility for the individual task. The collaboration domain involves the synergy between interaction, cognitive, and collective aspects. In contrast, the domain of cooperating involves the learning of collaborative skills and the transfer of knowledge and information. To provide a good and effective teamwork environment; Before you start your teamwork, choose the way you work: collaborative or cooperative. If you choose to collaborate, be sure that everyone joins in all phases of the process because in collaboration everyone should take responsibility for all processes. They can contribute to all study phases with their working styles and creativity. If you choose to cooperate, be sure that tasks distributed from the beginning, and everyone take their own parts' responsibility. To avoid complexity and confusion, hierarchical structure should be created in this kind of working. In this way, unifying in working style and univocality in the written product can be provided.

1.2.4. Managing Data and Resources

Data management is pivotal for maintaining the integrity of the research process. Authors should invest in organizing data meticulously and referencing sources accurately. Good practices in data management lend credibility to your work and make it replicable for future research (Tenopir et al., 2011). Apart from the usage in your study, managing data and resources has two different aspects.

- One of them is how to share this data and its copyright issues. Publishing or re-working with data can be restricted if you are funded from an institution. Also, there can be disagreements between peers, so these kinds of issues should be agreed upon before study begins.
- The second aspect of managing data and resources is how to store them. This aspect is also an ethical issue because storing sensitive data and providing confidentiality is very important for studies and researchers' reliability.

In other words, data management is vital to maintaining the integrity of the research process. Organizing data neatly and referencing sources accurately increases the reliability of the study and ensures its reproducibility for future research. While data management includes sharing and copyright issues, it also addresses ethical issues such as storing and protecting the privacy of data.

1.2.5. Ethics and Integrity

Maintaining ethical standards is non-negotiable in scientific writing. This includes transparent reporting of methods and results, giving due credit through citations, and obtaining necessary permissions for copyrighted material (Resnik, 2015). Ethical violations, which are currently one of the most problematic issues for the scientific community, not only harm the studies carried out, but also significantly damage the credibility and therefore the career of the researcher conducting the study. In this regard, compliance with ethical principles in scientific research is an important issue that researchers should pay careful attention to.

Researchers must adhere to a series of important ethical standards in scientific research ethics. Compliance with ethical standards enhances the credibility of researchers, improves the quality of their research, maintains the integrity of the scientific community, and ultimately provides reliable information to society. Here are some key points they need to pay attention to:

- *Transparency and Accuracy*: It is essential to transparently report the methods and findings of the research and present them accurately. Data manipulation should be avoided, and the results should be realistically reflected.
- *Copyright and Citation*: When quoting from other works, proper credit should be given. Permissions required for the use of copyrighted materials should be obtained.
- *Human and Animal Experiments*: Ethical standards must be followed in experiments conducted on humans or animals. This includes obtaining informed consent from participants.
- *Data Management*: It is important to manage data in an orderly and secure manner. The confidentiality of sensitive data should be maintained, and it should be accessible when necessary.
- *Conflict of Interest*: Researchers should clearly disclose any conflicts of interest related to their studies and take measures to minimize the impact of these conflicts on the results.
- *Plagiarism*: Respect should be shown for the ideas and works of other researchers, and forms of plagiarism such as plagiarism should be avoided.

The ethical standards mentioned above can be obtained from a wide range of sources, and these principles are generally accepted practices in the scientific community. These ethical standards are generally considered as principles of scientific research ethics and are often included in the ethical rules of various research institutions, universities, and scientific publishing organizations. Additionally, these principles can be detailed in scientific publications, research guidelines, and ethical codes. For example, organizations such as the American Psychological Association (APA) and the National Institutes of Health (NIH) provide guidance and policies on scientific research ethics. Moreover, the publication rules of

scientific journals often include these ethical principles, and authors must follow these principles.

1.3. Identifying a Unique Research Topic

1.3.1. Importance of Uniqueness

In the competitive landscape of academic publishing, the originality of the research topic is paramount. A unique research topic attracts more readership and is more likely to be cited by other researchers. The distinctive subject matter amplifies the paper's scientific, societal, or policy-related contributions, giving it greater impact (Merton, 1973; Bornmann & Mutz, 2015). The study's originality will be an element that will increase the prestige of the researcher conducting the study (Cryer, 2006).

How to Create a Unique Topic

- **Preliminary Literature Review**: A preliminary review of existing literature is necessary before landing on a specific topic. This review helps identify what has already been studied, thereby highlighting the gaps that must be addressed (Fink, 2019). Therefore, such a study is one of the most important stages for the originality of the work mentioned in the previous title. A healthy literature review will guide the researcher in "doing what has not been done".
- **Consult Experts and Mentors**: Feedback from experienced researchers can provide invaluable insights. This process may help refine the topic and its objectives (Johnson & Onwuegbuzie, 2004).
- **Feasibility Analysis**: Assess the feasibility of the topic in terms of data availability, time, and resources because an ideal research topic is unique and achievable (Creswell & Creswell, 2017). Thus, studies that are not realistically implemented will not only result in an aimed conclusion but also cause serious time loss for the researcher.
- **Scoping the Research Area**: Determining the scope is essential in finalizing a research topic. A topic too broad can make the research unfocused, while too narrow may limit its significance and applicability (Booth, Colomb, & Williams, 2008). Thus, tools like concept mapping or mind-mapping are suggested to visualize the breadth and depth of the potential research area (Novak & Cañas, 2008). Otherwise, researchers can get lost in the labyrinths of scientific study.
- **Finalizing the Topic:** Once the scope has been determined, finalizing the topic involves clearly stating the research question(s) or hypothesis. This step often includes specifying the study population, setting, and variables of interest. The finalized topic should be unique and framed in a way that lends itself to empirical investigation (Creswell & Creswell, 2017).

In summary, a unique research topic attracts more readers and increases the likelihood of being cited by other researchers. Additionally, the original topic strengthens the article's scientific, social or policy contributions and provides greater impact. For an original/unique research topic, a preliminary review of the existing literature should first be conducted, and feedback should be obtained from experts and consultants to identify gaps. Next, the suitability of the topic in terms of data accessibility, time and resources should be evaluated and the scope of

the research area should be determined. Finally, research questions or hypotheses should be clearly stated, and the research topic should be formulated in a way that is unique and amenable to empirical investigation. These steps help researchers create an original research topic while providing a framework for clarifying and elaborating the research topic.

1.4. Building Your Argument

1.4.1. What is an Argument?

An argument is the main idea of your essay or thesis, also called a "claim", "thesis" or "hypothesis". An argument is directly linked to the academic conversation the scholars work on and is supported by data or evidence that supports the idea. In academic texts, the author tries to convince the reader of an argument they defend by presenting proves, findings, interpretations, and comparing with other studies about a subject. Therefore, Fahy (2008) characterizes academic writing as a form of a debate containing logical arguments. Thus, a scientific argument should have “clearly defined topic” and one “side” of and academic debate.

1.4.2. Where to present an argument?

Since the argument in academic texts is the main claim of the study, in academic writing, it can be presented more than once and in different ways.

- **Presenting the argument in the abstract**: Generally, when skimming, readers read the abstract to see if the study is relevant to their research. It is, therefore important to mention the argument in the abstract to appeal to your potential readers.
- **Presenting the argument in the literature review:** Since academic studies aim to persuade the reader as a party to an academic debate, the literature review includes many different arguments that different studies defend in the field of similar subject matter. For this reason, expressing your argument in the literature review reveals what your study will contribute to the literature and what it can offer differently from previous studies.
- **Presenting the argument in the discussion:** The discussion section is where you compare the results of your academic study with other related academic studies in the literature, confirming the studies that support your results and emphasizing your differentiating results. Therefore, by presenting your argument in the discussion section and discussing it with the results of other academic studies, you can demonstrate the contribution of your study to the literature and the originality of the study you have designed.

As a result, arguments can be presented more than once and in different ways in academic writing. First, it is important to present the argument in the summary section. Because readers often look at the abstract to determine whether the study is relevant to their research. Next, articulating the argument in the literature review reveals how the study will contribute to the literature and how it may differ from previous studies. Finally, presenting the argument in the discussion section helps to demonstrate the study's contribution to the literature and the originality of the designed study by comparing the study's results with other relevant academic studies. In this way, presenting the argument in different parts of the academic text highlights the contributions and originality of the work.

1.4.3. Where do arguments come from?

When you create your study's argument, you need to use scientific information such as empirical, theoretically and practice-based data. Then, in order to provide originality of the research, you need to define connections and distinctions between your studies and others in the literature. Murray (2013) offers some questions to hone your own argument as;

- What are the connections between your work and other scholars and researchers?
- What are the distinctions between your work and theirs?
- What is the main connection between your paper and their publications?
- What is the main distinction between your paper and theirs?

In other words, existing scientific data should be used to create the study's argument and the connections and differences between this data and other studies in the literature should be identified. Murray (2013) suggests some questions to improve this process. These questions include determining the study's connections and differences with other research.

1.4.4. How do you create an argument?

Ritzenberg and Mendelsohn (2021) suggested eight templates for developing arguments in their book of "*How scholars write*". These templates can be used in line with the aim of the study and the way arguments were created.

Table 3. *Ritzenberg and Mendelsohn's Argument Templates for Academic Writing*

Common Understanding and Complication Template:

- While most people think _____, a close examination suggests _____.
- Popular consensus has dictated that _____, but actually _____.
- Scholars have commonly argued _____, but in fact _____.

Whole and Part Template:

- Because _____ is in tension with the entire text, we must reconsider _____.
- When we consider the whole in light of the divergent part, we realize that _____.
- While _____ appears to diverge from the whole, in fact _____.

Part and Part Template:

- These two contradictory parts makes us realize something new about the whole object, that _____.
- While this part _____, this other part _____, which changes our understanding of _____.
- Although it appears that _____ conflicts with _____, in fact _____.

Form and Function Template:-

- Though the text is designed to _____, when we encounter _____, it forces us to realize that _____.
- The formal aspect of the object suggests _____, but its use suggests _____. We must therefore revise our understanding of the object from _____ to _____.

- While the text seems to assert that _____, the formal choice to _____ complicates the way we understand that assertion.

Presence and Absence Template:

- Given the presence of _____, the surprising absence of _____ suggests that we must rethink _____.
- Because the text is missing _____, readers must realize that _____.
- Though _____ appears to be missing, in fact we see _____.

Expectation and Observation Template:

- Though we expected _____, we observed _____; we can make sense of this discrepancy by _____.
- Where we might expect to see _____, we instead get _____, which leads us to rethink _____.
- By subverting our expectations, the object asks us to question the following assumptions: _____.

Claiming a New Scholarly Problem Template:

- While others have focused on the issue of _____, a more productive way to define the scholarly problem might be _____.
- Framing the problem as a matter of _____, neglects to address _____. Reframing the problem instead as _____ allows us to understand _____.

Claiming a New Project Template:

- A new research method that entails _____ will account for what the commonly used method cannot account for, namely _____.
- While previous studies have taken the approach of _____, that approach cannot offer insight into _____. Instead, this study takes a different approach: _____.

According to Table 3, Ritzenberg and Mendelsohn (2021) present eight different templates of argument construction in academic writing. These templates are based on common understanding and complication themes, whole and part, piece and part, form and function, presence and absence, expectation and observation, assertion of a new scientific problem, and assertion of a new project. For example, one template used in constructing an argument is called the "Common Understanding and Complication Template". It aims to challenge a common belief of a topic and then reveal its complexity. Each template effectively presents arguments in different sections of academic writing.

1.5. Organizing Your Academic Writing

According to Belcher (2019), academic writing has two structural levels. They are:

Macrostructure: the outline of the article/coherence

> *Macrostructure is the superstructure, the overarching meaning working down through the entire article to organize it, with the argument being the main organizing principle. You have a coherent macrostructure when each section, subsection, and paragraph of your article is organized argumentatively into an overall logical structure.*

Microstructure: diagrams of the articles' paragraphs and sentences /cohesion

> *Microstructure is the focused meaning working up from the paragraph and sentence level, with clarity as the organizing principle. You have a cohesive microstructure when each sentence is clear and grammatical, leads logically to the following sentence, and adds up to a paragraph that has a unifying concept and hangs together.*

1.5.1. Structure of Academic Writing

The shape of an hourglass can be used as a metaphor for organizing the structure of academic work. Accordingly, at the beginning of your academic writing, you provide background information, historical background, or conceptual framework with other studies in literature from a broad perspective. Next, from a narrower perspective, your argument paves the way for the content of your work. Then, the content of your study is presented, which is the narrowest and most specific in scope. This includes your findings and your interpretations of these findings. Then, with discussions, the scope starts to expand with the results of other studies in the literature. Conclusions and recommendations include the broadest conclusions to address the literature and suggestions for practitioners and other researchers (Jirge, 2017).

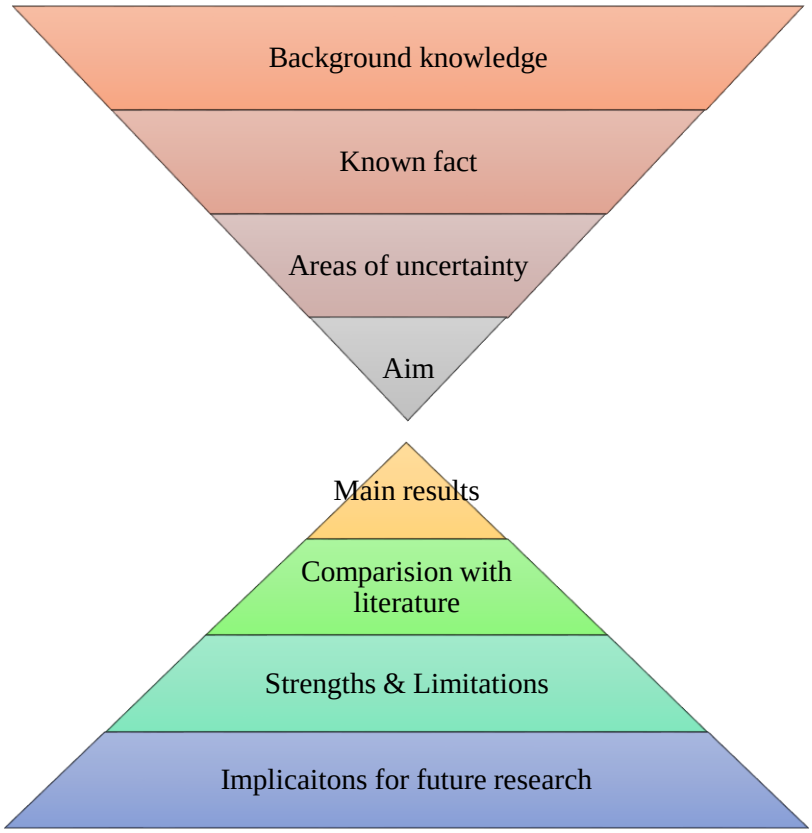

Figure 1. *The Hourglass Structure of Academic Writing* (Jirge, 2017).

At the beginning of academic writing, background information, historical background, or conceptual framework are presented from a broad perspective. Then, from a narrower perspective, your argument leads to the content of your work. The content of your work is then presented, which is the narrowest and most specific in scope. This includes your findings and interpretations of those findings. Then, through discussions, the scope expands with the results of other studies in the literature. Conclusions and recommendations include the broadest conclusions to address the entire literature and recommendations for practitioners

and other researchers. As can be seen from Figure 1, the hourglass moves from wide to narrow and then from narrow to wide. Your body paragraphs should be topic specific and focus on a single idea or point supporting your academic work. This is similar to the narrowest part of an hourglass. Conclusions are where you review all your main points and wrap things up.

1.6. Making a First Impression: Strategies for Crafting Research Paper Title

1.6.1. Significance of a Well-crafted Title

A well-crafted title is the initial point of contact between the paper and potential readers. It holds significant weight in capturing the audience's attention, concisely summarizing the research, and influencing whether the paper will be read further or cited. In this respect, we can consider the article title to be the study's showcase. The more successfully the title is presented, the more people interested in the work will increase. An ineffective title may lead to the work being overlooked, even if the content is groundbreaking (Jamali & Nikzad, 2011; Hartley, 2007). Thus, the title you used should exactly match your work. For example, you will write an academic article on academics' academic writing skills in qualitative research writing. Here are some tips for creating a title for this study.

- Titles such as "Academic Writing" or "Academic Writing in Qualitative Research" are too broad because this study is about the writing skills of a specific population group. This makes it difficult to capture readers who will be interested in your work.
- A title such as "Preparing the Method Section in Qualitative Academic Writing" cannot cover the study because it is too narrow.
- The title of your study should be related to the subject area that your study focuses on. For example, you used a mixed design in this study and titled it "A Mixed Design Practice on Academics' Qualitative Research Writing". Your study can be considered a research design practice-oriented study rather than an academic writing-oriented one due to the concept you focus on in the title. Likewise, in the peer review process for publication, it can be evaluated by a peer who is a methodology expert instead of a field expert you worked on.
- The title should briefly describe the main topic and scope of the paper. What will be given in the article should be provided in a short, utterly descriptive way and without question marks. Avoid vague or overly complex language.
- While being descriptive, aim for brevity. A shorter title is easier to read and remember.
- Including relevant keywords enhances discoverability through search engines and databases.
- Specialized terminology may alienate readers who are not experts in the field, so avoid using jargon.

As a result, the title should be fully compatible with the content of your work and related to the subject area it focuses on. Additionally, the title should briefly and descriptively describe the main subject and scope of the study. It's important to aim for brevity when being descriptive. Because a short title is easier to read and remember. Using relevant keywords increases the work's discoverability.

1.7. Writing an Abstract

1.7.1. Definition and Importance

An abstract is a brief, yet comprehensive summary of a research paper that provides readers with an overview of the research objectives, methodology, findings, and implications. An abstract's quality significantly impacts the paper's visibility and reception in academic and professional circles (Lorenc & Hicks, 2016; Pham & Hoffmann, 2015). When researchers encounter a satisfactory abstract, they will be eager to access the article's content. Tips for writing abstract:

- **Summarize** the article, not introduce it. Novice authors often write abstracts as if they were introductions. Do not—that is what introductions are for.
- **Tell a story**. State the puzzle or problem the article addresses, rather than giving a barrage of data without an argument or a conclusion.
- State the **argument** and a claim for the significance of that argument.
- Reveal the **most valuable findings**. People are more likely to read an article if they know what is most interesting about it up front.
- State **methods** briefly, in no more than a sentence. Do not let your description of how you conducted the study or developed your theoretical frame take over the abstract.
- Use **strong verbs**, not vague ones. Instead of "exploring" or "examining" a subject, your abstract "argues" or "demonstrates." Instead of "attempts to" or "tries to," your abstract "shows." (One journal editor told me that if she sees the word explores anywhere in an abstract, it's a red flag, suggesting that the article is not argumentative.)
- Include all the most **relevant keywords** since many search engines search by abstract and title alone.

Elements of abstract:

- **Background/problem:** State why I embarked on the project—often some reference to a gap or debate in the literature or a real-world situation or problem.
- **Objective/aim:** State what my project/study intended to figure out, the article's topic.
- **Method/design:** State how I accomplished the project; name my data and methodology.
- **Results/findings:** State what I found through the project and my findings.
- **Discussion/conclusion/recommendation:** State what conclusions I draw from the project and my argument (and recommendations, if that is appropriate).
- **Keywords:** List the keywords or search terms that I want to appear in my abstract (Belcher, 2019).

Table 4 shows an example of abstract from Özgenel and Mert (2019)'s study. This abstract was analyzed in terms of its main parts with different colors.

An abstract is a brief but comprehensive summary of the research paper, providing readers with an overview of the research's aims, methodology, findings, and conclusions. The quality of the abstract significantly affects the visibility and acceptance of the article in academic and professional circles. Researchers who come across a good abstract will look forward to

accessing the article's content. Some tips to consider when writing an abstract are to summarize the article, not introduce it; tell an original story and state the problem the article addresses; state the argument and its importance; to reveal the most valuable findings; briefly state methods and use strong verbs; to include the most appropriate keywords. Key elements included in the abstract include background/problem, purpose, method/design, results/findings, conclusions, discussion, recommendation, and keywords.

Table 4. *An Example of Abstract Structure*

This research is based on the idea that teachers' performance at school level directly contributes to school effectiveness by achieving their educational objectives. In the research, relational survey model, which is one of the survey models, was used. 426 teachers (286 women and 140 men) participated in the study. Data were collected through School Effectiveness Scale (Hoy, 2014) and Teacher Performance Evaluation Scale (Özgenel, 2019). Data were having been analyzed by t test, ANOVA, correlation, and regression. According to the research findings, teachers' perceptions of school effectiveness do not show significant differences according to their gender and seniority; but according to their educational background and school level. School effectiveness perceptions of undergraduate teachers are higher than those of graduate teachers. Primary and secondary school teachers perceive their schools more effectively than high school teachers. While teachers' performances do not show significant differences according to their educational background and seniority; it shows according to their gender and school levels. The performance of female teachers is higher than male teachers. Primary and secondary school teachers' performances are higher than those of high school teachers. Teachers' performance decreases as the school level progresses from primary, secondary and high school. A moderate and positive relationship was found between teachers 'performances and school effectiveness (r=.358; p<.01) and teachers' performances was explained 12% of the total variance in school effectiveness. In other words, teachers' performances positively affect the effectiveness of school. In the study, it was concluded that teachers' performance predicted school effectiveness and positively influenced. When it is recognized that building effective schools is a difficult process, teachers are expected to be involving and perform at a high level in order to overcome these challenges and achieve the school's basic objectives at the desired level. Therefore, it may be recommended to policy makers and school leaders that teachers determine their performance, receive feedback and establish a performance evaluation system with improvements as a result of the performance evaluation process.
Objective Methods Results/findings Conclusions Recommendation
Keywords: School effectiveness, performance, teacher performance.

Source: Özgenel and Mert (2019).

1.8. Keyword Selection

5.1.1 Importance of Keywords

Keywords enhance the discoverability of a paper in academic databases. They are the building blocks for future literature searches and citations (Jacobs, 2009). Therefore, accurate choices in determining keywords will ensure that the work stands out in the sea of scientific articles.

Strategies for Keyword Selection

- *Relevance*: Choose keywords that are most relevant to the core topic.

- *Popularity*: Utilize commonly searched terms within the academic community (Garg & Turtle, 1997).
- *Synonyms*: Include keyword variations to cover a broader search scope

1.9. Introduction Section

Introductory chapters should fulfil two basic functions. These provide the necessary preliminary information to the audiences and *grab the reader's attention to the text*. To provide the necessary preliminary information, authors can write their introductions with background information, conceptual frameworks or historical backgrounds. The type of introduction to be written here depends on the author's preference and the requirements of the text structure. According to Murray (2013) although "being interesting" is one of the last things you want to say about your academic paper, to grab your audience's attention, you need to be wary about the topic you worked on branded as "important" in your subject area. Also, that interesting theories deny certain assumptions of their audiences. Thus, the introduction section should emphasize the importance and study's originality that changes the perspective. In this point, Belcher (2019) suggests starting to academic writing with a gripping first sentence such as a telling anecdote, a striking depiction of your subject, an aggressive summary of the literature, a dire social problem, an intriguing thought puzzle, or a solid claim about the significance of your topic. Here, some opening style examples from Belcher (2019):

Subject opening:

Since the identification of the Zika virus in Brazil in early 2015, the virus has spread rapidly throughout the Americas. (Rasmussen et al. 2016)

(For an article about the relationship between the virus and birth defects)

Anecdotal opening:

When I was growing up in New York City, my parents used to take me to an event in Inwood Park at which Indians—real American Indians dressed in feathers and blankets—could be seen and touched by children like me. This event was always a disappointment. (Tompkins, 1986)

(For an article analyzing US textbooks' presentation of indigenous peoples' role in US history)

Critical opening:

"Historians have been much more concerned with explaining questions surrounding how Africans produced, transported, and sold captives than with exploring African strategies against the slave trade." (Diouf 2003)

(For an article about Guinea Bissauans' strategies for resisting the slave trade)

Significance opening:

Few children's movies can rival the success of The Lion King or the controversy that has surrounded it since it was first shown commercially in 1994. (Martin-Rodriguez, 2000).

(For an article about Latina/o immigration to the United States as the anxious subtext of a Disney film)

Historical opening:

In the 1970s and 1980s, amid concerns over the negative effects of concentrated urban poverty and suburban resistance to the encroachment of public housing, the U.S. Department of Housing and Urban Development (HUD) slowed the construction of new large-scale public housing

projects and increased the use of Section 8 certificates and vouchers to subsidize low-income households in the private rental market (Marr, 2005).

(For an article about tactics that community workers used to help low-income families gain housing when landlords were suspicious of Section 8 vouchers)

Argumentative opening:

Civic education is important. (Blair 2003)

(For an article arguing that civic education is essential to a functioning democracy)

Introductions play a dual role: these provide readers with basic background information and aim to capture their attention. Authors achieve the former by including background details, conceptual frameworks, or historical contexts. The choice of introduction style depends on the author's preference and the structural requirements of the text. To effectively attract the attention of readers, the importance and originality of the topic is emphasized. For example, one might start with an engaging opening sentence such as an anecdote, literature summary, a thought-provoking question, or a statement that emphasizes the importance of the topic.

1.9.1. Statement of the Problem

The "Statement of the Problem" is a critical introduction component. It briefly describes the research gap or problem your study aims to address. A well-articulated problem statement clearly explains what the study seeks to resolve and provides a framework for setting your research objectives and questions (Creswell & Creswell, 2017). It is essential to ensure that the problem is neither too broad nor too narrow; both extremes can make the study less impactful (Ellis & Levy, 2008).

Here is an example of problem statement from "Driscoll (2011) Connected, disconnected, or uncertain: student attitudes about future writing contexts and perceptions of transfer from first year writing to the disciplines. *Across the Disciplines*, *8*(2).":

This article begins by providing a review of relevant research concerning transfer of writing knowledge, theories of transfer, and issues related to motivation and perceived course value. Next, the article discusses the method of inquiry and context for the study. Results from the study are followed by a discussion of findings. The article closes by presenting teaching strategies and techniques to facilitate the transfer of writing knowledge both in FYC and in disciplinary writing contexts. As this study will demonstrate, the attitudes that students bring with them about writing impact their perceptions of the transferability of writing knowledge; because we know transfer of learning is an "active" process, these attitudes may be detrimental to their ability to learn and effectively use prior writing knowledge in disciplinary courses (Driscoll, 2011, p. 2).

Students' Difficulty with Transfer Across the Disciplines Evidence for the complexity of writing transfer in FYC and across the disciplines is evident in the work done by Herrington (1984), McCarthy (1987), Walvoord and McCarthy (1990), Beaufort (2007), Bergmann and Zepernick (2007), and Wardle (2007). Nearly all of the research on writing transfer indicates that if students fail to recognize similar features in diverse writing contexts and tasks, then the transfer of writing skills will most likely be unsuccessful. Although students often have been taught writing processes and skills that would assist them throughout their educational careers, these studies show that they are often unable to draw upon that knowledge and instead perceive each situation as entirely new and foreign. In her qualitative examination of the writing in two college chemistry courses, Herrington (1984) found that students believed that the writing tasks and required skills in each course were very different despite the many similarities Herrington found between the tasks (p. 331). Herrington also discovered that each course represented a unique

learning situation where students needed to learn how to adapt their prior knowledge in order to be successful (Driscoll, 2011, p. 2).

As you can see from the example above, after drawing the main framework and explaining the main concepts Driscoll (2011) created a separate sub-heading as, "Students' Difficulty with Transfer Across the disciplines" in her introduction section. In this article, she explores the connections between theories of student attitudes and motivation and theories of transfer to investigate their relationship. Thus, she tried to clarify what she done and to address the gap the study's filled by explaining students' current writing transfer problems according to main studies in literature. The below table shows how to organize the structure of an opening paragraph according to the themes of the "**general topic", "what the literature has found", "missing aspects or unanswered questions", "the aim of the study",** and **"the study approach"**. Structured information clarifies the purpose, findings, gaps, and aims of the study within the broader context of the research on bullying, parenting, and cultural influences (Cinkir, 2018).

Table 5. *Opening Paragraph Example*

For a study on child development, parenting, and cultural influences on school bullying	
The impact of parenting and cultural factors on school bullying is a significant area of research in child development. Cultural values and various parenting styles profoundly affect children's bullying behaviors. Individualism is associated with both bullying and victimization, emphasizing the role of cultural norms (Georgiou, Ioannou, & Stavrinides, 2018). Authoritative parenting tends to mitigate bullying and improve peer relations, whereas authoritarian and uninvolved parenting may exacerbate it (Zhao, 2023). Additionally, mothers' emotional states and responsiveness influence whether children are likely to bully or be bullied, with positive parenting reducing bullying risks and neglect or abuse increasing them (Georgiou, 2008; Lereya, Samara, & Wolke, 2013). The existing research reveals a significant gap in understanding how parenting and cultural factors influence school bullying, specifically lacking comprehensive studies that consider cultural nuances for developing effective, culturally sensitive interventions suited for diverse populations (Zhao, 2023). This study aims to investigate how different parenting styles and cultural backgrounds affect school bullying, focusing on the mechanisms by which cultural values and parenting practices influence both victimization and perpetration, to develop culturally attuned interventions for diverse educational environments. The study examined the	**Statement of the general topic (Green)**  **General statement about what the literature has found (Orange)**  **Statement about what the literature is missing or where there is an unanswered question (Yellow)**  **Aim of the study (Blue)**

impact of the socio-cultural environment on bullying behavior among minority youth in high-risk contexts in Turkiye, emphasizing the need for contextually sensitive interventions.

General statement of the study approach (Purple)

In summary, when stating the problem, it is important to pay attention to how wide or narrow the impact area of the study is. For example, information and theories synthesized from existing literature can form the research framework. Research can reveal the complexity of the problem, and this claim can be based on data compiled from other studies. The study contributes to this gap in the literature by aiming to investigate the relationship between the variables subject to research.

1.9.2. Significance of the Study

Highlighting the significance of the study allows you to make a compelling case for why your research matters. It explains how the research contributes to existing literature, fills a research gap, or solves a practical problem. This stage gives the reader why he/she should read the work and the aspects in which the work stands out from others. The significance of the study should be discussed both at a theoretical level, contributing to academic discourse, and a practical level, impacting policy or real-world applications (Rossig & Prätsch, 2005; Creswell & Creswell, 2017). Asking the right questions is the key to obtaining scientific and consistent answers. It's crucial to back your claims with existing literature to build credibility and position your work within the larger scientific dialogue (Hart, 1998).

A well-crafted introduction sets the stage for a compelling and academically rigorous paper. By clearly stating the problem and outlining the significance of your study, you can attract a wider audience, generate more impactful discussions, and contribute effectively to your field of research. Here is an example of the Significance of the Study paragraph from "Driscoll, D. L. (2011). Connected, Disconnected, or Uncertain: Student Attitudes about Future Writing Contexts and Perceptions of Transfer from First Year Writing to the Disciplines. *Across the Disciplines*, *8*(2).":

> *Transfer is not just an issue for first-year composition (FYC) faculty; disciplinary faculty depend on writing knowledge to transfer. In fact, universities hold an institutional assumption that knowledge, skills, and techniques gained in FYC are able to transfer to other contexts—disciplinary, civic, personal, and professional. FYC is understood to provide students with functional literacy in academic prose; without successful transfer, disciplinary faculty may be forced to spend time teaching basic writing strategies rather than advanced disciplinary writing skills or other course content (Driscoll, 2011).*

As it can be seen from this example, Driscoll (2011) explained transferring skills' importance by

- its effects on learning,
- importance in FYC,
- different aspects and contexts of transferring,
- and what it would be without successful transfer.

The significance of the research is crucial in justifying the importance of your research effort. It describes how your work contributes to existing science, addresses a gap in research, or solves a practical problem. By contextualizing your work within broader academic discourse

and real-world applications, you give readers compelling reasons to engage with your work. Driscoll (2011) exemplifies this by emphasizing the centrality of writing transfer skills across disciplines, highlighting its important role in academic literacy and the potential consequences of ineffective transfer on educational outcomes.

6 2. THEORETICAL BACKGROUND

The theoretical background serves as the scaffolding for your research, helping you to contextualize your study within the broader academic discourse. In the context of our hypothetical paper, the theoretical grounding might revolve around theories of academic communication, scientific knowledge dissemination, and institutional barriers affecting academic publishing (Clark & Smith, 2017). This theoretical framing not only situates the research within existing scholarship but also offers a lens through which to analyze the gathered data. Correctly constructing the theoretical framework will serve to ease the burden of the research in all subsequent stages of the study.

2.1.Conducting a Literature Review

A robust literature review serves multiple purposes: it outlines existing research, identifies gaps, and justifies your study. Qualified and in-depth research on what has been done about the research topic beforehand will serve as a beacon for the study's progress. For the subject of barriers in academic publishing, a literature review should examine previous studies on academic publishing processes, authorship challenges, and existing strategies for overcoming barriers (George et al., 2016; Lee & Taylor, 2014). Because the literature review convinces your audience about the importance and originality of your study, different degree and research products need different levels of literature reviews. Thus, Hart (1998)'s literature review framework was given as an example in Table 5.

Table 6. *Degrees and The Nature of The Literature Review*

Degree and research product	Function and format of the literature review in research at these levels
BA, BSc, BEd project	Essentially descriptive, topic-focused, and mostly indicative of main current sources on the topic. The analysis of the topic is in terms of justification.
MA, MSc, MPhil dissertation or thesis	Analytical and summative, covering methodological issues, research techniques and topics. There may be two literature-based chapters, one on methodological issues, which demonstrate knowledge of the advantages and disadvantages, and another on theoretical issues relevant to the topic/problem.
PhD, DPhil, DLitt thesis	Analytical synthesis, covering all known literature on the problem, including that in other languages. High level of conceptual linking within and across theories. Critical evaluation of previous work on the problem. Depth and breadth of discussion on relevant philosophical traditions and ways in which they relate to the problem.

Source: Hart (1998).

In academic research, a comprehensive literature review plays a vital role in summarizing existing studies, identifying gaps, and defending the necessity of existing work. The depth and scope of the literature review may vary depending on the academic level and type of academic work performed. For example, undergraduate projects often focus on defining the topic and defending its importance. At the same time, master's theses may have analytical and summative discussions and several literature-based chapters covering methodological and theoretical aspects. Doctoral theses, on the other hand, require a more comprehensive review that will include an analytical synthesis of all relevant literature, critical evaluation, and in-depth discussions of the philosophical tradition pertinent to the problem. This approach ensures that the literature review effectively supports the significance and originality of the research.

2.2.Literature Analysis and Synthesis

The synthesis and analysis of the literature go beyond mere summarization; they aim to make sense of the existing body of work and to integrate it into a coherent narrative. This narrative should set the stage for your study, allowing you to situate your research questions and hypotheses within a clearly defined context (Fink, 2014; Snyder, 2019). Thus, "discourse synthesis" or "writing from the sources" can defined as:

- Synthesis should aim to create new knowledge from existing knowledge, i.e., other sources.
- Thus, synthesis is not a summary, but summaries can be a part of the synthesis.
- Synthesis is analysis that connects multiple pieces of evidence from different sources to compare, contrast, and draw conclusions.
- In synthesis writing, writers should not simply report what others said on a topic.
- Writers are expected to make interpretations to create new ideas.
- Also, writers should create arguments in their synthesis writings.

Definition

- *Cambridge English Dictionary:* "The act of combining different ideas or things to make a whole that is **new and different from the items considered separately**.
- Combining individual pieces of evidence across sources, so your readers can understand how the individual pieces work together.

For the topic, the synthesis would bring together findings on the systemic challenges in publishing, such as peer-review timelines, with more individual-level challenges, such as language barriers and lack of mentorship.

Literature analysis and synthesis go beyond summarizing existing research, aiming to make sense of these studies and integrate them into a coherent story. This process provides a platform to place research questions and hypotheses in a clear context. When synthesizing, authors combine evidence from different sources, compare it, and draw conclusions while incorporating what others say and their own interpretations. This process allows readers to understand how the individual pieces fit together and provides a broader understanding.

Table 7. *An Example of Literature Analysis and Synthesis Matrix*

Subject: Culturally Responsive Classroom Management Skills for Teachers

Main Ideas - Themes - Questions*	**LITERATURE ANALYSIS**			**SYNTHESIS**
	Source 1 **Drake, 2017**	**Source 2 Hur and Suh, 2018**	**Source 3 Kim, 2019**	Teachers teaching refugee students often struggle with insufficient professional training and resources, which adversely impacts their ability to manage classroom behaviors and learning challenges effectively. First, the education offered to teachers in these settings is either extremely limited or completely absent, severely hindering their professional preparedness (McCarthy and Vickers, 2012). Additionally, they are not well-equipped in terms of resources, which compounds the difficulty they have in addressing students' behavioral issues (Hur and Suh, 2018). Moreover, these teachers frequently encounter severe difficulties with student learning behaviors and interpersonal clashes, further complicating their teaching environment (Gorski, 2012). In conclusion, the lack of adequate training and resources in refugee camps critically impairs teachers' effectiveness in managing both behavioral and educational challenges in their classrooms.
Question 1: What kind of problems do teachers face in classes with refugee children?	In refugee camps, the education provided to teachers and other professional education is limited or non-existent (McCarthy and Vickers, 2012).	Teachers face students' behavior problems and are not adequately prepared to handle them in terms of resources (Hur and Suh, 2018).	Teachers face difficulties in student learning behavior and clashes (Gorski, 2012).	

Argument/Clai

Evidence/Proof

Concluding sentence

Source: Cinkir (2023).

2.3.Expressing the Significance / Contributions of Your Study

Academic studies aim to contribute to the relevant literature in which the study is conducted and to answer some problem situations in that field. In academic writing, it is therefore necessary to state the contribution and significance of the work to the literature. A strong and clear significance/contribution claim can help your audience understand why they should read your articles and how your articles benefit them. As a writer, you can put the significance/contribution statements in different places in your academic studies. They can be in abstract, introduction and discussion sections of your study.

* Main Ideas Themes-Questions can be expanded according to the topic and scope…

In the abstract. Abstracts grab and hold readers' attention to your study. Thus, stating the significance/contribution of your study can be useful for your target audience. Teng, et. al. (2022)'s article's abstract can be shown as an example:

> *This empirical study serves two purposes. The first purpose is to validate a newly developed instrument, the Metacognitive Academic Writing Strategies Questionnaire (MAWSQ), which represents the multifaceted structure of metacognition in an English as a Foreign Language (EFL) academic writing setting. The second purpose is to delineate the predictive effects of different metacognitive strategies on EFL academic writing performance. Data were collected from 664 students at a university in mainland China. Confirmatory factor analyses (CFA) provided evidence for the fit for two hypothesized models, i.e., an eight-factor correlated model and a one-factor second-order model. Model comparisons documented that the one-factor second-order model was a better model, through which metacognition functions as a higher order construct that can account for the correlations of the eight metacognitive strategies, pertaining to declarative knowledge, procedural knowledge, conditional knowledge, planning, monitoring, evaluating, information management, and debugging strategies. Results also provided evidence for the significant predicting effects of the eight strategies on EFL academic writing performance. The empirical evidence supports the transfer of metacognition theory from educational psychology to interpreting EFL academic writing.*

In the introduction. According to Cooper (2015), introduction sections have three parts: what is known, what is unknown, and what your burning question, hypothesis, or aim is. Thus, the significance or contribution part of your study explains how much of the unknown part is going to be revealed in line with your burning question, hypothesis, or aim. As an example, apart from the introduction section of Teng, et.al. (2022) can be seen:

> *… The development of academic writing is in the hands of those who understand, plan, set goals for writing tasks and react to, and reflect on what has been written (Sasaki et al., 2018). In this respect, we see a potential in assessing EFL learners' use of metacognitive academic writing strategies and the predictive effects of metacognitive writing strategies on academic writing. The purpose of the present study is thus twofold: (a) to validate a questionnaire about metacognitive strategies on academic writing; and (b) to explore the extent to which strategies predict EFL students' academic writing performance. Findings can shed light on the understanding of metacognitive strategies on EFL academic writing. Teachers can thus gain insight on how to foster instruction of targeted metacognitive writing strategies for students. A final contribution is the potential for researchers to transfer educational psychology theory, e.g., self-regulation and metacognition, to EFL academic writing pedagogy.*

In the discussion section. The discussion section includes comparing your results with other directly relevant data from the published literature. Therefore, the contribution of your study to the literature and the importance of your results for the literature can be emphasized once again in this section. As an example, apart from the discussion section of Teng, et.al. (2022) can be seen:

> *The empirical findings support that metacognition functions as a theoretical construct that can account for the significant correlations of eight lower-order metacognitive strategies in academic writing. Consistent with Schraw and Moshman's (1995) study,*

the construct of metacognition accounts for a "systematic structure of knowledge" that can be used to explain and predict a broad range of learning strategies (p.356). The present study also sheds light on the metacognition theory that deploys a range of strategies related to declarative knowledge, procedural knowledge, conditional knowledge, planning, monitoring, evaluating, information management strategies, and debugging strategies (Schraw & Dennison, 1994).

The importance or contributions of a scientific study are important issues that must be clearly expressed in academic writings. Academic studies aim to contribute to the relevant literature in their field and address specific problem situations. It is important to express the importance of the work and its contributions to the existing literature. A strong, clear claim about the importance or contribution of the research can help readers understand why they should be interested in the research and how it benefits them. These statements can be included in various sections of the academic article, such as summary, introduction, and discussion. For example, clearly stating the importance or contribution of the study in the abstract can attract and maintain the reader's attention, making the study more relevant and useful to the target audience.

In summary, academic studies aim to contribute to the relevant literature and answer some problems in those fields. Therefore, in academic writing, it is necessary to state the contribution and importance of the study to the literature. A strong, clear contribution claim can help your audience understand why they should read your article and how your article benefits them. These statements can be included in the abstract of your work, in the introduction and discussion sections.

2.4.Research Questions and Hypotheses

Research questions guide the inquiry and are closely tied to the research purpose (Yin, 2013). We have previously stated that asking the right questions will make the researcher's job much easier during the research process. When determining these questions, it should not be overlooked that the literature should be utilized to the maximum extent. For instance, one research question could be "What are the individual-level barriers that academics face when publishing in scientific journals?" Hypotheses can then be formed to guide the empirical testing of these questions.

Example: *Aim of the study and research questions*

Aim

This research aims to identify the obstacles academics encounter in the process of publishing articles in scientific journals and to determine effective strategies for overcoming these obstacles.

Research Questions

- What types of obstacles do academics encounter when publishing articles in scientific journals?
- How prevalent are these obstacles that academics encounter?
- What strategies are employed to overcome these obstacles?
- How can the effectiveness of these strategies be evaluated?

- Are there significant differences in these obstacles and strategies among academics in different disciplines or career levels?
- How are issues of ethics and integrity related to these obstacles and strategies?

Research questions are the guiding elements of a study and are closely related to the research purpose. Asking the right questions helps the researcher guide the study process effectively. It is important to determine these questions by making maximum use of the literature. Hypotheses can be formulated to test answers to questions. Research questions and purpose determine the study's focus and draw the research's direction.

2.5.Research Framework

2.5.1. Presenting the Framework

The research framework serves as the backbone of your study, providing a coherent structure that guides the research from the initial questions to the final conclusions. In a study like "Academics' Process of Publishing in Scientific Journals: Obstacles and Overcoming Strategies," a research framework could include elements like the types of obstacles academics face, coping mechanisms, ethical considerations, and outcomes. A clear presentation of the framework aids in easier comprehension and adds credibility to your research (Miles & Huberman, 1994).

The research framework for a study on academic publishing obstacles may start with identifying the key obstacles, such as lack of resources, inadequate mentoring, or difficulty accessing publishing platforms. These challenges are then cross-referenced with variables such as the academic discipline, career level, and geographic location. Coping strategies are integrated into the framework to investigate how they mitigate these obstacles.

2.5.2. Visual Representations

Visual aids like flowcharts, diagrams, or mind maps can make your research framework more accessible. Visual representations allow you to show relationships between different variables and help you understand complex structures (Yin, 2018). This framework delineates the academic's journey towards publication, delineating obstacles encountered and potential coping mechanisms, thereby providing readers with a concise overview of the analysis process and facilitating comprehension of various data analysis stages. In this context, the fact that visualization is very helpful in increasing the understandability of the study reveals that visualization should be an instrument that the researcher should frequently use. The following Figure 2 provides a “Research Framework” for the "Embedded-Mixed Study Design" among Mixed Methods Research designs.

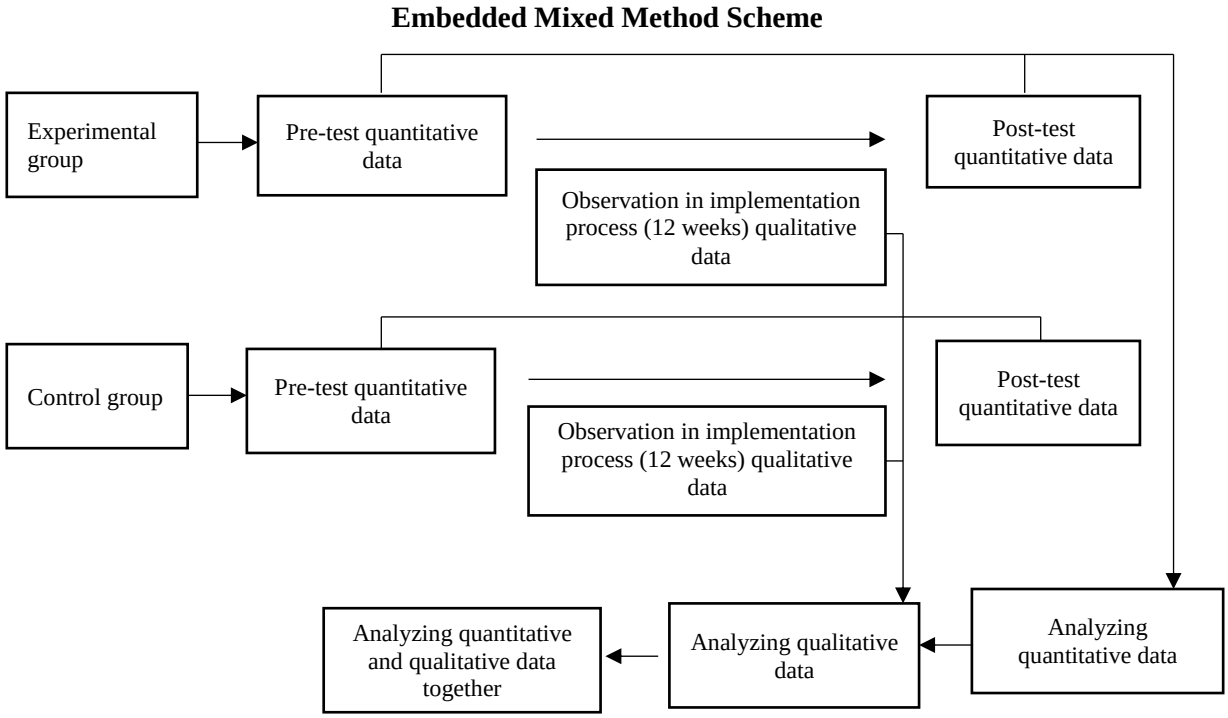

Figure 2. *Visual Example of Research Framework* (Özdemir (2019).

A scheme may start with the academic's intent to publish, followed by the various obstacles encountered. Arrows can indicate possible coping mechanisms and lead to different outcomes, such as successful publication or withdrawal from the publishing process. This visual aid would provide a snapshot of the complicated analysis process, making it easier for readers to digest the study's analysis stages and different types of data analysis.

3. METHODOLOGY

Methodology in research serves as a structured approach to acquiring scientific knowledge, drawing upon reasoning, senses, and intuition as sources of knowledge (Paltridge & Starfield, 2007). These three sources are used alone or sometimes together during the production of knowledge. However, for acquiring or creating scientific knowledge, it must have certain characteristics. Foremost among these is that scientific knowledge must proceed following a discipline at all stages and fully realize the application of certain procedures. In addition, in the study prepared for scientific information, the researcher's limitations, past experiences or prejudicesresearcher's limitations, past experiences or prejudices that may affect the study result should be explained in detail. Thus, scientific study methods can be called procedural templates that contain all these contents together. Researchers choose one of these templates that is suitable for their purposes and the conditions of their studies and follow it from the beginning to the end of the research process. This way, information emerges, each stage of which can be controlled by different researchers and repeated and confirmed when necessary. Since following the scientific process fit methodological requirements is the only way to achieve to create scientific knowledge for researchers, methodology knowledge becomes more important. Figure 3 gives a brief overview of the sub-headings of the methodology. However, all the elements in the methodology are more detailed.

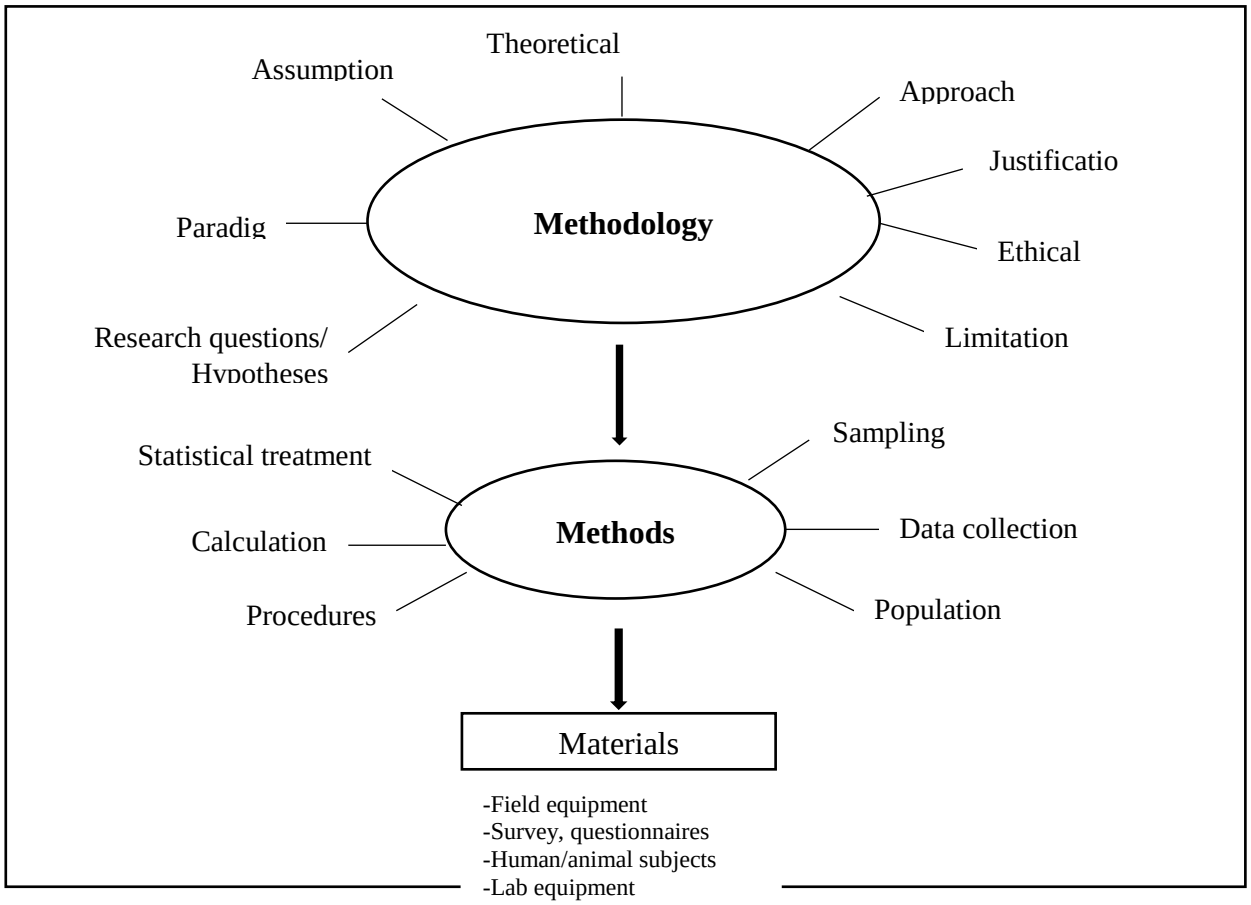

Figure 3. *Visual Map of Typical Components of a Methodology* (Paltridge & Starfield, 2007).

Figure 3 is a visual map of the research methodology and shows typical components of the research methodology. This map guides researchers to understand the steps, methods, and strategies in the research process. For example, methodological elements such as data collection methods, analysis techniques, participant selection, sampling methods, and ethical guidelines are represented in this map. Researchers can use this map to create a conceptual framework when planning their own studies or when they want to understand existing methodological approaches.

3.1.Choosing the Research Method and Design

Selecting the appropriate research method is essential to address the study's purpose and research questions. Research design is a plan to answer your research question. A research method is a strategy used to implement that plan. Research design and methods are different but closely related, because good research design ensures that the data you obtain will help you answer your research question more effectively.

Qualitative research explores and understands the meaning individuals or groups ascribe to a social or human problem. The research process involves emerging questions and procedures, data typically collected in the participant's setting, data analysis inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data. The final written report has a flexible structure. Those who engage in this form of inquiry support a way of looking at research that honors an inductive style, a focus on individual

meaning, and the importance of rendering the complexity of a situation. Figure 4, adapted from Creswell (2007), shows the main qualitative research designs.

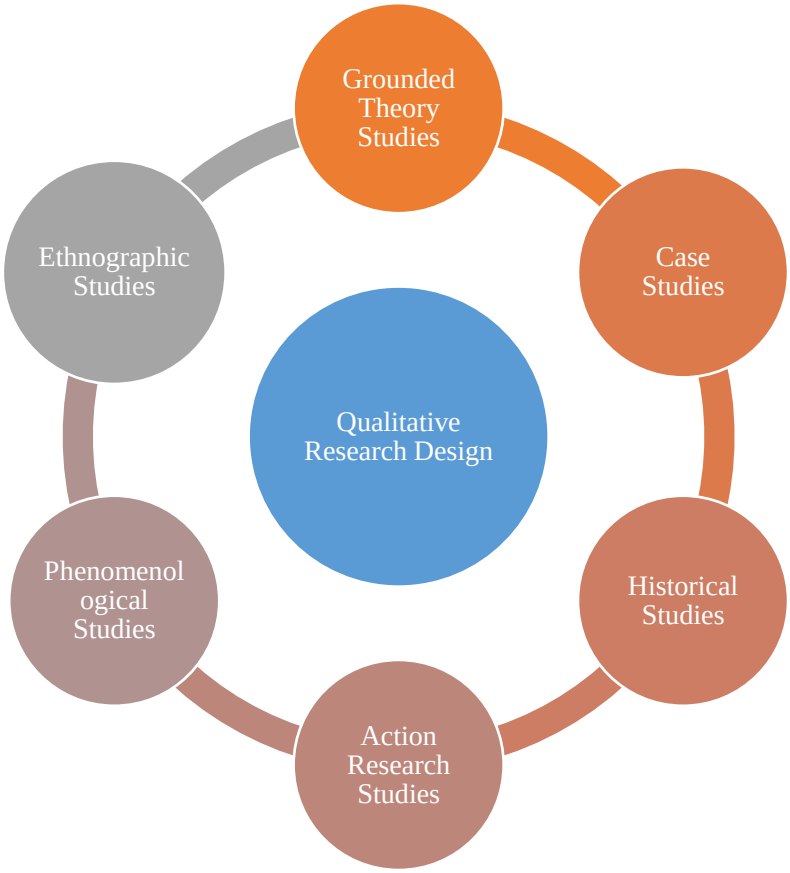

Figure 4. *Qualitative Research Designs*

Figure 4 is adapted from Creswell's (2007) work and shows basic qualitative research designs. Qualitative research is a tool for exploring and understanding the meaning individuals or groups give to a social or human problem. The research process involves emerging questions and procedures, data are generally collected in the participant's environment, data analysis takes place deductively from the general to the specific, and the researcher interprets the meaning of the data. The final written report has a flexible structure. Participants in this type of inquiry endorse a reductionist style of inquiry, a focus on individual meaning, and a perspective that affirms the importance of reflecting the complexity of a situation.

Quantitative research is a means for testing objective theories by examining the relationship among variables. These variables, in turn, can be measured, typically on instruments, so that numbered data can be analyzed using statistical procedures. The final written report has a set structure consisting of an introduction, literature and theory, methods, results, and discussion (Creswell, 2008). Like qualitative researchers, those who engage in this form of inquiry have assumptions about testing theories deductively, building protections against bias, controlling for alternative explanations, and being able to generalize and replicate the findings. Figure 5 shows the types of quantitative research methods.

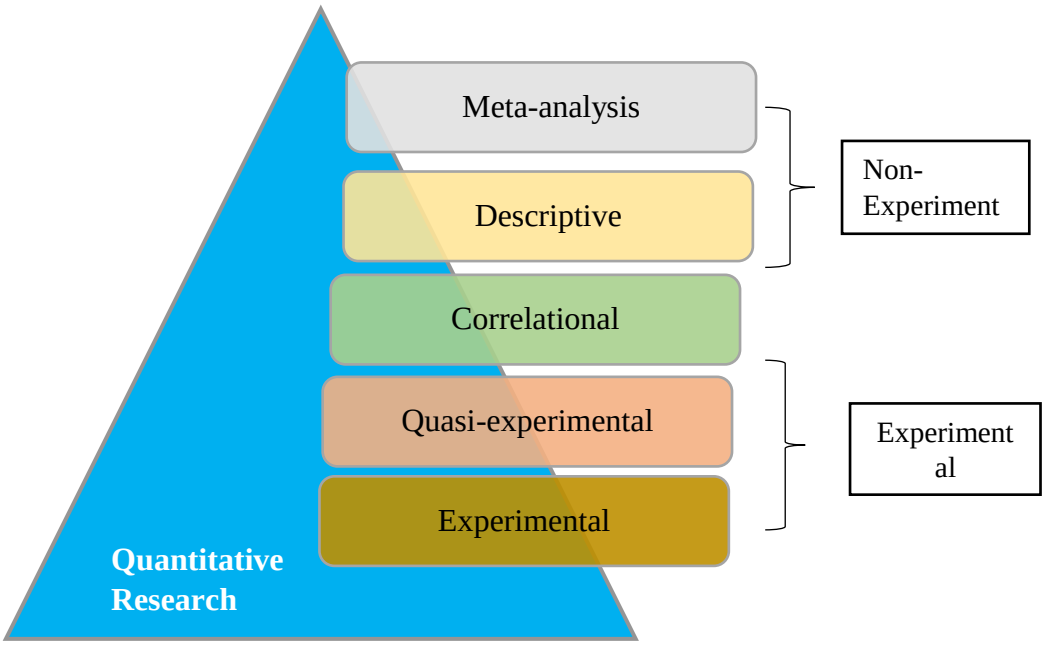

Figure 5. *Types of Quantitative Research*

Figure 5 shows the types of quantitative research methods. **Descriptive Research**: Aims to explain phenomena through data collection, organization, presentation and interpretation. Experimental Research: Aims to manipulate the interaction between independent and dependent variables to determine causal relationships. Correlational Research: Aims to evaluate relationships between variables but does not establish a causal relationship. Quasi-Experimental Research: Rather than providing all the controls of experimental research, it is conducted with a slightly looser level of control, so it is a transitional type between correlational and experimental research. Quantitative research is a way to test objective theories by examining the relationship between variables. Meta-analysis is a statistical method that aims to combine similar studies' results in a research field and reach more reliable results. These variables, in turn, can typically be measured on instruments, so that numerical data can be analyzed using statistical procedures. The final written report has a specific structure consisting of introduction, literature and theory, methods, results, and discussion sections.

Mixed methods research is an approach to inquiry that combines or associates both qualitative and quantitative forms. It involves philosophical assumptions, using qualitative and quantitative approaches, and mixing both approaches in a study. Thus, it is more than simply collecting and analyzing both kinds of data; it also involves using both approaches in tandem so that a study's overall strength is greater than qualitative or quantitative research (Creswell & Plano Clark, 2007). In Table 6, Abeza, et. al. (2015)'s table modified from Creswell and Plano-Clark's studies, contains main characteristics of different kinds of mixed research designs and their specific requirements were given. Researchers should choose their research methods in terms of the nature of their research, their own data usage tendencies, analyzing choices, and how they design the process.

Table 8. *Mixed Research Designs*

Criteria				Notation	Theoretical perspective	Description
Timing	Designs	Weighting	Mixing/ stage of integration			
Sequential	Explanatory	Usually quantitative	Interpretation phase	QUAN→qual	May be present	The research seeks to elaborate on or expand the findings of one method with another method
	Exploratory	Usually qualitative	Interpretation phase	QUAL→quan		
	Transformative	Qualitative, quantitative, or equal	Interpretation phase	Qual →quan or quan→qual	Use of theoritcal perspective (e.g. advocacy)	
Concurrent	Triangulation	Preferably equal; can be quant or qual	Interpretation or analysis phase	QUAN+QUAL	May be present	The research converges two types of data at same time to provide an inclusive analysis of the research
	Embedded	Qualitative or quantitative	Analysis phase	QUAN (qual) or QUAL (quan)		
	Transformative	Qualitative, quantitative, or equal	Usually analysis phase, can be interpretation phase too	Qual+quan or quan+qual	Use of theoretical perspective (e.g. advocacy)	

Source: Abeza, et. al. (2015).

Table 6 contains the main characteristics and specific requirements of different types of mixed research designs. Researchers should choose research methods based on the nature of their study, their data use tendencies, their analysis choices, and how they design the process. The table covers sequential and concurrent mixed research designs, their theoretical perspectives, timing, weighting, and integration stages. These designs provide researchers with a framework for planning and designing their studies and offer solutions tailored to different research needs.

3.2.Population Sample and Study Group

In scientific research, terms such as population, sample, study group, or participants refer to people, situations, thoughts, or objects on which research is conducted. Depending on the type of study to be conducted, your ability to reach the population you will work on, the result you want to achieve, and the type and size of the population may vary. Thus, identifying the population and determining the sample size is crucial for generalizability and validity (Cohen, Manion, & Morrison, 2013). For example, in one quantitative study, the population could include academics from various disciplines and career levels. In a qualitative study, a researcher can work with just one scholar to get deeper information from his or her thoughts and specific experiences on the current research topic. Also, in qualitative studies researchers

should take "participants" in their studies and consider the participants' main features, thoughts, perspectives…etc. as different variables affect the results of the study. On the other hand, the population, target population, and sample terms have different features. In Figure 6, Creswell's classification of them is given.

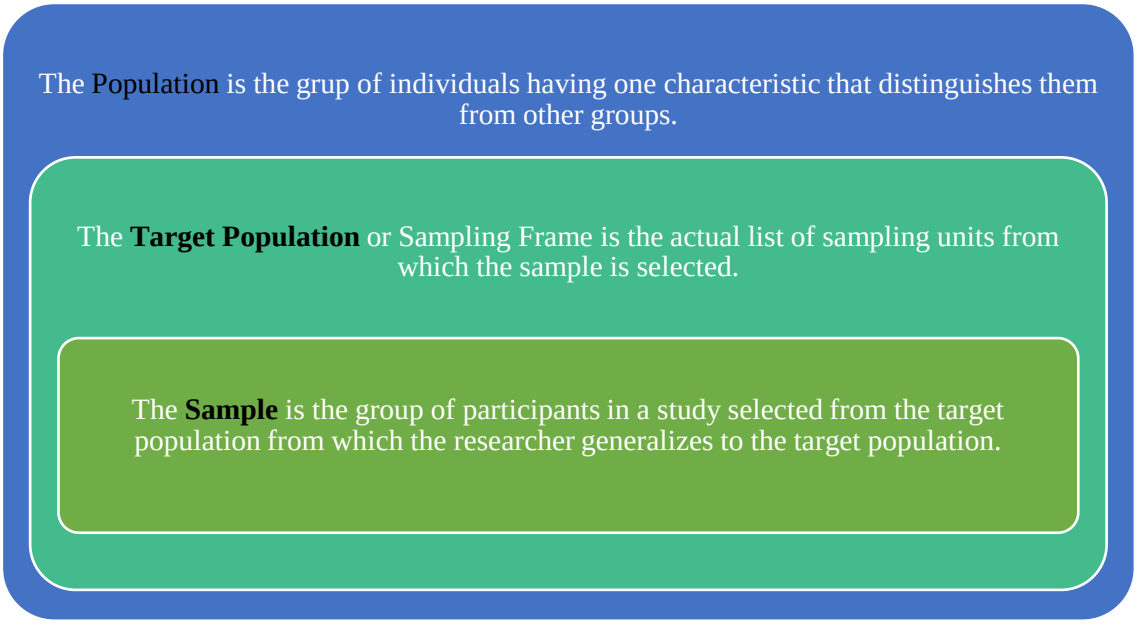

Figure 6. *Differences between the Population, Target Population or Sample Frame, and Sample* (Creswell, (2012).

In academic studies, due to various reasons, researchers usually cannot reach the entire research population. Thus, choosing the correct sampling which successfully represents the whole is crucial. Sampling methods can divide into two parts as: random and non-random (purposeful) sampling. Although in purposeful sampling, researchers intentionally select individuals and sites to learn or understand the central phenomenon; in random sampling, they randomly select representative individuals to generalize results from these individuals to a population (Creswell, 2009). Figure 7, visualizes the main sampling methods under random and non-random sampling categories.

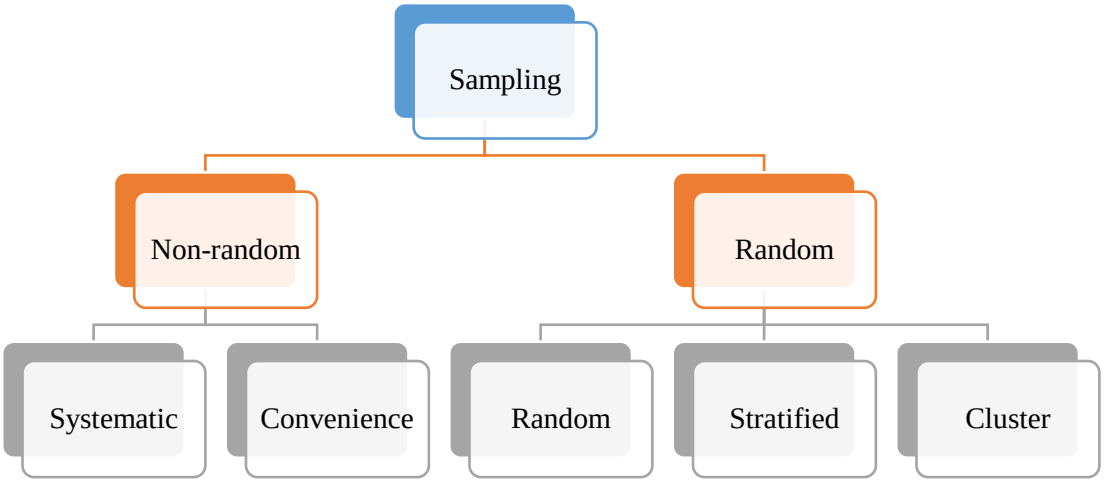

Figure 7. *Main Sampling Methods* (Academic Skills Kit, 2024).

Figure 7 presents the main sampling methods under random and non-random sampling categories. Sampling methods include different strategies that researchers use to select a representative sample from a population. Random sampling methods include methods in

which each member has an equal probability of being selected, while non-random sampling methods include methods that guide sample selection based on a particular characteristic of the population. This table , guides them in choosing an appropriate sampling method, and helps them better understand their sampling strategies. Also, these sampling methods have some advantages and disadvantages. In table 7 they can be seen.

Table 9. *Advantages and Disadvantages of Sampling Methods*

Sampling Methods	Advantages	Disadvantages
Random Sampling	• Easy to implement. • Each member of the population has an equal chance of being chosen. • Free from bias.	• If the sampling frame is large random sampling may be impractical. • A complete list of the population may not be available. • Minority subgroups within the population may not be present in sample
Stratified	• Strata can be proportionally represented in the final sample. • It is easy to compare subgroups.	• Information must be gathered before being able to divide the population into subgroups.
Cluster	• Cuts down the cost and time by collecting data from only a limited number of groups. • Can show grouped variations.	• It is not a genuine random sample. • The sample size is smaller and from thus the sample is likely to be less representative of the population
Systematic Sampling	• Easy to select. • Identified easily. • Evenly spread over the entire population.	• May be biased where the pattern used for the samples coincides with a pattern in the population.
Convenience Sampling	• Cuts down the cost of preparing a sampling frame as it is less time-consuming.	• Bias, as it is does not represent the population well.

Source: Academic Skills Kit (2024).

Table 7 outlines five different sampling methods—Random, Stratified, Cluster, Systematic, and Convenience Sampling—each with specific advantages and disadvantages. Random Sampling is simple and unbiased, but not practical for large populations and may miss minority subgroups. Stratified Sampling ensures proportional representation and facilitates subgroup comparison but requires prior information to divide the population. Cluster Sampling reduces costs by focusing on a limited number of groups, though it may not provide a genuinely random sample and can be less representative. Systematic Sampling is easy to implement and evenly distributed across the population but can introduce bias if the sampling pattern aligns with a population pattern. Lastly, Convenience Sampling is less time-consuming and reduces costs by using an accessible sampling frame, but does not represent the population well, introducing significant bias. Each method offers trade-offs between ease

of implementation, cost, time efficiency, and the potential for bias, making the choice of method dependent on the specific requirements and constraints of the research study.

3.3.Data Collection Tools and Process

Different tools like surveys, interviews, and observations can be utilized depending on the research method. Standardizing these tools is critical to ensure consistency (Bryman, 2016). Data collection can be divided into two types :primary and secondary data collection methods. While in primary data collection researchers collect data by themselves, in secondary data collection, they use the data gathered from published sources. Thus, the secondary data is already gathered by someone else for another reason, but these data can be used by other researchers in their research (Taherdoost, 2021). In Figure 8, the main characteristics of primary and secondary data collection methods were given.

Figure 8. *Primary and Secondary Data Collection Methods* (Taherdoost, 2021).

Figure 8 shows the key features of primary and secondary data collection methods. Primary data collection methods represent data collected directly by researchers, while secondary data collection methods refer to data collected previously.

3.4.Validity, Reliability, and Trustworthiness of Studies

Ensuring validity and reliability is crucial for the credibility of your study. For quantitative aspects, statistical tests for reliability can be employed, while for qualitative aspects, techniques like triangulation can be used (Lincoln & Guba, 1985).

Cronbach's alpha could be used to measure the reliability of the questionnaire, while the validity of qualitative data might be assessed through member checks.

To ensure the trustworthiness of qualitative research, four main criteria should be provided: credibility, transferability, dependability and confirmability (Stahl and King, 2020). All researchers working on qualitative research should prove that they implemented all phases of research design in accordance with these criteria. These criteria can be summarized as Table 8.

Table 10. *Four Main Criteria of Trustworthiness*

Criteria	Definition
Credibility	Credibility aims to answer the question of "How congruent are the findings with reality?" it can be provided by various triangulation processes as *data*, *investigator*, *theoretical*, and *environmental* triangulations.
Transferability	Transferability means transferring patterns and descriptions from one research to another. Although qualitative research does not (cannot) aim for replicability, its patterns and descriptions can provide some extensions to new study's circumstances.
Dependability	Dependability aims to build trust in creating data because the researcher is the source of the data. If somebody else saw it the same way, it makes the data more dependable. For dependability researchers make *peer debriefing* or *peer scrutiny*
Confirmability	Confirmability makes qualitative research get as close to objective reality as it can. In confirmability researchers try to make their research more precision and accuracy, like non-involvement to natural environments.

Source: Stahl and King (2020).

Table 8 summarizes the four basic criteria researchers apply for trustworthiness in qualitative research. These criteria are defined as credibility, transferability, dependability, and confirmability. Credibility aims to determine how consistent the findings are with reality, and this can be achieved through various triangulation processes such as data, investigator, theoretical and environmental triangulation. Transferability refers to the ability to transfer patterns and descriptions from one study to another. Dependability aims to ensure that the researcher is a reliable source in creating data and information is exchanged or evaluated with colleagues to increase reliability. Confirmability aims to match qualitative research to objective reality as much as possible, and researchers strive to further their research in terms of accuracy and precision.

4. DATA ANALYSIS

4.1.Quantitative Studies

Analyzing quantitative data involves statistical methods to interpret the data collected from the research instruments (Field, 2013). Descriptive and inferential statistics could be employed to understand the distribution and impact of obstacles in academic publishing. Table 9 outlines the common mistakes made by authors when conducting quantitative analysis:

Table 11. *Common Mistakes Made by Authors When Conducting Quantitative Analysis*

Common Mistakes	Explanation & Consequences	Possible Solutions	References
Inadequate Sample Size	A small sample size can lead to low statistical power, reducing the credibility of the results.	Pre-study power analysis to determine an appropriate sample size.	(Cohen, 1992)
P-Hacking	Manipulating analyses to find statistically significant p-values, compromising the study's integrity.	Pre-register the study and stick to the planned analyses.	(Simmons, Nelson, & Simonsohn, 2011)
Lack of Control Variables	Ignoring potential confounding variables can lead to incorrect conclusions.	Identify and control for potential confounders.	(Cohen, Cohen, West, & Aiken, 2003)
Inappropriate Statistical Tests	Using the wrong tests can produce misleading or invalid results.	Consult a statistician or use guidelines to choose the appropriate test.	(Field, 2013)
Ignoring Assumptions of Statistical Tests	Violating assumptions like normality or homoscedasticity can invalidate results.	Check assumptions and use tests that are robust to violations if needed.	(Tabachnick & Fidell, 2013)
Overreliance on Significance Testing	Solely relying on p-values ignores the practical significance of findings.	Use effect sizes and confidence intervals.	(Cumming, 2014)
Not Accounting for Multiple Comparisons	Conducting multiple tests increases the chance of Type I error.	Use correction methods like Bonferroni or Holm.	(Holm, 1979)
Unclear Presentation of Results	Poorly presented results are difficult to interpret.	Use tables, figures, and clear language.	(APA Publication Manual, 7th Edition, 2020)

Table 9 describes common mistakes made during quantitative research and their causes, consequences, and possible solutions. Examples of these errors include insufficient sample size, p-hacking, lack of control variables, inappropriate statistical tests, ignoring the assumptions of statistical tests, over-reliance on significance tests, ignoring multiple comparisons, and unclear presentation of results. For example, insufficient sample size can result in low statistical power and reduce the credibility of the results. To resolve this situation, a sample size analysis can be performed beforehand. Manipulating p-values may compromise the integrity of the study, so the study may need to be registered in advance and adhere to planned analyses.

4.2.Qualitative Studies

Qualitative analysis requires coding and thematic development to understand the underlying patterns in the data (Saldaña, 2015). Content analysis could be performed on the interview transcripts to identify recurring themes related to obstacles and coping mechanisms.

4.2.1. Content Analysis

Content Analysis is the systematic examination of written, verbal, or visual forms of communication (Krippendorff, 2004). This method is particularly useful for understanding what occurs frequently or infrequently within a specific data set. Content analysis is often used in media studies, political analyses, social sciences, and market research. The aim is to construct some sort of "reality" or meaning by counting or categorizing elements within the text. Its importance lies in measuring and interpreting social, cultural, or political trends. The content analysis is a research method used to identify patterns in recorded communication. The Table 10 outlines the common mistakes made by authors when conducting content analysis:

Table 12. *Common Mistakes in Content Analysis*

Aspect	Common Mistakes in Content Analysis
Research Design	The absence of a clear framework or model
	Lack of clarity in the objectives of the analysis
Sampling	Inconsistent or unclear sampling criteria
	Sampling too little or irrelevant data
Coding Scheme	Inadequately defined categories or themes
	Lack of inter-coder reliability
Data Collection	Failure to ensure the quality of the data sources
	Using non-representative samples of texts
Data Analysis	Inadequate or inconsistent coding
	Overgeneralization or oversimplification of findings
Validity and Reliability	Ignoring issues of validity and reliability
	Lack of pilot testing for coding categories
Interpretation	Ignoring the context of the content
	Confusing content with meaning
Reporting Findings	Failure to adequately support claims
	Omitting limitations of the study

Table 10 summarizes common errors in content analysis in different aspects of various research processes. Errors in research design are noted, such as the lack of a clear framework or model and the vagueness of the purposes of the analysis. In the sampling phase, errors include inconsistent or unclear sampling criteria and insufficient or irrelevant data sampling.

In the process of determining the coding scheme, problems such as inadequately defined categories or themes and lack of reliability among coders arise. During the data collection phase, errors occur in ensuring the quality of data sources and using unrepresented text samples. During the data analysis process, errors are made in inadequate or inconsistent coding, overgeneralization, or the simplification of findings. Mistakes in validity and reliability are made, such as ignoring validity and reliability issues and not pilot testing coding categories. At the interpretation stage, errors are found in ignoring the context of the content and mistaking content for meaning. At the stage of reporting the findings, mistakes are made, such as supporting the claims insufficiently and overlooking the study's limitations.

4.2.2. Thematic Analysis

Thematic Analysis is a form of qualitative data analysis that aims to generate meaning by searching for different themes or patterns within a data set (Braun & Clarke, 2006). It is versatile and suitable for different disciplines and research questions. It is frequently used in psychology, health research, social sciences, and humanities. The aim is to organize and understand complex data sets, to interpret or provide an in-depth explanation of a phenomenon. Its importance lies in revealing the researcher's nuanced understanding of the data and often provides deep insights into participants' experiences or understandings. Table 11 offers a comparative look at the steps typically involved in Thematic Analysis according to these scholars.

Table 13. *Steps Typically Involved in Thematic Analysis According to These Scholars*

Stage	Braun & Clarke (2006)	Creswell (2017)
Data Preparation	Data collection and organization	Data collection and organization
Initial Reading	Repeatedly reading the data	Skimming data for basic ideas
Coding	Generating initial codes	Preliminary coding
Theme Identification	Identifying potential themes	Identifying thematic structures
Theme Review	Refining themes	Reviewing relationships among themes and codes
Theme Definition	Defining clear narratives for themes	Defining themes in detail
Report Writing	Writing up the thematic analysis	Writing up the thematic analysis

Table 11 provides a comparative overview of the steps typically involved in Thematic Analysis. There are certain similarities and differences between the steps proposed by Braun and Clarke (2006) and Creswell (2017). Both approaches focus on the data collection and organization process in the data preparation phase. In the initial reading phase, the Braun and Clarke approach recommends reading the data repeatedly, while the Creswell approach focuses on identifying key ideas more quickly. Both approaches involve creating initial codes in the coding process, but the way this process is implemented may differ between approaches. Both approaches involve identifying and developing themes in the theme identification and review phases, but the processes' details and focus may vary. Finally, at the report writing stage, both approaches involve expressing the thematic analysis in writing.

5. FINDINGS / RESULTS

The presentation of research findings is a crucial step in disseminating knowledge. Your presentation style should align with the study's objectives and research questions. Data can be presented through textual explanations, tables, and figures (American Psychological Association, 2020). The design of the findings/results section should be shaped by research questions because all findings are used to answer these questions. On the other hand, the design style is totally up to the authors. They can categorize findings in terms of research questions, headings, and sub-headings of the results' concepts, analyze tools, or data types (like qualitative and quantitative dimensions of mixed studies)

For a study on "Academics' Process of Publishing in Scientific Journals," a combination of pie charts and textual explanations could elucidate the common challenges faced and the strategies used by academics to overcome these challenges.

5.1. Preparing Tables and Figures

Visual aids like tables and figures can help to make complex data more understandable. Consistency in labeling, units, and scales is crucial for effective communication (Tufte, 2001). Table 12 and Table 13 show two examples of qualitative and quantitative data analysis.

Table 14. *An Example of Qualitative Findings of One Theme with Thematic Analysis*

Codes	**N**	**Categories**	**Themes**
Distance writing classes saving time	2	The effect of adaptation to/ conduct of lessons on time	Time in distance writing class
Adapting to distance classes taking time	2		
The process of distances writing classes taking time	1	The effect of activities and assignment in lessons on time	
Distance writing tasks take time	3		

Source: Özdemir (2023).

Table 12 explains how thematic analysis is performed and how qualitative data is organized, thus providing researchers with an understanding of how themes and categories are determined. It explains the qualitative findings obtained in the thematic analysis by showing the relationship between codes, categories and themes. For example, the code "Distance writing classes saving time" is divided into different categories to the theme "Time in distance writing class" and is collected under this theme.

Table 15. *Example of Quantitative Findings of One T-Test Analysis Table*

Variables	Groups	*N*	$\bar{X}$	*SD*	t	*df*	p
School effectiveness	Undergraduate	380	4,628	,919	3,029	424	,003
	Graduate	46	4,195	,884			
Teacher performance	Undergraduate	380	4,394	,525	1,384	424	,167
	Graduate	46	4,282	,455			

Comparison of teachers' performance and teachers' perceptions of school effectiveness according to their educational background

Source: Özgenel and Mert (2019).

Tables could be used to list common obstacles and the percentage of respondents citing each obstacle. Figures might include graphs illustrating how different coping strategies correlate with publishing success.

5.2. Interpretation of Findings

Interpreting the findings involves explaining their significance and implications. Interpretation should align with the research questions and the existing literature (Yin, 2018).

An example of one interpretation of findings (Table 13 of this study) can be seen below.

> When Table 3 is examined, teachers' performances do not show significant differences according to their educational status (p>.05); school effectiveness perceptions differ significantly (p<.05). Perceptions of school effectiveness of undergraduate teachers ($\bar{X}$=4,628; sd=.919) are higher than perceptions of graduate teachers ($\bar{X}$=4,195; sd=.884).

As you can see, Özgenel and Mert (2019):

- Before the sub-headings, figures, or tables, they gave short background information of the analysis types and related concepts,
- Only explained their results following their related research question, without speculative or interpretive comments,
- Used the past tense in their interpretations, and
- explained the result as concisely as possible.

In other words, it is crucial to define the significance and implications of the findings and align them with the research questions and existing scientific studies. For example, Özgenel and Mert (2019) reported in their study that although there was no significant difference in teachers' performances according to their educational background, perceptions of school effectiveness differed significantly. In particular, teachers with undergraduate degrees perceive schools as more effective than teachers with postgraduate education. Özgenel and Mert (2019) meticulously included background information about analysis types and related concepts, especially before each subsection, avoided speculative expressions, used the past tense in their comments, and expressed their findings concisely following the research questions.

6. DISCUSSION, CONCLUSION, AND RECOMMENDATIONS

6.1. Discussion Based on Results

In the discussion section, the researcher can explore the findings' meanings, implications, and limitations. It should provide an interpretation of how the results fulfil or fail to fulfil the expectations set out by previous literature (Hart, 1998). The purpose of the discussion section is to find answers to the questions asked in the research, to examine and interpret the meanings of the results obtained in terms of the research problem, and to use the results obtained based on the findings to support the answers to the questions of the research. This is the part where the researcher shows all his merit, creativity, theoretical and conceptual mastery of his field, and his capacity to think analytically. The support and contribution of the obtained results to the studies in the field and the theoretical framework must be expressed. The most critical point in this section is to interpret what the results mean in that field and to reveal to what extent the study adds new information to the existing knowledge in that field and whether the

study has critical importance for the future (Conn, 2017). As you can remember, the hourglass structure metaphor is from the structure of the academic writing section, and the triangle at the bottom starts from the discussion section and continues to the conclusion and suggestions. Also, as seen from Figure 9, the discussion section should be designed as a triangle, too, from specific findings to general wrap-ups with the other related studies in the literature.

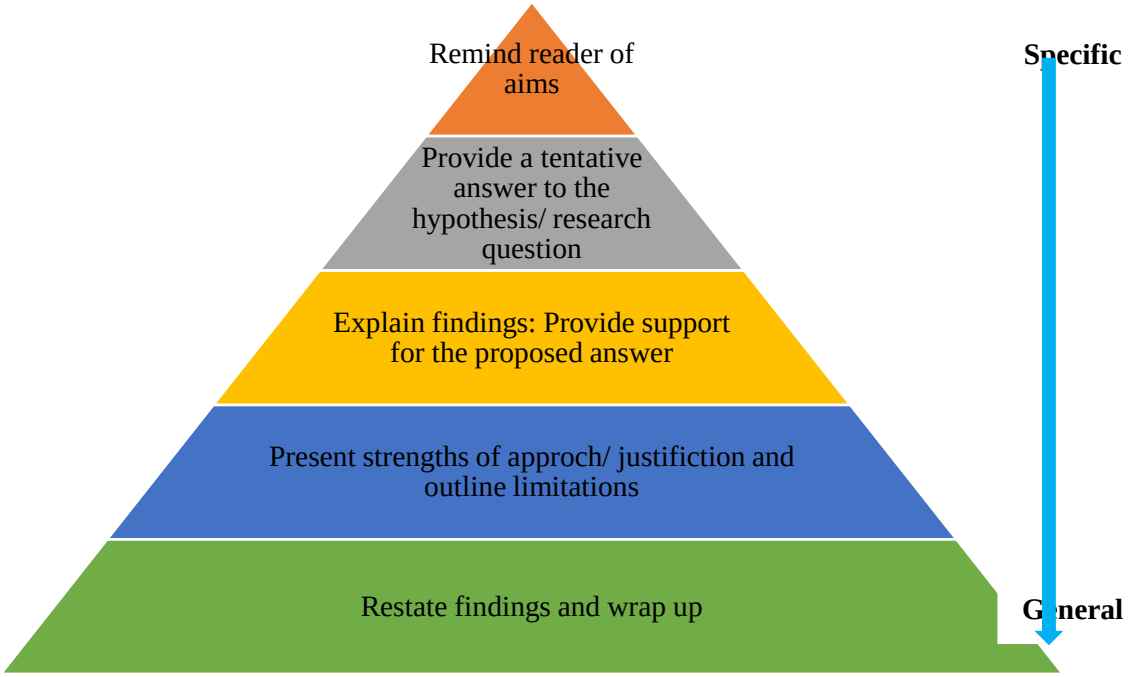

Figure 9. *Discussion Section's Plan* (Federation University Australia Study Skills, 2024).

Figure 9 describes the design of the discussion section. The discussion section in academic writing resembles an hourglass structure in which the triangular base extends from specific findings to broader implications and connections to relevant literature. Presented visually, the discussion section highlights the progression from detailed analysis to broader conclusions and their connections to relevant literaThis strategy is recommended as a triangle that extends from the specific findings of the research to broader conclusions and recommendations.

Paltridge and Starfield (2007) suggested strategies for writing discussion sections as;

- Write a sentence about everything they (your audiences) know now that they didn't know when they started their research.
- Sort the sentences into groups.
- Write headings for each of the groups of sentences.
- Write sub-headings for each sentence in each group.
- Use this as a framework for planning the Discussion chapter.

This framework can help present the research results in a more understandable and structured way. Additionally, relating the results to previous literature allows the study's findings to be understood and interpreted within an overall context. This process can guide researchers in organizing the discussion section and presenting the results effectively. Also, because discussion sections aim to discuss the study's results with related studies in previous literature, this framework can be designed like Table 14.

Table 16. *An Example of Discussion Writing Framework*

Sentences	Groups	Headings / Sub-headings	Related studies with overlapping results	Related studies with differentiated results
1.	X	A		
2.	Y	B		
…..	…	….		

This framework can be designed as in Table 14, as the discussion sections aim to discuss the study results with relevant studies in previous literature. The example in Table 14 includes studies associated with relevant outcomes but also specifies studies associated with different outcomes.

6.2.Writing the Conclusion

Conclusions should succinctly summarize the main findings, directly answering the research questions posed at the study's outset (Creswell & Creswell, 2017). The conclusion section is the section that reads the entire article and relates the conceptual and theoretical framework of the article to the themes emerging in the discussion section. This section should be of a nature that can be understood, interpreted, and applied in practice by researchers interested in the field.

According to Thompson (2005) conclusion sections should include:

- introductory restatement of aims of research questions;
- consolidation of present research (e.g. findings, limitations);
- practical applications/implications;
- recommendations for further research.

Some researchers may prefer to write the recommendation and implications as separate headings or academic journals or institutes may request such a way of writing. If they separately, the *recommendation* section can include actionable steps for practitioners and policymakers and indicate the broader impact of the study (Smith, 2010). In *implications*, the researcher can describe his experiences during the research process and reveal the lessons to be learned from these experiences. On the other hand, it can emphasize the research of new research findings added to the theoretical framework in the field and the issues that are felt to be lacking and thought to need to be added. In Table 15, Blair et al.'s (2016) conclusion section is analyzed in terms of its main parts with different colours.

Table 17. *Analysis of Study's Conclusion Section*

This study adds to the academy through problematizing a growing trend in instructional design in higher education and widens the debate so that the understanding of what might be regarded as 'success' in relation to the flipped classroom can be thought of in terms of both student satisfaction and student performance. There is a general move in higher education towards student-centred instructional design - that is often supported by ICT. The introduction of the flipped classroom has brought these two aspects together and several advantages of flipping are to be found in the literature. However, there is a need to examine the flipped classroom in relation to educational outcomes. Whilst academic results are clearly important to student and faculty, Bishop and Verleger (2013) report that student performance in relation to the flipped classroom is under-

reported in the literature. This study examined two cohorts of students in the academic years 2012/13 (traditional) and 2013/14 (flipped) and sought to find whether the introduction of the flipped format improved the learning experience in relation to exam performance and student perception. While the course-maintained results that were above the campus and faculty average, there was no significant change in the overall course pass rate and a slight decrease in the average mark achieved (although this was not a like-for-like analysis). The study was also able to show some evidence of a correlation between attendance in class and final exam marks – in both the tradition and flipped format. Analysis of the qualitative data showed a slight improvement in how students perceived the course and the lecturer's reflection shows that they are keen to continue with the flipped format as it allowed for more time to "strategize on optimizing student learning". The lecturer's reflection also suggests that the lecturer expects better student results from future iterations of this course—although no real rationale is given for this. The flipped classroom is a relatively recent phenomenon, and we are just beginning to understand its impact on student performance. Data gathered from future cohorts will help clarify whether it is better to flip or not. Until that time, it is recommended that practitioners who are keen to teach in a flipped classroom pay careful attention to the effort it takes to instigate such an environment against the levels of satisfaction shown by students and the students' examined performance.

- introductory restatement of aims, research questions;
- background information from literature (optional)
- consolidation of present research (e.g. findings, limitations);
- practical applications/implications;
- recommendations for further research

Source: Blair et al. (2016).

This table analyzes the conclusion of Blair et al.'s (2016) study. Results include background information from the literature while restating the purpose of the study and research questions. It consolidatingng existing research, findings, and limitations, and discusses practical applications or implications. It also provides suggestions for future research. The table provides a guide for structuring and understanding the study results. As a result, the conclusion of a scientific article/writing summarizes the main findings of the research and emphasizes the importance of these findings. It also identifies the study's limitations, offers suggestions for future research, and indicates the study's unique contributions to the field. Results are conveyed clearly and concisely, avoiding complex language or unnecessary details. This section helps the reader understand the research's importance and grasp the study's main message.

6.3.Limitations

Every study has limitations, such as sample size, methodology, or contextual factors, and acknowledging these is crucial (Leedy & Ormrod, 2015). Limitations may include the scope of the study, which was restricted to academics within a particular discipline or geographic region. In Table 16, Özdemir's (2023) limitation section analyzed in terms of its main parts with different colors.

Table 18. *Analysis of a Limitations Section*

This study is not a generalizable study for a large-scale universe, as it was a qualitative study and limited to eight students. As the study was conducted throughout one course level, the effects of the aspects transferring to the next course levels, as well as the forming the basis for the next issues on the future course levels were not observed. Since the course was given online, the writing samples were collected through the Microsoft Word program. Therefore, skills related to handwriting and paper layout were not addressed. • limitation because of the methodology • limitation because of the sample size • limitation because of the contextual factors • limitation because of the scope of the study

Source: Özdemir (2023).

Every study faces limitations that may arise from factors such as sample size, methodology, or contextual constraints, and it is important to acknowledge these limitations. For example, the limitations of a study conducted by Özdemir (2023) are analyzed in Table 16, highlighting various issues such as methodology, sample size, contextual factors, and scope of the study. The qualitative nature of the research and its limitation to only eight students means that the findings cannot be generalized to a wider universe. Additionally, the focus of the study on a single course level prevents observations regarding the transferability of the results to subsequent levels or the development of the subjects over time. Additionally, since the course is delivered online, the lack of handwriting samples overlooks considerations of handwriting skills and paper layout. These limitations underscore the need for caution when interpreting the study results and suggest avenues for future research.

7. ADDITIONAL TOPICS

7.1.Ethical Declaration

Ensuring ethical integrity is paramount in academic research. An ethical declaration affirms that the study was conducted in line with ethical standards, such as obtaining informed consent from participants (Resnik, 2015). The paper could include a statement confirming that all subjects gave informed consent and that the study received ethical approval from an institutional review board.

7.2.Conflict of Interest

Transparently reporting any potential conflicts of interest maintains the integrity of the research process (Thompson, 1993). Authors should disclose any affiliations, funding, or relationships that could be perceived as influencing the research outcome.

7.3.Funding and Sponsorship

Acknowledging the sources of funding ensures transparency and recognizes the contributions of sponsoring organizations (Moses & Dorsey, 2009). The authors could mention any grants or scholarships received during the study and the sponsors' role (if any) in the study's design, implementation, or reporting.

7.4.Copyright

Clarifying copyright issues ensures that the work is properly credited and that there are no legal implications for the reuse of the material (Rodrigues, 2013). Permissions should be duly obtained and cited in this section if the study incorporates copyrighted materials.

7.5.Acknowledgments

Thanking individuals or organizations that contributed to the study but are not included as authors is a common practice (Wager, 2011). Acknowledgments might include thanking research assistants, advisors, or any institutions that provided resources for the study.

8. WRITING REFERENCES

6.1 8.2. How to List References

Properly citing references is essential for establishing a research paper's credibility and acknowledging others' work (Nicholas & Watkinson, 2014). References should be listed in alphabetical order by the last name of the first author. Each entry should provide sufficient information for the reader to locate the source.

6.2 8.2. Formatting Styles (APA, MLA, Chicago, etc.)

Different disciplines and journals, such as APA, MLA, or Chicago, may require different citation styles. Each style has its rules for formatting references (American Psychological Association, 2020; Modern Language Association, 2021; The Chicago Manual of Style, 2017).

To reach different styles of writing, making citations, and referencing, you can use official websites of these styles.

APA Style Guideline: https://apastyle.apa.org/style-grammar-guidelines

Chicago Style Guideline: https://www.chicagomanualofstyle.org/tools_citationguide.html

MLA Style Guideline: https://style.mla.org/

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8 APPENDICES

APPENDIX 1

Checklist in a Cross-Table Format Covered Essential Aspects of a Research

Checklist Item	Quantitative Research	Qualitative Research	Mixed Methods Research
Planning and Design			
Define Research Question	✓	✓	✓
Identify Variables (if applicable)	✓		✓
Conduct Literature Review	✓	✓	✓
Develop Hypothesis (if applicable)	✓		✓
Choose Sampling Method	✓	✓	✓
Plan for Data Collection	✓	✓	✓
Ethical Approval	✓	✓	✓
Data Collection			
Select Instruments/Tools	✓	✓	✓
Data Gathering	✓	✓	✓
Pilot Test (if applicable)	✓	✓	✓
Data Analysis			
Code and Input Data	✓	✓	✓
Statistical Analysis	✓		✓
Thematic Analysis		✓	✓
Interpretation			
Compare Results to Hypotheses	✓		✓
Draw Conclusions	✓	✓	✓
Reporting and Dissemination			
Write Abstract	✓	✓	✓
Write Introduction	✓	✓	✓
Methodology Section	✓	✓	✓
Results Section	✓	✓	✓
Discussion Section	✓	✓	✓

Conclusion Section	✓	✓	✓
References in APA Format	✓	✓	✓
Peer Review	✓	✓	✓
Publish or Present Findings	✓	✓	✓

Note: The ✓ indicates that the checklist item is relevant to that particular research methodology.

APPENDIX 2

Common Mistakes Made by Authors in Quantitative Research

Common Mistakes in Quantitative Research	Explanation & Consequences
Poorly Defined Research Questions	Lack of focus makes it difficult to design an effective study and interpret results.
Inadequate Literature Review	Failing to understand prior research may result in redundancy or poor framing.
Incorrect Sample Size	Too small or too large a sample can compromise the validity and reliability of findings.
Sampling Bias	Non-random sampling can introduce bias, making the results non-generalizable.
Inadequate Instrumentation	Poorly designed tools can lead to inaccurate data collection.
Ignoring Assumptions of Tests	Failure to meet assumptions for statistical tests can invalidate results.
P-Hacking	Manipulating data or analysis until statistical significance is achieved compromises integrity.
Overuse of p-values	Relying solely on p-values ignores other important factors like effect size.
Overgeneralizing Results	Extending findings to populations not studied can be misleading.
Lack of Replicability	Failing to provide enough detail in the methodology makes it hard to replicate the study.
Confounding Variables Not Controlled	Ignored variables can affect the outcome, casting doubt on the results.
Data Dredging	Searching through data to find patterns post-hoc undermines hypothesis testing.
Misinterpreting Results	Incorrectly explaining statistical outcomes can mislead readers.
Poorly Structured Reporting	Inadequate or unclear presentation can make it hard for readers to understand findings.
Ignoring Ethical Guidelines	Ethical lapses can discredit the study and harm participants.
Inadequate Peer Review	Failing to properly review introduces the risk of publishing incorrect or misleading findings.

APPENDIX 3

Common Mistakes Made by Authors in Qualitative Research

Aspect	Common Mistakes in Qualitative Research
Research Question	- Too broad or vague
	- Lack of alignment with the methodology
Sampling	- Inadequate description of the sampling strategy
	- Overgeneralization from a small or non-representative sample
Data Collection	- Poorly constructed interview questions
	- Lack of triangulation to ensure validity
Data Analysis	- Insufficient depth in analysis
	- Neglecting to identify themes or patterns
Ethical Considerations	- Inadequate informed consent
	- Failure to protect participant anonymity
Interpretation	- Overgeneralizing findings
	- Ignoring negative cases or outliers
Reporting	- Lack of thick description
	- Inadequate citation of qualitative research methods

APPANDIX 4

Common Mistakes Made by Authors When Conducting Mixed-Method Research

Aspect	Common Mistakes in Mixed-Method Research
Research Design	- Lack of clear rationale for using a mixed-method approach
	- Inadequate integration of qualitative and quantitative data
Research Questions	- Inconsistencies between qualitative and quantitative questions
	- Overly complex or convoluted research questions
Sampling	- Inconsistent sampling methods for qualitative and quantitative components
	- Insufficient sample size for either method
Data Collection	- Using inappropriate instruments for one or both methods
	- Failure to pilot test instruments
Data Analysis	- Inadequate reconciliation of conflicting results
	- Failure to validate findings across methods
Ethical Considerations	- Inconsistencies in ethical considerations for qualitative and quantitative data
	- Failure to maintain confidentiality across methods
Interpretation and Reporting	- Biased emphasis on one method over the other
	- Inadequate integration in discussions and conclusions

APPENDIX 5

Comparing the Steps for Conducting Content Analysis as Suggested by Some Well-Known Researchers

Step	Creswell's Suggestions	Miles & Huberman's Suggestions	General Best Practices
Research Question	Clearly define the research question or hypothesis.	Formulate a clear research question.	Define the purpose and research questions.
Literature Review	Conduct a literature review for context.	Review literature for theoretical frame.	Conduct a literature review.
Sampling	Decide on sampling methods and sample size.	Choose sample setting and subjects.	Determine what will be your unit of analysis.
Design Framework	Develop a conceptual framework.	Develop a conceptual framework.	Design the coding scheme or use existing ones.
Data Collection	Collect textual data for analysis.	Gather data and prepare data files.	Gather the materials you intend to analyze.
Pilot Testing	Test coding scheme on a sample.	Pilot test for reliability.	Test the coding scheme for reliability.
Coding	Begin coding the data based on the coding scheme.	Code data and identify themes.	Systematically code the text/data.
Reliability and Validity	Check for coder reliability and validity.	Confirm inter-coder reliability.	Check and ensure reliability and validity.
Data Analysis	Analyze coded data.	Run preliminary analysis.	Conduct the statistical analyses of coded data.
Interpretation	Interpret the findings in the context of the research.	Develop and verify interpretations.	Interpret the data and draw conclusions.
Reporting	Write up findings, implications, and limitations.	Report findings and practical implications	Present the findings, discuss implications.
Peer Review	Seek external validation through peer review.	External audit for validation.	Seek feedback for validation.

MIXED METHODS DESIGNS

1. INTRODUCTION

1.1. Mixed Methods Research

Quantitative and qualitative research paradigms represent two different approaches to empirical research, but are not necessarily exclusive, and their principled combination has led to the emerging of the third research approach – mixed methods research.

Mixed methods research involves different combinations of qualitative and quantitative research either at the data collection or data analysis level (Dörnyei, 2007, p. 24). Its beginnings date back to the 1970s, when the concept of the 'triangulation' was introduced into social sciences from navigation and land surveying, where it refers to the method for determining the unfamiliar position of a certain spacial point through the measurement operations from two familiar points (Dörnyei, 2007, p. 43). Its purpose is to achieve a fuller understanding of the target phenomenon, by viewing it from different angles, as well as to verify one set of findings against the other, i.e. to validate one's conclusion by presenting converging results obtained through different methods (Dörnyei, 2007, p. 164).

1.2. Mixed Methods Theory Use

The theory use in mixed methods studies may include theory deductively, as in quantitative theory testing and verification, or inductively, as in an emerging qualitative theory or pattern. A social or health science theory may be used as a framework to be tested in either a quantitative or qualitative approach to the inquiry. Another way to think about theory in mixed methods research is as a theoretical lens or perspective to guide the study. Studies are beginning to emerge that employ mixed methods designs using a lens to study gender, race or ethnicity, disability, sexual orientation, and other bases of diversity (Mertens, 2003).

Historically speaking, the idea of using a theoretical lens in mixed methods research was mentioned by Greene and Caracelli (1997). They identified the use of a transformative design as a distinct form of mixed methods research. This design gave primacy to value-based, action-oriented research, such as in participatory action research, and empowerment approaches. In this design, they suggested mixing the value commitments of different traditions (e.g. bias-free from quantitative, and bias-laden from qualitative), the use of diverse methods, and a focus on action and solutions. The implementation of these ideas in the practice of mixed methods research has been carried forward by other authors.

1.3. Mixed Methods Research Questions and Hypotheses

Speaking about methods, researchers typically do not see specific questions or hypotheses especially tailored to mixed methods research. However, there is an ongoing discussion about the use of mixed methods questions in studies, and also about the design of a mixed methods study (Creswell et al., 2007; Tashakkori & Creswell, 2007).

A strong mixed methods study should start with a mixed methods research question so as to shape the methods, and the overall design of a study. As a mixed methods study relies on neither quantitative or qualitative research alone, some combination of the two provides the best information for the research questions and hypotheses. To be considered are what types

of questions should be presented, as well as when, and what information is the most needed to convey the nature of the study:

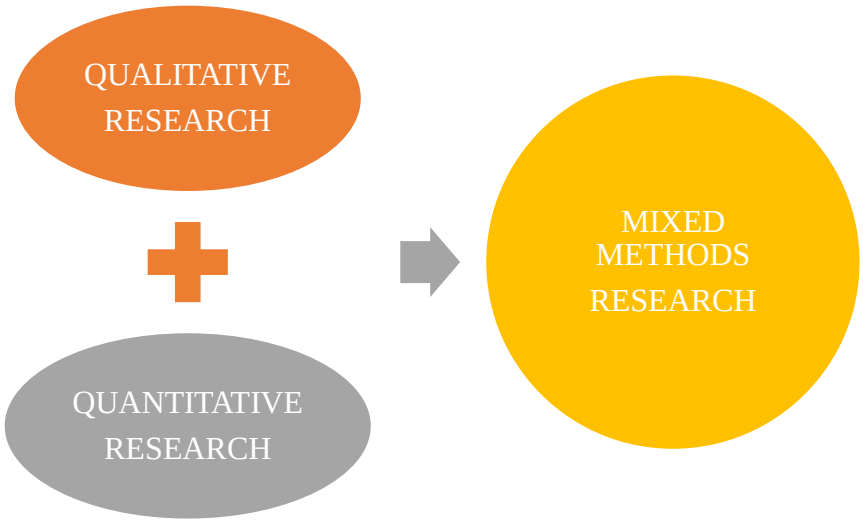
- both qualitative and quantitative research questions (or hypotheses) need to be asked in a mixed methods study in order to narrow and focus the purpose statement. These questions or hypotheses can be asked at the beginning or when they emerge during a later phase of the research. For example, if the study begins with a quantitative phase, the investigator might introduce hypotheses. Later in the study, when the qualitative phase is addressed, the qualitative research questions would appear.
- some attention should be given to the order of the research questions and hypotheses. In a two-phase project, the first-phase questions would come first, followed by the second-phase questions so that readers can see them in the order in which they will be addressed in the proposed study. In a single-phase strategy of inquiry, the questions might be ordered according to the method that is attached the greatest importance in the design.
- a mixed methods research question that directly addresses the mixing of the quantitative and qualitative strands of the research should be included. This is the question that will be answered in the study based on the mixing (Creswell & Clark, 2007). This is a new form of questions in research methods, and Tashakkori and Creswell (2007) call it a 'hybrid' or 'integrated' question. This question could either be written at the beginning or when it emerges (for instance, in a two-phase study, in which one phase builds on the other, the mixed methods question might be placed in the discussion between the two phases). It can assume one of the two forms. The first one is to write it in a way that conveys the methods or procedures used in the study (e.g. Does the qualitative data help to explain the results from the initial quantitative phase of the study? (Creswell & Clark, 2007). The second form is to write it in a way that conveys the content of the study (e.g. Does the theme of social support help to explain why some students become bullies in schools? (Tashakkori & Creswell, 2007).

There are several different ways in which all types of research questions (i.e. quantitative, qualitative and mixed) can be written in a mixed methods study:

- write separate quantitative questions or hypotheses and qualitative questions. These could be written at the beginning of a study or when they appear if the study unfolds in stages or phases. With this approach, the emphasis is placed on the two approaches, and not on the mixed methods or integrative component of the study.
- write separate quantitative questions or hypotheses and qualitative questions and follow them with a mixed methods question. This highlights the importance of both the qualitative and quantitative phases of the study, as well as their combined strength and this is probably the ideal approach.
- write only a mixed methods question that reflects the procedures or the content (or write the mixed methods question in both the procedural and content-based approach), and do not include separate quantitative and qualitative questions. This approach would enhance the viewpoint that the study intends to lead to some integration or connection between the quantitative and qualitative phases of the study (i.e. the sum of both parts is greater than that of each single part).

2. MIXED METHODS RESEARCH DESIGNS

'Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g. use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration' (Johnson et al. 2007, p. 123).



Mixed methods research is gaining popularity in social sciences because it combines the strengths of both quantitative and qualitative research to address the complex social problems, which neither qualitative nor quantitative approaches on their own can properly address, while their combined use provides an expanded understanding of research problems (Creswell, 2009, p. 188). So, a mixed methods design is characterized by the combination of at least one qualitative and one quantitative research component (Schoonenboom & Johnson, 2017, p. 108).

Morse's Notation System

Morse (1991) established a commonly used mixed methods notation system, in which the components are marked as *qual* and *quan* (or QUAL and QUAN to emphasize primacy) for qualitative and quantitative research respectively. Plus (+) sign refers to the concurrent implementation of components, and arrow (→) refers to sequential implementation of components. To ensure the equity of both research traditions, each abbreviation contains the equal number of letters, i.e. four (Schoonenboom & Johnson, 2017, p. 108).

Characteristics of Mixed Methods Design Process

Several primary characteristics that should be considered during a mixed methods design process include as follows: the purpose of mixing, theoretical drive, timing, point of integration, typological use, and degree of complexity (Schoonenboom & Johnson, 2017, p. 109).

Purpose: the overall goal of a mixed methods design is to expand and strengthen the conclusions of a study, thus making a contribution to the existing literature. A mixed methods

research study should be of sufficient quality to answer the research questions, and achieve 'multiple validation legitimation' (Johnson & Christensen, 2017) by meeting the relevant combination of quantitative, qualitative and mixed methods validities in each research study. Based on an analysis of mixed methods designs, Green, Caracelli, and Graham (1989) proposed a classification of purposes, which is still popular, and includes as follows:

- triangulation – seeking convergence, corroboration, correspondence of results of different methods;
- complementarity – seeking elaboration, enhancement, illustration, clarification of the results from one method with the results from the other method;
- development – seeking to use the results of one method to help develop or inform the other method with regard to sampling, implementation, measurement decisions;
- initiation – seeking to discover the paradox and contradiction, new perspectives of frameworks, the recasting of questions and results from one method with questions or results from the other method;
- expansion – seeking to extend the breadth and range of inquiry by using different methods for different inquiry components (Schoonenboom & Johnson, 2017, p. 110).

It is important for a researcher to begin a study with at least one research question, and then carefully consider what the purposes of mixing are. One can use mixed methods to examine different aspects of a single research question, or one can use separate but related qualitative and quantitative research questions. Nevertheless, the mixing of methods, methodologies, and/or paradigms will help to answer the research questions, and make improvements over a more basic study design. Fuller and richer information will be obtained in a mixed methods study.

Theoretical drive: mixed methods research can have three different drives, as formulated by Johnson et al. (2007):

- qualitative dominant (or qualitatively driven) mixed methods research is the type of mixed research in which one relies on a qualitative view of the research process, while concurrently recognizing that the addition of quantitative data and approaches are likely to benefit the research project.
- quantitative dominant (or quantitatively driven) mixed methods research is the type of mixed research in which one relies on a quantitative view of the research process, while concurrently recognizing that the addition of qualitative data and approaches are likely to benefit the research project.
- the area around the center of the (qualitative-quantitative) continuum, i.e. equal status, is convenient for the person that self-identifies as a mixed methods researcher. This researcher takes as his or her starting point the logic and philosophy of mixed methods research. These mixed methods researchers are likely to believe that qualitative and quantitative data and approaches will add insights into most, if not all, research questions. The equal status research is most easily conducted when a research team is composed of qualitative, quantitative, and mixed methods researchers, who interact continually, and conduct a study to address one superordinate goal (Schoonenboom & Johnson, 2017, p. 113).

Timing: it has two aspects: simultaneity and dependence (Guest, 2013). Simultaneity forms the basis of the distinction between concurrent and sequential designs. In a sequential design, the quantitative component precedes the qualitative one, or vice versa. In a concurrent design, both components are executed (almost) simultaneously. In the notation of Morse (1991), concurrence is indicated by '+' between components (e.g. QUAL + quan), while sequentiality is indicated with '→' (QUAL → quan). It is possible to collect interview data and survey data of one inquiry simultaneously, and in that case, the research activities would be concurrent. It is also possible to conduct interviews after the survey data have been collected (or vice versa), and in that case, research activities are performed sequentially. The second aspect of timing is dependence. Two research components are dependent if the implementation of the second component depends on the results of data analysis in the first component. Two research components are independent if their implementation does not depend on the results of data analysis in the other component. A researcher can often choose whether to perform data analyses independently or not. A researcher can analyse interview data and questionnaire data of one inquiry independently, and in that case, the research activities would be independent. It is also possible to let the interview questions depend upon the outcomes of the analysis of the questionnaire data (or vice versa), and in that case, the research activities are performed dependently. It is up to the researcher to determine whether a concurrent-dependent design, a concurrent-independent design, a sequential-dependent design, or a sequential-independent design is needed to answer a particular research question or set of research questions in a given situation.

Point of integration: each true mixed methods study has at least one point of integration called the point of interface by Morse and Niehaus (2009) and Guest (2013), at which the qualitative and quantitative components are brought together. Having one or more points of integration is the distinguishing feature of a design based on multiple components. It is at this point that the components are 'mixed', and hence the label 'mixed methods designs'. The term 'mixing', however, is misleading as the components are not simply mixed, but have to be integrated very carefully. Determining where the point of integration will be, and how the results will be integrated, is an important, if not the most important, decision in the design of mixed methods research (Schoonenboom & Johnson, 2017, p. 115). Some primary ways of integrating the components are as follows:

- merging the two data sets,
- connecting from the analysis of one set of data to the collection of a second set of data,
- embedding one form of data within a larger design or procedure, and
- using a framework (theoretical or programme) to bind together the data sets (Creswell & Clark, 2011, p. 76).

Commonly Used Mixed Methods Designs

Creswell (2009) provides the explanation of six main, commonly used mixed methods designs, which include as follows:

Sequential Explanatory Design

It appeals to the researcher with strong quantitative inclination. Quantitative data collection and analysis are followed by qualitative data collection and analysis, which build on the results of the initial quantitative results. It is usually used when unexpected results arise from quantitative analyses, and qualitative data collection serves to examine the surprising results in more detail. It is easy to implement because the steps fall into separate stages, and therefore it is easy to describe and report.

Sequential Exploratory Design

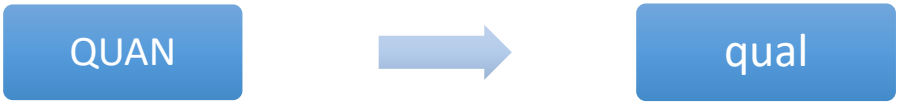
First, qualitative data are collected and analysed, followed by a quantitative data collection and analysis that builds on the results of the first, qualitative phase. Quantitative data and results help to interpret qualitative findings, but the aim is to initially explore a phenomenon. It is appropriate when testing elements of an emergent theory resulting from the qualitative phase, as well as to generalize findings to different samples, or when an instrument needs to be developed.

Sequential Transformative Design

It is a two-phase project, but with a theoretical lens such as gender or race overlaying the sequential procedures. The initial phase can be either qualitative or quantitative, and is followed by the second phase, also either qualitative or quantitative, which builds on the earlier phase. The theoretical lens shapes the research question aimed at exploring a problem and guides the study.

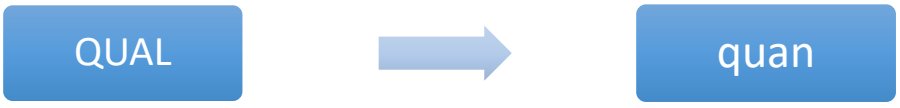
Sequential designs are visually presented in Figure 5.

Sequential Explanatory Design (a)



QUAN → QUAN → qual → qual → Interpretation
Data collection analysis Data analysis Data collection Data analysis of entire

Sequential Exploratory Design (b)



QUAL → QUAl → quan → quan → Interpretation
Data collection analysis Data analysis Data collection Data analysis of entire

Sequential Transformatory Design (c)

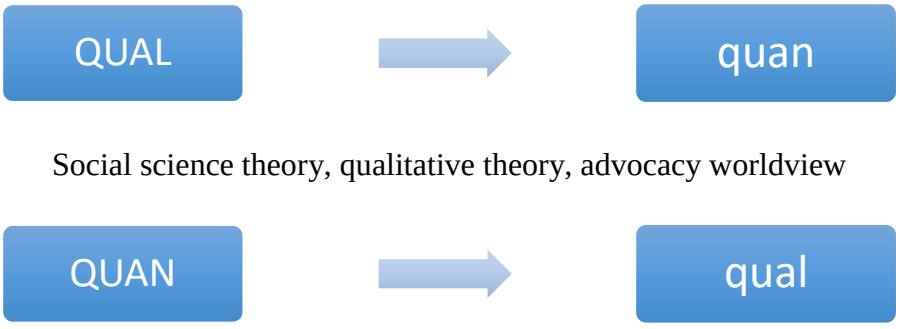


Figure 5. *Sequential Designs (Creswell, 2009)*

Concurrent Triangulation Design

The researcher collects both quantitative and qualitative data concurrently, and then compares the two databases to determine if there is a convergence, difference, or some combination of the two. This model generally uses separate quantitative and qualitative methods as a means to offset the weaknesses inherent within one method with the strengths of the other (or conversely, the strength of one adds to the strength of the other). The mixing during this approach, usually found in an interpretation or discussion section, is to actually merge the data (i.e. transform one type of data into the other type of data so that they can be compared easily) or integrate or compare the results of two databases side by side in a discussion. The concurrent data collection results in a shorter data collection time period as compared to the one of the sequential approaches because both the qualitative and quantitative data are gathered at the same time at the research site. This model also has a number of limitations. It requires great effort and expertise to adequately study a phenomenon with two separate methods. It can also be difficult to compare the results of two analyses using different forms of data.

Concurrent Embedded Design

Both qualitative and quantitative data are collected simultaneously, but this approach has a primary method that guides the project, and a secondary database that provides a supporting role in the procedures. Given less priority, the secondary method (qualitative or quantitative) is embedded or nested within the predominant method (qualitative or quantitative). The mixing of the data from the two methods is often done to integrate the information and compare one data source with the other, typically accomplished in the discussion section of a study. However, the data also may not be compared but reside side by side as two different pictures that provide an overall composite assessment of the problem. This would be the case when the researcher uses this approach to assess different research questions or different levels in an organization.

Concurrent Transformative Design

It is guided by the researcher's use of a specific theoretical perspective, as well as the concurrent collection of both quantitative and qualitative data. This perspective can be based on ideologies such as critical theory, advocacy, participatory research, or a conceptual or theoretical framework. This perspective is reflected in the purpose or research questions of the study. It is the driving force behind all methodological choices, such as defining the problem, identifying the design and data sources, analysing, interpreting, and reporting results. The choice of a concurrent model, whether it is triangulation or embedded design, is made to facilitate this perspective.

Concurrent designs are visually presented in Figure 6.

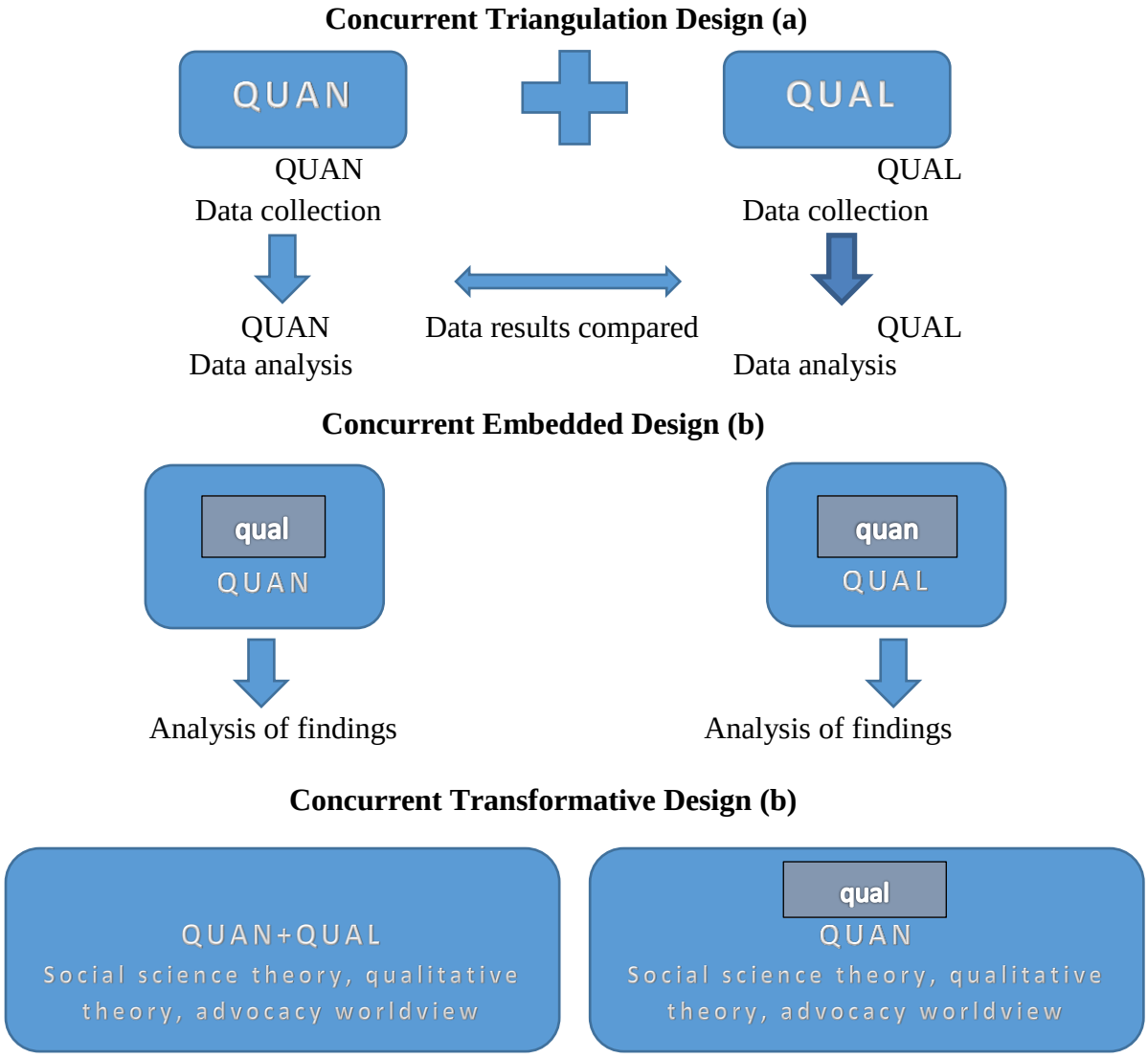


Figure 6. *Concurrent Designs (Creswell, 2009).*

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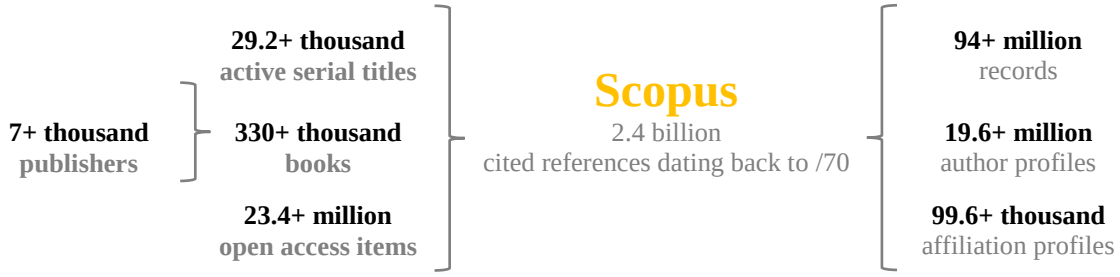
META ANALYSIS

9 Part I. Meta-Analysis fundamentals

This module is designed to equip you with the essential skills and knowledge needed to conduct and interpret meta-analysis, a powerful statistical tool for synthesizing research results across multiple studies. Throughout the module, you will learn about key concepts and methodologies that can be applied in various fields, including medicine, psychology, education and social sciences. By the end of this course, you will be able to critically evaluate meta-analytic literature, perform your own meta-analyses, and apply these techniques to increase the rigor and reliability of research. Whether you are a novice or experienced researcher, this course will provide you with information and tools to improve your understanding and practice of meta-analysis.

In 1976, Gene Glass introduced the term 'meta-analysis' to describe the statistical analysis of a comprehensive collection of research findings from individual studies. This process, which involves integrating the findings from a group of empirical studies focused on the same research question, calculates the average and variability of overall population effects (Field & Gillett, 2010; Glass, 1976; O'Rourke, 2007).

The growth of science depends on accumulating knowledge and building on the past work of others. As scientific development quickens and the amount of information in the literature continues to explode (for example, about 500,000 new articles are added to the National Library of Medicine's PubMed database each year), scientists need help to keep up with the latest research and recommended practices (Fig. 1).



Numbers shown are rounded and current as of December 2023. Scopus is updated daily.

FIGURE 1. SCOPUS (INFOGRAPHIC OF THE OVERWHELMING AMOUNT OF CURRENT KNOWLEDGE).

In the past, professionals depended on experts to summarize the literature and provide recommendations. However, over time, researchers started to examine the accuracy of these review articles and discovered that the evidence often did not support the recommendations. They began to promote a more scientific approach to reviews that did not rely on the subjective opinion of a single expert. This new approach required documented evidence to support claims and a systematic process conducted by a diverse team to ensure comprehensive review of all evidence. This process is now referred to as a systematic review.

9.1 Systematic Review

A systematic review involves a thorough analysis of a specific research question. It involves systematically identifying, selecting, evaluating, and synthesizing all relevant, high-quality research evidence to address the question. This process combines the results of multiple interconnected primary studies using methods that reduce biases and random errors. A well-conducted systematic review

provides high-quality evidence for clinical practice and is widely regarded as the standard for guiding clinical practice. (Yusuff, 2023).

A systematic literature review is an essential research method for evidence-based reasoning. It involves gathering information from multiple studies, which leads to a comprehensive understanding of a topic. Unlike a narrative review, a systematic review identifies the criteria for selecting articles and uses explicit and standardized search methods, providing the audience with enlightenment and information. This method is based on predetermined criteria and aims to help researchers choose studies and tools for developing articles with original information.

While systematic literature reviews are commonly used in medicine, they can be adapted for other research areas. However, researchers from other fields must follow relevant guidelines to ensure their studies effectively address research questions and meet their objectives. Conducting a systematic literature review in business fields like management, marketing, and information systems typically adheres to a standardized approach, albeit with some variations and adjustments. These steps are designed to yield the most pertinent findings for the research at hand.

A systematic review of research must be impartial and transparent in its methodology. The general principles that should underpin all systematic reviews are the following:

Transparency is critical in systematic literature reviews to ensure the accuracy of conclusions and the methodological approach. This transparency safeguards against misrepresentation by evaluating each research phase and clarifying its relevance and quality.

The initial framework of a systematic review is essential in guiding and maintaining the integrity of the process, keeping the focus on research objectives, and preventing the influence of literature characteristics on the procedure. An exhaustive search aims to uncover all relevant studies, reducing bias and simplifying access to research content. Thus, it ensures that a limited set of studies does not unduly influence conclusions.

Synthesizing search results leads to concise and accessible conclusions regarding the quality of research on a given topic.

The PRISMA flowchart in Fig. 4 gives the reader a better understanding of the review process. The overall goal of the coding procedure is to provide a comprehensive description of the studies considered and to obtain an overview of the study sample quickly. The coding sheet supports this procedure.

9.2 Assessing the quality of the sample is one of the phases in systematic literature reviews.

This assessment can be carried out using various approaches, such as the medicine case and the JBI (Joanna Bridge Institute) checklist. However, depending on the concrete objectives of the studies in question, this assessment is optional for some systematic literature reviews.

Systematic reviews employ a rigorous, scientific approach to thoroughly search for and assess all evidence using established and predetermined analytical methods (Committee on Standards, 2011). A systematic review involves a methodical literature search to consolidate information from various studies using a specific protocol to address a focused research question. The process aims to locate and utilize all accessible published and unpublished evidence, meticulously evaluate it, and present an objective summary to formulate sound recommendations. The synthesis can be qualitative or quantitative, but its defining characteristic is adherence to guidelines that allow for reproducibility.

The widespread adoption of systematic reviews has transformed the evaluation of practices and how practitioners acquire information about which interventions to employ. Table 1 outlines some critical distinctions between narrative and systematic reviews.

Table 1. *Key Differences Between Narrative And Systematic Review*

Narrative review	Systematic review
Broad overview of topic	Focus on well-formulated questions
Content experts	Multidisciplinary team
Not guided by a protocol	A priori defhed protocol
No systematic literature search	Comprehensive, reproducible literature search
Unspecified selection of studies	Comprehensive, reproducible literature search
No critical appraisal of studies	Quality assessment of individual studies
Formal quantitative synthesis unlikely	Meta-analysis often performed when data available
Conclusions based or opinion	Conclusions follow analytic plan and protocol
Direction for future research rarely given	States gaps in current evidence

Source: Schmid Et Al. (2020, P.2).

The concept of the modern systematic review can be traced back to a 1976 paper by Gene Glass in psychology. In this paper, Glass provided a quantitative summary of all the studies that evaluated the effectiveness of psychotherapy (Glass, 1976). He also introduced the term "meta-analysis" in educational psychology to describe the statistical analysis of an extensive collection of results from individual studies in order to integrate the findings (Cheung, 2015, p. 44). Today, systematic reviews are widely used across various scientific disciplines. In healthcare, however, "meta-analysis" primarily refers to quantitative data analysis from a systematic review. This means that systematic reviews without a quantitative analysis in healthcare are not typically labelled as meta-analyses, although this distinction still needs to be firmly established in other fields. We will maintain these distinct terms, using "meta-analysis" to denote the statistical analysis of data collected in a systematic review.

Systematic reviews generally involve six significant components: topic preparation, literature search, study screening, data extraction, analysis, and report preparation (Schmid et al., 2020). Each involves multiple steps, and a well-conducted review should carefully attend to all of them (Fig. 2.).

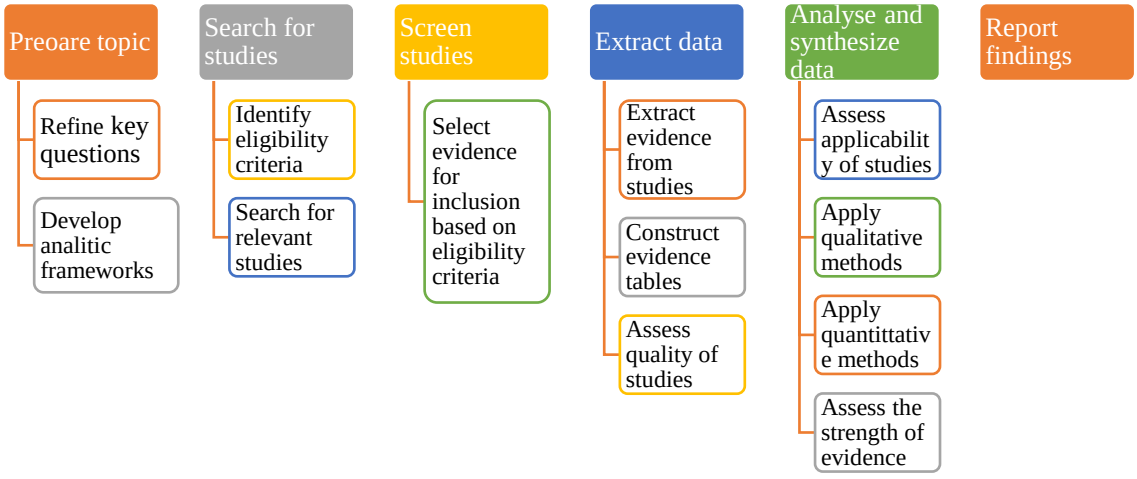


FIGURE 2. SYSTEMATIC REVIEW PIPELINE (WALLACE ET AL., 2013, P. 2)

9.3 Meta-Analysis

9.3.1 Definition and Purpose of Meta-Analysis

Meta-analysis is a widely accepted and collaborative method to synthesize research findings across various disciplines (Cheung & Vijayakumar, 2016). It is a fundamental tool that combines outcome data from individual trials to produce pooled effect estimates for different outcomes of interest. This process increases the sample size, improves the statistical power of the findings, and enhances the precision of the effect estimates. Synthesizing results across studies is crucial for understanding a problem and identifying sources of variation in outcomes, making it an essential part of the scientific process (Gurevitch et al., 2018). The reliability of the information presented relies on the calibre of the studies included and the thoroughness of the meta-analytical procedure. Some concerns have been expressed about the ultimate usefulness of such a complex and time-consuming procedure in establishing timely, valid evidence on various specified topics throughout the evolution of the current meta-analytic methodology (Papakostidis & Giannoudis, 2023).

Meta-analysis is a robust method for consolidating data from multiple studies to generate evidence on a specific topic. It is a statistical technique used to combine the findings of several studies (Gurevitch et al., 2018). However, there are various crucial considerations when interpreting the results of a meta-analysis.

Meta-analysis is a scientific research approach that objectively evaluates the literature on a given subject. As a collection of statistical methods for aggregating the effect sizes across different datasets addressing the same research question, meta-analysis provides a potent, informative, and unbiased set of tools for summarizing study results on the same topic. It offers several advantages over narrative reviews, vote counting, and combining probabilities (Table 1.). Meta-analysis is based on expressing the outcome of each study on a standard scale. This "effect size" outcome measure includes information on each study's sign and magnitude of an effect of interest. In many cases, the variance of this effect size can also be calculated (Koricheva et al., 2013).

Table 2. *Comparison Of Methods Of Research Synthesis*

Characteristics of the review type	Narrative review	Vote counting	Combining probabilities	Meta-analysis
İmposes restrictions on the type of studies that can be used in review	*no*	*no*	*no*	*yes*
İnterprets study outcome based on its statistical significance	*no*	*no*	*yes*	*no*
Considers sample size and statistical power of the individual studies being combined	*no*	*yes*	*yes*	*yes*
Assesses statistical significance of the mean (overall) effect (i.e., whether it is significantly different than zero)	*no*	*no*	*yes*	*yes*
Assesses the magnitude of the mean effect	*no*	*no*	*no*	*yes*
Allows analysis of source of variation among studies	*no*	*no*	*no*	*yes*

Source: Koricheva Et Al. (2013, P. 8).

Meta-analysis involves combining the findings of several studies to estimate a population parameter, usually an effect size, by calculating point and interval estimates. In addition, meta-analyses are important for identifying gaps in the literature, highlighting areas where more research is needed and areas where the answer is definitive, and no new studies of the same type are necessary. This aspect of meta-analysis helps keep the audience informed about the research landscape, guiding them towards areas that require further exploration.

Meta-analyses are fundamental tools of Evidence-Based Medicine (EBM) that synthesize outcome data from individual trials to produce pooled effect estimates for various outcomes of interest. Combining summary data from several studies increases the sample size, improving the statistical power and precision of the obtained effect estimates. Meta-analyses are considered to provide the best evidence to support clinical practice guidelines. The quality of the evidence presented relies on the calibre of the studies included and the thoroughness of the meta-analytic procedure. Some concerns about the usefulness of such a complex and time-consuming procedure in establishing timely, valid evidence on various specified topics have been expressed.

A systematic review is a consistent and reproducible qualitative process of identifying and appraising all relevant literature to a specific question. Meta-analysis takes this process further by using specific statistical techniques that allow for a quantitative pooling of data from studies identified through the systematic review process.

A meta-analysis can be carried out if the systematic review uncovers enough and suitable quantitative information from the summarised studies (Gurevitch et al., 2018).

Meta-analysis is now a popular statistical technique for synthesizing research findings in many disciplines, including educational, social, and medical sciences (Cheung, 2015). Google Scholar published more than 107,000 meta-analyses in 2022 alone (Irsova et al., 2023). Classical meta-analysis is aggregated person data meta-analysis, in which multiple studies are the analysis units. Compared to the original studies, the analysis of multiple studies has more power and reduces uncertainty. Following this, different meta-analysis approaches have been developed. Therefore, with prior knowledge of the differences between these approaches, it is clear which approach should be used for the data aggregation. For example, in the early days, different meta-analytic approaches used the aggregation of different types of effect sizes (e.g., d, r); today, the transformation of effect sizes is common (Kaufmann & Reips, 2024).

It's important to note that there are two distinct aggregation models in meta-analysis: the fixed and the random effects model. The fixed effects model operates under the assumption that all studies in the meta-analysis stem from the same population, and the true magnitude of an effect remains consistent across all studies. Therefore, any variance in the effect size is believed to be a result of differences within each study, such as sampling errors.

Unlike the fixed-effects model, the random-effects model supposes that effects on the population differ from one study to another.

The idea behind this assumption is that the observed studies are samples drawn from a universe of studies. Random effects models have two sources of variation in a given effect size: variation arising from within studies and from variation between studies.

Evidence from a meta-analysis is inherently associated with the quality of the primary studies. Meta-analyses based on low-quality primary studies tend to overestimate the treatment effect.

Consider this: Why should we conduct a meta-analysis instead of relying solely on leading experts' reviews or primary single-study investigations as sources of the best evidence? This question prompts us to delve deeper into the unique benefits and insights that meta-analysis can offer.

While meta-analysis presents numerous benefits, including increased precision, the ability to address new questions, and resolving conflicting claims, it's crucial to tread carefully. If not conducted with meticulous attention, meta-analyses can lead to misinterpretations, particularly if study designs, biases, variation across studies, and reporting biases are not thoroughly considered (Higgins et al., 2023).

Understanding the type of data resulting from measuring an outcome in a study and selecting appropriate effect measures for comparing intervention groups is of utmost importance. Most meta-analysis methods involve a weighted average of effect estimates from different studies, a decision that rests on the shoulders of the researcher.

Studies with no events provide no information about the risk ratio or odds ratio. The Peto method is considered less biased and more powerful for rare events. Heterogeneity across studies must be considered, although many reviews do not have enough studies to investigate its causes reliably. Random-effects meta-analyses address variability by assuming that the underlying effects are normally distributed, but it is essential to interpret their findings cautiously. Prediction intervals, which are a range of values that are likely to include the true effect, from random-effects meta-analyses help illustrate the extent of between-study variation.

Preparing a meta-analysis involves making numerous judgments. Among these, sensitivity analyses stand out as a crucial tool. They should meticulously examine whether overall findings are robust to potentially influential decisions, providing a reassuring layer of reliability and robustness to your research.

Preparing a meta-analysis requires many judgments. Sensitivity analyses, a crucial tool, should examine whether overall findings are robust to potentially influential decisions, ensuring the reliability and robustness of your research (Deeks et al., 2023).

Many leading journals feature review articles penned by experts on specific topics. While these narrative reviews are highly informative and comprehensive, they express the subjective views of the author(s), who may selectively use the literature to support personal views. Consequently, they are susceptible to numerous sources of bias, relegating them to the bottom of the level-of-evidence hierarchy. This underscores the critical importance of conducting high-quality meta-analyses, which can provide a more objective and comprehensive view of the available evidence.

In a marked departure from narrative reviews, systematic reviews and meta-analyses are meticulously designed to minimize bias. They achieve this by identifying, appraising, and synthesizing all relevant literature using a transparent and reproducible methodology. This rigorous approach ensures that the evidence obtained is the most reliable, establishing systematic reviews and meta-analyses as the gold standard at the pinnacle of the hierarchy of evidence.

However, given the massive production of flawed and unreliable synthesized evidence, a major overhaul is required to generate future meta-analyses. The quality of the chosen studies should receive strong attention, as should the consistency and transparency in conducting and reporting the meta-analysis process.

Conducting a meta-analysis properly involves combining data from multiple individual studies, ideally randomized control trials, to calculate combined effect estimates for different outcomes of interest. This is particularly useful for reconciling conflicting results from the primary studies and obtaining a

single pooled effect estimate that is thought to represent the best current evidence for clinical practice. Moreover, through significantly expanding the sample size, meta-analyses enhance the statistical strength of their results and, ultimately, offer more accurate effect assessments.

Meta-analyses can be classified as cumulative/retrospective or prospective. The predominant approach in the literature is cumulative. However, in a prospective meta-analysis (PMA), study selection criteria, hypotheses, and analyses are established before the results from studies pertaining to the PMA research question are available. This approach reduces many of the issues associated with a traditional (retrospective) meta-analysis (Seidler et al., 2019).

The results of a meta-analysis are presented graphically in a forest plot (see Fig. 5). A forest plot would display the effect size estimates and confidence intervals for every study included in the meta-analysis. The meta-analysis should also assess the heterogeneity of the included studies. Commonly, heterogeneity is assessed using statistical tests. The x2 and I2 tests are commonly used. A x2 test with a P-value of > 0.05 or I2 greater than 75% indicates significant heterogeneity. In conducting a meta-analysis, you can utilize either a fixed effect model or a random effect model. If there is no heterogeneity, a fixed effect model is utilized; otherwise, a random effect model is applied. An assessment of publication bias is also required to check that positive, significant, or small studies do not influence the results. Results are displayed graphically in a funnel plot (see Fig. 5), recommended where more than ten studies have been included in the meta-analysis (Yusuff, 2023).

Despite the ongoing methodological deficits in currently published meta-analyses, there is a clear path to improvement. When conducted in adherence to strict and transparent rules, systematic reviews and meta-analyses can ensure the reproducibility and robustness of the search process, the reliability and validity of their findings, and the clarity of reporting.

The meta-analysis process involves a thorough approach, considering all potential influences on the results. For example, the random-effects model assumes that the true effect estimate varies among the primary studies due to differences in their clinical characteristics. This model's combined effect size estimate represents an average estimate of all the individual study estimates. Choosing the right statistical model for combining data is a complex decision that hinges on the degree of variation between studies. However, there are no clear thresholds regarding the amount of variation that would determine which model to use.

Moreover, the statistical tests for variation often need more power to detect significant differences. The fixed-effects model is generally used when there is no variation in a meta-analysis, especially when many studies with large sample sizes are included. In such cases, there is confidence in the ability of the variation test to detect significant differences. Results from this model usually have narrower confidence intervals. On the other hand, when there are concerns about variation, the random-effects model is considered a better choice. It generates wider confidence intervals around the estimates and is a more conservative option for the analysis. In a meta-analysis with a large number of studies and adequate sample sizes, where statistical variation is not detected, using the fixed-effects model is justified (Papakostidis & Giannoudis, 2023).

Finally, the quality of evidence obtained through a meta-analysis should be evaluated using one of three tools: GRADE (Grading of Recommendations Assessment, Development and Evaluation)[1], PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis)[2] or AMSTAR (A

[1] https://www.gradeworkinggroup.org/
[2] https://www.prisma-statement.org/

Measurement Tool to Assess systematic Reviews)[3]. All these tools assess confidence in the effect estimate for each specific outcome of interest. Its use significantly enhances the strength and dependability of the findings, offering researchers assurance about the quality of their research. Therefore, they are a crucial component of meta-analysis that should be considered.

Even though meta-analyses, particularly those based on high-quality RCTs, are regarded to provide the best evidence, the problem of inconclusiveness of a meta-analysis is not associated to a potentially diminished methodological quality or lack of adherence to the accepted standards of conducting and reporting a proper meta-analysis. The problem is that the majority of systematic reviews are flawed, misleading, redundant, useless or all of the above (Ioannidis, 2017).

Papakostidis and Giannoudis (2023) point out that innovative types of systematic reviews and meta-analyses (some of them stemming from older ideas) are likely to witness a renowned interest soon in the hope of achieving a more reliable evidence synthesis. There are four types of such innovative meta-analyses:

- Prospective meta-analysis, a method based on designing prospective trials with a predefined purpose, offers a promising approach. When these trials are completed, they can serve as primary studies for a meta-analysis. This method can address a wide range of research questions, from focused clinical inquiries to comprehensive research agendas, demonstrating its versatility and potential impact. This adaptability can inspire the audience about the wide range of applications of this method.
- Meta-analysis of individual participants' data, while offering a more robust approach to handling confounders and formulating new hypotheses, presents its challenges. These include potential time constraints and logistical complexities. Moreover, the risk of selective reporting bias should be seriously considered, underscoring the need for meticulous planning and execution. This awareness of the challenges can make the audience feel prepared and cautious.
- Network meta-analyses allow the analytic process to be extended to more than two treatment groups, utilizing direct and indirect comparisons between them. This approach not only provides a more comprehensive understanding of the treatment landscape but also allows for the comparison of treatments that have not been directly compared in individual studies. Although most of them are based on already published data, they can still build on prospective meta-analytic designs or individual-level data.
- Umbrella meta-analyses, which synthesize evidence from all relevant systematic reviews and meta-analyses on a specific topic, constitute an attractive way to distil and translate large amounts of evidence.

9.3.2 Meta-Analysis Fundamentals

Meta-analysis is a statistical approach widely used in the research community to combine data from multiple studies. Its primary purpose is to provide a comprehensive understanding of a particular phenomenon by identifying patterns, trends, and inconsistencies that may need to be apparent in individual studies. Meta-analysis is advantageous in reconciling contradictory findings from different studies and increasing statistical power. However, it is essential to recognize the potential biases associated with meta-analysis, such as publication bias and the quality of included studies. Rigorous planning and execution of several vital steps are required to conduct a reliable meta-analysis. There are various meta-analysis methods, each with unique strengths and limitations. Lastly, it is crucial to

[3] https://amstar.ca/index.php

report the results of a meta-analysis transparently and accurately to enhance interpretability and reproducibility, contributing to the advancement of knowledge in respective fields.

Based on the query about meta-analysis fundamentals, here is a summary based on the relevant abstracts:

- Definition: Meta-analysis is a statistical technique that combines the results of multiple primary studies to calculate point and interval estimates of a population parameter, usually an effect size.
- Applications: This versatile statistical technique finds use in a multitude of fields, from psychology to international business, from medicine to clinical research, providing a quantitative synthesis of literature and estimating summary effect sizes.
- Methodology: Proper methodology application is crucial, including bibliographical search, appropriate study combination, and correct result representation to ensure validity.
- Challenges: Issues such as heterogeneity of primary studies, publication bias, and interpretation difficulties are fundamental aspects that need to be addressed for the internal validity of meta-analyses.
- Teaching and Guidance: The complexity of meta-analysis necessitates the availability of guidelines and practical examples to improve the quality of published meta-analyses, making it achievable for junior researchers and clinicians with expert guidance.

In conclusion, the fundamentals of meta-analysis encompass its definition, applications, methodology, challenges, and available guidance for conducting high-quality research. However, it is essential to note that while the abstracts provide a comprehensive understanding of meta-analysis fundamentals, they do not delve into advanced methods or specific statistical techniques for meta-analysis.

9.3.3 Importance of Meta-Analysis in Evidence-Based Research

Meta-analysis is a research synthesis method that involves reviewing primary research on a specific topic to integrate findings. This process is crucial to the scientific enterprise as it allows for properly evaluating evidence for different hypotheses and formulating generalizations. Research synthesis can be conducted qualitatively through narrative reviews or quantitatively using statistical methods to integrate results from individual studies (Koricheva et al., 2013).

Meta-analysis has had a transformative effect in many scientific fields, leading the way in establishing evidence-based practice. More importantly, it has been instrumental in resolving seemingly contradictory research outcomes, showcasing its problem-solving capability and revolutionary impact.

Meta-analysis is more than just a technique; it is a well-regarded and favoured approach for combining research results across different fields. It offers a comprehensive evaluation of a statistic's size based on current studies, thereby strengthening its reliability and significance.

9.3.4 Advantages and Disadvantages of Meta-Analysis

Pooling data from multiple studies increases the sample size and enhances the statistical power of the results and the accuracy of the calculated effect estimates. It is considered the most effective way to assess and examine the evidence for a specific issue, offering a high level of evidence and forming recommendations for clinical practice. However, the strength of the evidence provided depends closely on the quality of the studies included and the thoroughness of the meta-analytic process (Papakostidis & Giannoudis, 2023).

While meta-analysis has numerous advantages, it also has methodological weaknesses and potential difficulties in interpreting overall results. This underscores the need for readers to maintain a critical approach, fostering a sense of responsibility and diligence.

The field of meta-analysis is not without its ongoing debates and limitations, which continue to attract attention. These include issues such as publication bias and omitted variable bias, which are important to consider in the context of meta-analytic research.

Meta-analysis has many advantages over other research synthesis methods. Does this mean that meta-analysis is always preferred and that narrative reviews, combining probabilities, and vote-counting procedures must be abandoned altogether?

Among the various advantages, it is worth highlighting (Deeks et al., 2023; Koricheva et al., 2013):

- Meta-analysis provides a comprehensive literature assessment, offers a high level of evidence, and helps establish practice recommendations.
- Meta-analysis provides a more objective, informative, and powerful means of summarizing individual studies' results than narrative/qualitative reviews and vote counting.
- While the use of meta-analysis is on the rise, it is essential to note that understanding the method is valuable even if you are not planning to conduct your meta-analyses. This knowledge will enable researchers to follow and evaluate the literature in their field effectively.
- Applying meta-analysis to applied fields (e.g., conservation and environmental management) can make results more valuable for policymakers.
- Mastering the fundamentals of meta-analysis can significantly enhance the quality of data presentation in original research, making it possible to incorporate the findings into future research reviews.
- Conducting meta-analysis changes the way one reads and evaluates primary studies. It makes one acutely aware that the statistical significance of the results depends on statistical power and, in general, improves one's ability to evaluate evidence critically.
- To enhance precision: Many individual studies are too small to provide conclusive evidence about the effects of interventions. Precision is typically improved when estimates are based on a larger pool of data.
- Primary studies typically target specific participants and well-defined interventions to address questions beyond the scope of individual studies. Combining studies with varying characteristics allows us to explore the consistency of effects across a broader range of populations and interventions. This approach can also help identify reasons for differences in effect estimates.
- To resolve disputes from seemingly contradictory studies or to generate new hypotheses: Combining study results through statistical synthesis allows for a formal assessment of conflicting findings and exploration of reasons for varying results.

Meta-analysis alone or in combination with other research synthesis methods should be used whenever estimating the magnitude of an effect and understanding sources of variation in that effect is of interest and when at least some of the primary studies gathered provide sufficient data to carry out the analysis.

Emphasizing the importance of a critical approach, it becomes evident that it is crucial to identify deficiencies in methodology and interpret overall findings in meta-analyses. This approach addresses concerns about publication bias and the potential for erroneous findings when dissimilar studies with varying outcome data are included.

It is important to note some of its drawbacks, such as excluding low-quality studies. As an alternative to meta-analysis, "best evidence synthesis" would only consider reputable studies. The challenge here is determining the criteria for distinguishing between good and bad. It is advisable to include as many papers as possible and give importance to various aspects of study design based on the widely approved methodological practice. This allows to explore how different methods impact the estimated border effects. The impact factor of the publication vehicle and the number of citations each study receives must also be considered (Havranek & Irsova, 2016).

Replicability in research is of the utmost importance, as it enables other researchers to verify the findings and build upon the existing knowledge. To enable other researchers to reproduce our analysis, utilize the approach of seeking out studies that assess the impact of borders. It is acceptable to omit certain studies if their results do not systematically differ from those in our analysis.

Studies reporting numerous estimates significantly influence the meta-analysis. When each estimate is given equal weight, the imbalanced nature of data in meta-analysis means that studies with numerous estimates dictate the results. One potential solution is the mixed-effects multilevel model, which assigns approximately equal weight to each study if the estimates within the study are highly correlated. However, this method introduces random effects at the study level, which may be correlated with explanatory variables.

Authors' preferred estimates should carry more weight. Studies examining the border effect typically present numerous estimates and often favour a subset of these estimates (many results are presented as robustness checks). While some authors explicitly state their preferences, it is only possible to determine the preferred estimates for some studies. Instead, a researcher must control for data and methodology, which should be more straightforward to code and must encompass most of the authors' desires, such as controlling for multilateral resistance (Havranek & Irsova, 2016).

It is important to note that individual estimates are only partially independent due to authors utilizing similar data. When conducting meta-analysis, it is crucial to consider that individual clinical trials can be largely independent, particularly in medical research. However, most economic dataset’s regression results and observations are not independent in economics. The dependence among observations is addressed by clustering the standard errors at the level of individual studies and datasets.

There are too many potential explanatory variables, and it needs to be clarified which ones should be included. With numerous aspects of study design, finding a theory that substantiates the inclusion of all of them is challenging. For instance, an option is to assign more weight to extensive studies published in reputable journals, but it needs to be evident why they should consistently report different results.

Meta-analysis compares dissimilar findings. In economics, meta-analysis examines heterogeneous estimates. Various estimates are produced using different methods, and it is necessary to account for differences in the design of primary studies. To enhance the comparability of the estimates in a dataset, choose only to include the results concerning the impact of specific common variables and exclude the extensive literature on the others.

Errors in data coding are inevitable. Compiling data for meta-analysis involves months of reading and coding the data. Do not use research assistants for this assignment because there is a risk of immediately moving to regression tables and coding the data without thoroughly reviewing the primary studies. However, it is impossible to eliminate errors; we can only minimize them by independently collecting, comparing, and correcting the datasets, ensuring the reliability of our research.

Publication bias undermines the validity of meta-analysis. Researchers may overestimate the mean reported effect size and not accurately represent the true effect size when they report estimates displaying a particular sign or statistical significance.

In conclusion, meta-analysis involves critical steps such as question definition, data collection, analysis, and reporting results. Defining the question is crucial in shaping the focus and direction of the research. While it offers high-level evidence and informs clinical practice, it also faces challenges related to methodological weaknesses, publication bias, and potential limitations in achieving its objectives. Despite these limitations, meta-analysis significantly contributes to evidence-based practice in healthcare by providing a comprehensive synthesis of available research.

9.3.5 The case of Internet-Based Meta Analysis Research

Online versus offline differences in meta-analysis data collection must be considered. Internet-based research can collect large data sets from a diverse world population. Therefore, it is necessary to describe the sample of participants in detail to verify whether this potential of Internet-based research is used and how.

Relevant sample information, therefore, includes which country and in which languages the study was carried out, the age of the participants, and whether only university students were considered to assess the heterogeneity and generalizability of the results (Kaufman, 2024).

Like meta-analyses on traditional studies, for meta-analyses on Internet-based research for study aggregation, it is necessary to collect the number of participants and effect sizes for the output variables of interest. Especially for Internet-based surveys, the number of participants who dropped out is a valuable effect size to consider in meta-analyses.

Ideally, the coding procedure is conducted by a team of experts in the research area who will meta-analyse and agree on the different codes. At least two coders are required for any subsequent calculation of intercoder reliability values.

Freelon's (2010, 2013) ReCal software is ideal for intercoder reliability estimation and provides a data set quality value for subsequent analysis [4]. ReCal comprises three separate modules, each designed to handle specific types of data, whether nominal, ordinal, or interval/ratio-level. and is based on an online survey requesting study coding sent to the first authors. This strategy saves time and increases reliability in future meta-analyses. Additionally, Kaufmann & Reips (2024) provide a survey model for meta-analyses (Univ. Konstanz) [5].

Text mining is a valuable support tool in the coding procedure of systematic reviews, as it can potentially increase the objectivity of the review process.

[4] https://ln.run/PEGc4
[5] https://acesse.dev/dDDv5

Before performing any data aggregation analysis, a data description must be provided first, typically summarized in a table.

Thus, the general steps to follow are:

- Identify the objectives and formulate the research question.
- Develop a protocol.
- Conduct a literature search.
- Define inclusion and exclusion criteria.
- Select articles according to the defined inclusion and exclusion criteria.
- Explore and interpret the selected articles.
- Analyse and report the results obtained.

10 Part II. Methods of Conducting a Meta-Analysis

10.1 Overviews of the Meta-Analyses Components and Steps

Globally, a meta-analysis starts by formulating the research questions. The research questions should be tested based on the published studies. The published studies need sufficient information to calculate the effect sizes, which is essential for a meta-analysis. Comprehensive inclusion and exclusion criteria are established to determine which studies qualify for inclusion in the meta-analysis. The data can undergo statistical analysis once the effect sizes and study characteristics are gathered. The subsequent step involves interpreting the results and preparing reports to share the findings (Cheung, 2015).

Conducting a meta-analysis entails predefined eligibility criteria, exposure variables, primary and secondary outcomes of interest, and an analysis plan. Proper indications and methodologies, minimizing bias risk, and avoiding misleading conclusions are important. Meta-analysis is acknowledged as the optimal approach for objectively assessing and studying the evidence pertaining to a specific issue, furnishing a high level of evidence and contributing to the advancement of knowledge.

Sen and Yildirim (2022) organize the mandatory process of a meta-analysis into the following steps:

- Formulating the Research Question and Team: The process begins with formulating a straightforward research question and assembling a research team.
- Designing and Executing a Search Strategy: A systematic search strategy is crucial to finding all available evidence from published and unpublished sources.
- Screening and Extracting Data: A decision should be made on selecting appropriate studies from the collected studies. Relevant studies are screened, and data is extracted from these studies.
- Critical Appraisal and Analysis: Quality control/sensitivity analyses should be conducted. Each study should be critically appraised for potential biases, and the evidence should be assessed and analysed.
- The effect size for the chosen studies must be determined and computed separately for each study.
- The data needs to be pooled, and it's important to compute a summary statistic as well as a confidence interval.
- Additional analyses (heterogeneity, publication bias) should be done.
- Moderator analyses for moderator variables should be performed.
- Interpret the results and draw conclusions (inferences) based on them.

- Reporting and Disseminating Findings: The steps mentioned above should be reported together with the meta-analysis findings.

Figure 3 depicts the beginning phase of developing a question and methodically searching for relevant studies in the primary literature (Part I), as well as the phase where you gather data from publications, conduct statistical analyses, and present and explain your findings (Part II).

Meta-analysis methods have advanced notably over the last few years (Irsova et al., 2023). Performing a meta-analysis is conceptually no different from an empirical study because sometimes statistical problems bog you down. However, researchers usually design a study with their statistical abilities in mind or follow an established design that allows them to replicate a standard analytic approach. The difference between a good and a bad empirical study often boils down to whether an interesting question is being asked and the quality and quantity of the data collected using an unbiased sampling technique. The same principles apply to meta-analysis, where recently developed techniques allow for solid conclusions even when facing challenges in the underlying empirical literature (Irsova et al., 2023).

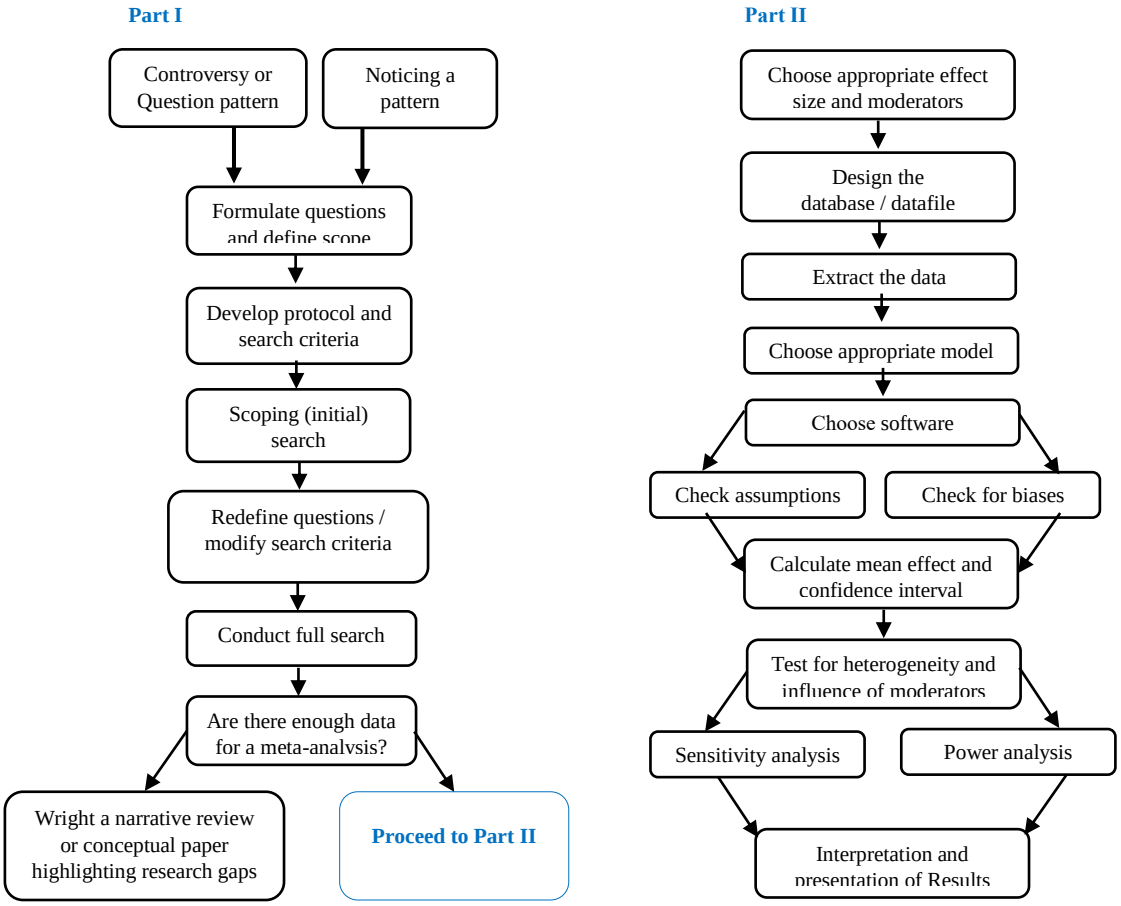


Figure 3. *Conducting A Meta-Analysis* (Koricheva et al., 2013, p. 16).

Despite the linear appearance of the process outline (Fig. 2), there is often uncertainty leading to certain steps being repeated. During Part I, the researcher may find it necessary to iterate through multiple cycles of scoping searches, adjusting study questions, and modifying the protocol and search criteria until confident that a comprehensive search will yield the desired results. A short description of what each step involves each step in the process.

10.1.1 Formulate Questions and Define Scope

When developing a research question for a systematic review or meta-analysis, it is important to ensure it is feasible, interesting, novel, ethical, and relevant. To examine a theoretical hypothesis, one must have studies that use experiments to test for causality (Tawfik et al., 2019). It is crucial to distinguish between studies reporting an observed relationship and those identifying relationships through experimental manipulation. Combine observational and experimental data to test a consistent relationship between variables. Consider the scope of generalization and the size of the data set you can handle. Focusing on questions within your area of expertise is helpful for more accessible research. The main questions typically revolve around the mean effect, differences from the null expectation, and explaining outcome variation among different studies. Group studies are based on the population studied, the methodology used, how the outcome is measured, and the comparison baseline. However, many moderators should be avoided, as it can lead to low statistical power. Lastly, it is crucial to be aware of confounded moderators and to decide how to address them in your analyses. This is not just a suggestion, but a responsibility that comes with conducting research. Being diligent in this aspect ensures the accuracy and validity of your research results.in your analyses, as this ensures the accuracy and validity of your research results (Koricheva et al., 2013).

10.1.2 Develop Protocol and Search Criteria

Once you have formulated your questions, you need to write up a protocol that will (1) formally specify the questions you intend to ask, (2) specify an objective search strategy, and (3) establish study inclusion criteria (Davis et al., 2021; Gurevitch et al., 2018; Koricheva et al., 2013).

Specifying the questions you intend to ask will include being specific about potential sources of heterogeneity in effect sizes (Côté & Jennions, 2013).

Specifying an objective search strategy entails not biasing data collection toward relevant papers that you are already familiar with; otherwise, this could affect the outcome as it is often easier to remember papers with significant results. Primarily, this involves making a list of which electronic databases you will search and what search terms you will use. Secondarily, an objective search strategy will involve a decision about how much effort to expend searching the "gray literature." For example, will you write to colleagues asking for unpublished data, and if so, who and why?

Once you have conducted a search and compiled a list of potential papers, you must establish study inclusion criteria. These criteria are often fairly obvious, and include the following:

a. Does the study fit the scope of your questions?
b. Does the methodology fit with how your question is defined?
c. If so, was it of sufficient magnitude or duration?
d. Does the study contain extractable data, that is, is there sufficient information to extract an effect size, its variance, and the sample size used?
e. Your inclusion criteria will sometimes have to consider study quality. This is far more difficult to assess than the criteria we have listed above, but it can be just as important.

It is worth noting, however, that as in primary research, your protocol for searching literature and extracting effect sizes will almost certainly be modified as you proceed. The reality is therefore that,

in many respects, your final protocol will end up describing what you did rather than what you ideally wanted to do. First, you must tell the reader how you collected your data. So, just as in primary research, you provide the reader with enough information on data collection and analysis to allow your review to be repeated and updated in the future. Second, you must have a protocol that forces you to evaluate continually whether your sampling is biased. A protocol increases the objectivity with which you compile data, but it should not blind you to the reality that the process of meta-analysis involves numerous subjective decisions; these are most apparent when trying to decipher the results of a given paper and deciding whether you can extract the necessary data for your synthesis (Côté & Jennions, 2013). If more than one person is collecting the data, a well-described and tested protocol is very important to ensure uniformity in data extraction and coding decisions about moderators.

10.1.3 Scoping: Refining Questions and Search Criteria; Selecting The Effect Size Measure

Sometimes, if you are confident that most studies will be confined to a few key sources, you might only search a limited set of journals. This was how almost all research syntheses were done before online databases. No one uses this approach anymore because of the explosion of data accessibility (at least for those with access to scientific journals). However, whether to delve into unpublished or "gray" sources remains important (Gurevitch et al., 2018; Koricheva et al., 2013).

Remember that during a scoping search, try to find only some studies or obtain a preliminary estimate of the mean effect. The main goals are to:

a. Consider estimating the amount of data available to help you make informed decisions about whether to expand or focus your study questions. This can really make a difference in your research.

b. Work out what factors vary among studies that you might encode as potential moderators.

c. Decide what criteria mark a study as irrelevant (e.g., if your search identifies 2000 papers to read in full, you will have to make some exclusion decisions based on the title, abstract, and place of publication);

d. Work out what criteria each potentially relevant study must fulfil before you try to extract an effect size.

e. Establish the format of your data extraction form/spreadsheet and

f. Decide upon the most suitable measures of outcome (effect sizes).

This last decision will often depend on whether data are reported as a relationship between two continuous variables, in which case the effect size r is the most popular choice in ecology and evolution. Alternatively, the decision may involve comparing two groups, in which case there is a range of options depending on whether the response variable is discrete or continuous. It is sometimes most straightforward to conduct separate meta-analyses, dividing studies based on the most appropriate effect size.

10.1.4 Conduct A Full Search

Conducting an initial search is a crucial step that validates the proposed concept, prevents duplication of previously discussed topics, and confirms an adequate number of articles for analysis. This process is not just a formality, but a significant contribution to the field (Tawfik et al., 2019).

Having established the protocol and scoping, the next step is a meticulous full search. It will generate numerous studies, but many will be discarded as irrelevant using criteria based on the study's title, abstract, or place of publication. The remaining 'potentially relevant' studies must be read more closely and divided into relevant and irrelevant. This process can lead to a significant reduction in the number of papers at each step. Be prepared for a large number (often the majority) of studies that you initially identify as relevant to be unsuitable for the meta-analysis. The final step is to extract the necessary information (effect sizes and moderators) from relevant papers. A finalized data spreadsheet is crucial, ensuring all the information you want to extract is included.

Understanding the trade-off between building up a pile of relevant papers and returning to them to extract effect size once you have a finalized data spreadsheet versus extracting data from a paper as you read it is essential. The advantage of the former is that you can be more confident that your spreadsheet contains all the information you want to extract. The latter's advantage is that you can read a paper in depth once.

Understanding exactly how a study was designed, and which relevant data are needed to extract an effect size can be surprisingly complex. Good notetaking is essential in this process and often no easier on a second reading. If you are confident that you have a good understanding of the main features of the relevant studies, you might consider designing a database and extracting data as soon as you classify a paper as relevant. The caveat, of course, is that you might still have to return to these papers if you later discover that you need to encode an additional moderator term or adjust your study inclusion criteria. Extracting information on the initial reading is most feasible when dealing with studies that closely follow a specific and commonplace experimental design.

Papakostidis and Giannoudis (2023) draw attention to the fact that, despite the last trend for quality improvement in recent years, methodological deficiencies have been found in currently published meta-analyses. Systematic reviews and meta-analyses should conform to strict and transparent rules, such as the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (see Fig. 4), ensuring the reproducibility and robustness of the search process, the reliability and validity of their findings and the clarity of reporting. These guidelines outline the basic steps to ensure all the requirements mentioned above are met, including the transparent reporting of the search strategy, study selection process, data extraction, and data synthesis:

1. A prospective study protocol is the cornerstone of a systematic review and meta-analysis. Its role in reducing bias and ensuring transparency cannot be overstated. This well-structured and succinct document should adequately describe all steps through the research process, including potential changes in the systematic review methodology. By doing so, it justifies these changes and prevents the introduction of bias in the selection of data for the review.

2. The search process is not just a step but the backbone of a systematic review and meta-analysis. Its robust and reproducible nature ensures the inclusion of all relevant data from eligible studies. This involves searching multiple electronic databases and reference lists, with databases like PubMed, EMBASE, or SCOPUS being essential. Additional databases such as Cochrane, Web of Science, and ProQuest should also be considered. It is also worth identifying potentially relevant grey literature by

searching conference proceedings' abstracts. However, inadequate search strategies and language restrictions can limit the number of eligible studies, introducing a significant amount of publication bias. This bias is even possible with the most comprehensive search strategy, as the failure to publish entire studies or all outcomes from a study is expected.

3. Internal validity of the primary studies: The term "internal validity" refers to the ability of a study to establish a reliable cause-and-effect relationship between a treatment and an outcome by limiting various confounders. It is a crucial aspect closely tied to the risk of bias and methodological quality of the included studies. Several tools have been developed to evaluate the risk of bias in primary studies, both for RCTs (randomized controlled trials) and observational studies.

4. The latest edition of the Cochrane Collaboration Risk-of-Bias tool (RoB-2)[6] provides a framework for assessing the risk of bias in the results of RCTs. It is structured into five domains of potential bias introduction into the study findings: (1) randomization process; (2) deviations of intended interventions; (3) missing outcome data; (4) measurement of the outcome; (5) selection of the reported results (Sterne et al., 2019). Within each bias domain, specific signalling questions aim to elicit information relevant to the risk of bias assessment[7]. The tool includes algorithms that map responses to these signalling questions onto a proposed risk-of-bias judgement for each domain. The possible risk-of-bias judgements are (1) Low risk of bias, (2) Some concerns, and (3) High risk of bias. The tool is depicted as a "traffic lights" display. The Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool outlines seven domains of potential bias occurrence (see Table 3): two in the "pre-intervention" phase, one in the "at intervention" phase, and four in the "post-intervention" phase.

5. Data Analysis and Reporting: While combining data from individual studies increases sample size and statistical power, it's crucial to explore the presence of statistical heterogeneity. This inconsistency in the treatment effect across the included studies can be misleading and reduce confidence in the conclusions. Quantifying the statistical heterogeneity is usually based on specific statistical tests (Higgins-I, Cochran Q-test). Authors of meta-analyses must explore the presence of statistical heterogeneity by adequately designing and performing sub-group and sensitivity analyses based on a priori hypotheses at the inception of the study protocol. Such hypotheses involve exploring the pooled analysis results into potentially more homogeneous data subsets (subgroups) based on, for example, clinical characteristics of samples, methodological issues, study design, and geographical origin of studies. Two different statistical models are used to produce combined effect estimates. The selection of the appropriate statistical model for pooling data depends on the presence of heterogeneity between the studies. However, there have not been defined clear cut-off values of the degree of heterogeneity that would dictate the selection of one model over the other. On the other hand, the statistical tests for heterogeneity are often underpowered for detecting significant heterogeneity:

a. The fixed-effects model assumes a single true effect size across all studies, represented by the pooled effect estimate. This model is typically used when there is no heterogeneity in a meta-analysis and when there are many studies with large sample sizes. In such cases, there is confidence that the test for heterogeneity is powerful enough to detect significant differences. The results obtained using this model tend to have narrower confidence intervals. If there are concerns about heterogeneity, the random-effects model (DerSimonian & Kacker, 2007) is considered a better choice. It

[6] https://methods.cochrane.org/bias/resources/rob-2-revised-cochrane-risk-bias-tool-randomized-trials
[7] See Table 1, in https://www.bmj.com/content/366/bmj.l4898.long

produces wider confidence intervals around the point estimates and is a more cautious option for the analysis. In the medical field, where the true effect is expected to vary across different populations, using the random effects model more frequently is more appropriate. The use of the fixed-effects model is reasonable in meta-analyses that include a sufficiently large number of studies with adequate sample sizes and where statistical heterogeneity has yet to be detected. Finally, the quality of the summarized evidence obtained from a meta-analysis should be evaluated using the transparent framework of the GRADE, AMSTAR or PRISMA tool (see Fig. 4). They assess the confidence in the effect estimate for each outcome of interest. Not using them in meta-analyses could result in a lack of transparency and potentially lead to misleading conclusions.

b. The random-effects model assumes that the actual effect estimate differs among the original studies because of differences in their clinical characteristics. Therefore, the combined effect size estimate generated based on this model represents an average estimate of all the individual studies' estimates.

c. Analysing the outcomes of a meta-analysis. It is essential to analyse the results of a meta-analysis, considering their significance. A statistically significant variance is not meaningful if it lacks relevance. Additionally, any difference can achieve statistical significance with a sufficiently large sample size. Conversely, when a non-significant overall effect estimate is calculated, it is essential to carefully assess whether what is considered relevant falls within the confidence interval of this estimate.

d. Validating the results is a significant step. Evidence centres such as the CEBM at Oxford University, a renowned institution in the field, develop important evaluation tools. They are instrumental in establishing the trustworthiness, scientific significance, and applicability of the collected evidence from a meta-analysis. With five key questions, CEBM is a reliable method to determine the validity of the study's findings.

Table 1. *Bias Domains Included In Robins-I*

Domain	Explanation
Pre-intervention	Risk of bias assessment is mainly distinct from assessments of randomised trials
Bias due to confounding	Baseline confounding occurs when one or more prognostic variables (factors that predict the outcome of interest) also predicts the intervention received at baseline. ROBINS-I can also address time-varying confounding, which occurs when individuals switch between the interventions being compared and when post-baseline prognostic factors affect the intervention received after baseline.
Bias in selection of participants into the study	When exclusion of some eligible participants, or the initial follow-up time of some participants, or some outcome events is related to both intervention and outcome, there will be an association between interventions and outcome even if the effects of the interventions are identical. This form of selection bias is distinct from confounding—A specific example is bias due to the inclusion of prevalent users, rather than new users, of an intervention.
At intervention	Risk of bias assessment is mainly distinct from assessments of randomised trials
Bias in classification of interventions	Bias introduced by either differential or non-differential misclassification of intervention status. Non-differential misclassification is unrelated to the outcome and will usually bias the estimated effect of intervention towards the null. Differential misclassification occurs when misclassification of intervention status is related to the outcome or the risk of the outcome and is likely to lead to bias.

Post-intervention	Risk of bias assessment has substantial overlap with assessments of randomised trials
Bias due to deviations from intended interventions	Bias that arises when there are systematic differences between experimental intervention and comparator groups in the care provided, which represent a deviation from the intended intervention(s). Assessment of bias in this domain will depend on the type of effect of interest (either the effect of assignment to intervention or the effect of starting and adhering to intervention).
Bias due to missing data	Bias that arises when later follow-up is missing for individuals initially included and followed (such as differential loss to follow-up that is affected by prognostic factors); bias due to exclusion of individuals with missing information about intervention status or other variables such as confounders.
Bias in measurement of outcomes	Bias introduced by either differential or non-differential errors in measurement of outcome data. Such bias can arise when outcome assessors are aware of intervention status, if different methods are used to assess outcomes in different intervention groups, or if measurement errors are related to intervention status or effects
Bias in selection of the reported result	Selective reporting of results in a way that depends on the findings and prevents the estimate from being included in a meta-analysis (or other synthesis)

Source: Sterne Et Al. (2019, P. 3).

10.1.5 Choosing Effect Measures and Computing Estimates of Effect

Higgins et al. (2023) consider four key points in this regard:

a. As review authors, researchers will likely encounter various outcome data types in your work. These include dichotomous, continuous, ordinal, count or rate, and time-to-event data. By familiarising these types, you can enhance your understanding of the research process and feel more empowered.

b. When comparing outcome data between two intervention groups ('effect measures'), there are many methods for each data type. Comparisons of binary outcomes can utilise a risk ratio, an odds ratio, a risk difference, or a number needed to treat. Continuous outcomes, on the other hand, can be compared using a mean difference or a standardised mean difference. This diversity of methods enriches researchers' comprehension of the research process.

c. Effect measures come in two types: ratio measures (risk ratio and odds ratio) or difference measures (such as mean difference and risk difference). Ratio measures are usually analysed using a logarithmic scale.

d. Information obtained from research reports might require conversion into a consistent or usable format for analysis.

10.1.6 Designing the Database/Datafile and Extracting Data

It is challenging to state the number of studies required for a meta-analysis. Factors affecting the decision may involve discipline-specific context, fixed or random-effects models used in the analysis, population values of effect sizes, and other considerations (Cheung & Vijayakumar, 2016). Designing a database is an art; a well-designed one can instil a sense of preparedness and confidence in you.

The basic rules are the same as those for an empirical study; you should ensure the datasheet contains all the information you need and is set out logically so that it is easy to complete and difficult to enter data in the wrong place. Use the most extended, most complicated-looking papers you have to trial test your datasheet. If it can handle them, you are off to a good start.

The main difference between an empirical study and a meta-analysis is that you must record which subjects you did and did not collect data from. In short, keep a bibliographic library of studies and

explain why some were excluded (e.g., irrelevant, missing critical information needed to satisfy inclusion criteria, not possible to extract an effect size and variance estimate).

A suitable protocol makes it relatively easy to encode information for study moderators. It provides a structured approach that simplifies the process, making it more manageable. In contrast, extracting effect sizes is among the most challenging parts of meta-analysis. It can lead to self-doubt, especially during your first meta-analysis. To extract effect sizes, you often must make subjective decisions. This process requires careful consideration and thoroughness to ensure the accuracy of your analysis.

Finally, have a protocol in place to deal with studies that report multiple effect sizes. Specifically, if treatment effects, which are the changes in the outcome of interest due to the treatment, are measured repeatedly over time, a structured approach will help you determine which comparisons you will use, providing a sense of guidance and control.

10.1.7 Literature Search and Study Selection

In conducting meta-analyses, it is imperative to possess a comprehensive comprehension of the subject matter. This may entail engaging in primary research, authoring an exhaustive narrative literature review, or demonstrating extensive pedagogical experience. Should the need for a co-author from the sub-field arise, it is essential to engage a collaborator with similar expertise. If a meta-analysis on the topic is extant, it is incumbent upon the researcher to substantiate the added value of their meta-analysis. This may hinge on factors such as the absence of accommodation for publication bias or heterogeneity in the original meta-analysis. The mere proliferation of new primary studies does not suffice as a justification (Irsova et al., 2023).

Furthermore, it is imperative to exhibit a substantial methodological advancement vis-à-vis the original meta-analysis. Superficial updates are best left as pedagogical exercises or the purview of artificial intelligence. Notwithstanding, exceptions to these guidelines may be warranted when significant advancements in research approaches and methodologies have cast doubt on the robustness of prior meta-analytic findings. Additionally, structural shifts within societies may have rendered previous effect sizes non-representative.

Based on your knowledge of the topic, assemble a list of five primary studies that you must include in the meta-analysis. You may enlist a large language model to ensure that you have selected the five most important studies. But be careful about relying too much on artificial intelligence since current models often provide factually incorrect results; always double-check and prioritise your expertise. Then, design your main search query using Google Scholar. We prefer Google Scholar to other databases because it includes all papers that have appeared online and allows you to go through the full text of papers, not just the title, abstract, and keywords. This flexibility in search query design empowers you to tailor your search to your specific needs. Using a single main query for a universal database makes it easier for other researchers to replicate your meta-analysis. Remember that Google Scholar's algorithms are subject to change, so depending on your topic, it might be beneficial to use an additional database to strengthen your approach. Use different combinations of the keywords employed in primary studies. You will know that your query is reasonably well prepared if the five most critical primary studies identified above are among the first hits. Spend several days fine-tuning the query (improving the percentage of highly relevant primary studies returned among the first 50 hits) and pay attention to the correct search syntax.

Fig. 4 describe PRISMA standard you can use to guide your search and selection as also report your results (Haddaway et al., 2022; Kaufmann & Reips, 2024).

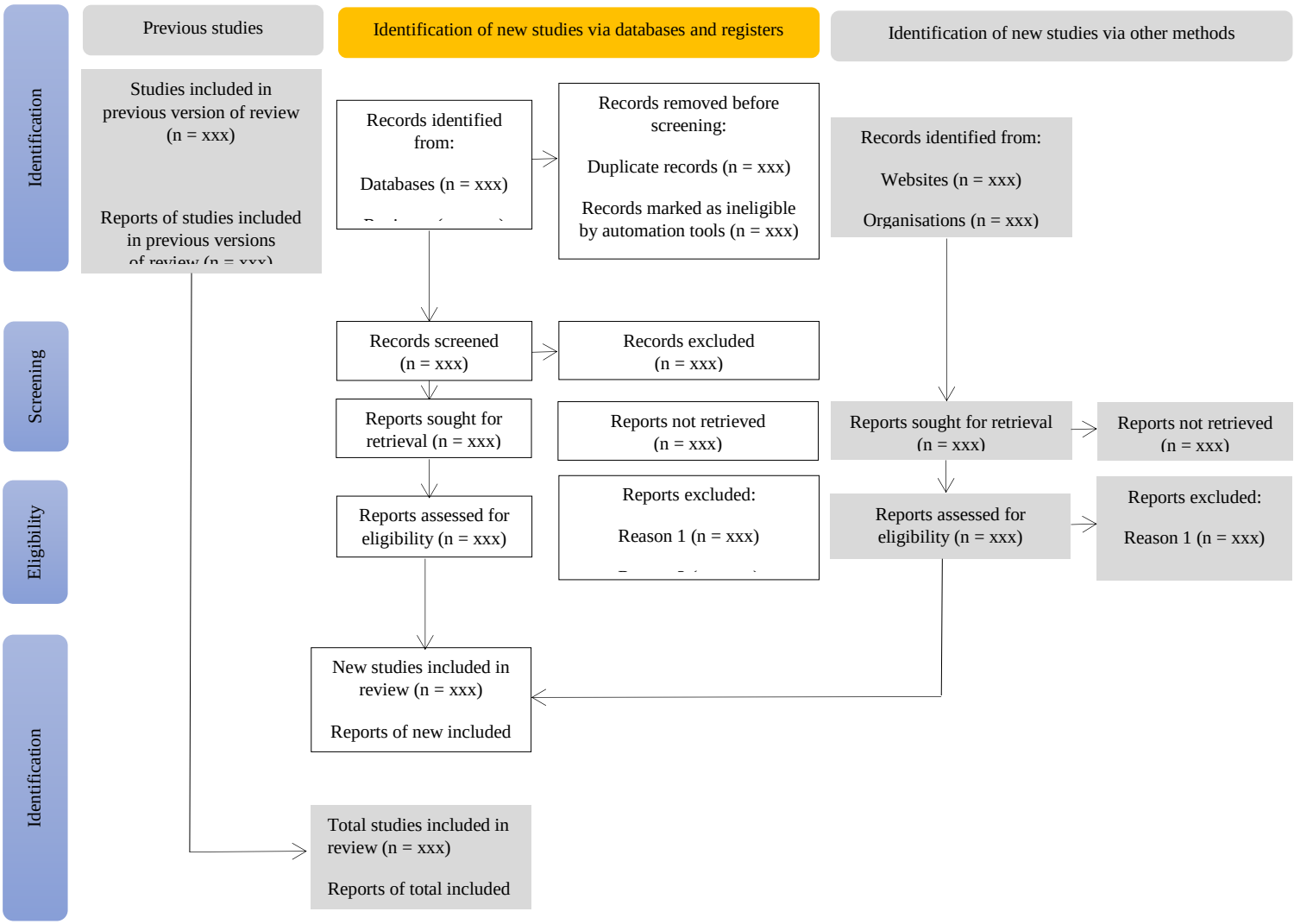


Figure 4. Prisma (Kaufmann, 2024, P.10-11; Haddaway Et Al., 2022, P.5).

10.1.8 Data Colletion

All co-authors must gather data for meta-analysis yourselves; it cannot be outsourced to research assistants. In the future, artificial intelligence (GPT 7?) will be capable of assisting with this time-consuming task. However, at present, there is no alternative to the authors of the meta-analysis, who, as specialists in the field, are uniquely qualified to meticulously review each primary study and methodically construct their dataset manually, one data point at a time (Irsova et al., 2023).

Unlike the authors of most econometric studies, meta-analysts do not take existing data but create new databases. Examples of meta-analysis datasets are available at https://www.meta-analysis.cz/.

At least two co-authors must gather the data independently. This rigorous process, while time-consuming, is crucial for ensuring the reliability of the meta-analysis. Mistakes can be expected when manually coding studies (which often consist of dozens of pages in PDF format) and having two experts collect the data allows for easy identification and correction of errors. The effect sizes gathered for meta-analysis should be comparable qualitatively and quantitatively. This means that not only

should the same estimated sign indicate an effect in the same direction, but it should also be meaningful to compare the actual sizes of the effects across primary studies.

Quantitatively comparable effect sizes include correlation coefficients, odd ratios, elasticities, dollar values, and standardised mean differences. Regression coefficients are generally only comparable quantitatively with further transformations because different primary studies can use different units of measurement or functional forms of the independent and dependent variables. An exception is represented by regressions in which variables on both sides are used in logarithms, and, therefore, the regression yields estimated elasticities.

Collecting all estimates reported in the primary studies is imperative. This approach is recommended for five reasons (Irsova et al., 2023):

1. It provides a comprehensive view, ensuring that no information is discarded, and eliminating the need for subjective judgment. This comprehensive approach to data collection gives the researchers confidence in the thoroughness of their analysis. You can always present a meta-analysis of the corresponding subsample of the dataset to give greater weight to the estimates preferred by the authors.
2. An exclusive analysis like this can confirm the strength of the results or establish a starting point. However, disregarding other estimates is unjustified even in the latter scenario.
3. When conducting original research, it is common to carry out extra verifications to guarantee the accuracy of the findings. Occasionally, the researchers themselves consider these findings to be less reliable. By incorporating all the findings, it is possible to assess whether the "inferior" results differ consistently from those favoured by the authors.
4. When conducting a best-practice meta-analysis, it is still appropriate to give greater weight to the authors' preferred results. At times, it is challenging to determine objectively which results favour the author. However, collecting and analysing all the findings can empower the researchers to make informed decisions without the need for subjective judgments.

Examining any outliers and influential points in your data is important. One method to do this is creating a funnel plot, a scatter plot of effect sizes and their precision. Suppose you notice data points that significantly deviate from the main funnel shape or raise concerns in DFBETA (a method for measuring the influence of individual data points on regression analysis)[8]. In that case, reviewing the primary studies associated with those data points is advisable. This review will help ensure that there are no errors in the data or the primary studies, and it may also reveal nuances in how the studies were conducted, making their results incomparable to the rest of the research literature. If there are still uncertainties, reaching out to the authors of the primary studies can provide clarity. It is crucial to address any influential or leverage points identified by DFBETA, as they can heavily impact the results of your meta-analysis. This may involve correcting or excluding these points as a last resort. Additionally, it is not just recommended, it's essential that robustness checks be reported to show the impact of removing outliers or employing winsorization (replace observations above and below a certain centile with the value of that centile) on the data (Zigraiova et al., 2020). Ultimately, your results should be driven by reliable and influential research findings, and if this is the case, the prominence of these findings should be justified in detail.

Finally, ensure that apart from effect sizes and standard errors, you also gather information on significant differences in the context where the estimated effect sizes were obtained. Most meta-analyses should gather at least ten variables (often dummy binary variables which take the value 0 or 1) reflecting differences in data, methods, and publication characteristics. Depending on the size and

[8] See https://blogs.sas.com/content/iml/2019/06/17/influence-regression-dfbeta.html

complexity of the database, more variables may be needed, but it is advisable to keep the number below 30 for simplicity. For instance, consider if the primary study's experiment focuses on a representative sample of the population or only on a specific group, the country where it was conducted, whether a placebo or an alternative treatment was assigned to the control group, publication date, impact factor of the outlet, and the number of yearly citations received.

Before collecting data, prepare a list of variables to code carefully. This can be the most challenging and creative part of a meta-analysis. The number of potential variables is nearly unlimited, so selecting the most important ones is essential based on discussions in the literature and your expertise. A comprehensive language model can help identify some of the dimensions in which primary studies vary. However, it's crucial to remember that double-checking is vital as artificial intelligence can sometimes provide misleading results. This caution and attention to detail will ensure the accuracy of your meta-analysis.

Consider including additional information that complements what you collect from primary studies. This comprehensive approach, which goes beyond the primary studies, can provide a more thorough understanding of the research context. For example, if the primary studies were conducted in various countries, including country (or region) characteristics might be valuable as additional variables. Experiment results can be influenced by factors such as temperature, humidity, or the country's financial development, which might be impossible to analyse by individual primary studies alone. By considering and including such additional information, your meta-analysis can be more comprehensive and insightful (Irsova et al., 2023).

10.1.9 Effect Size Estimation

Mastering the art of meta-analysis may seem straightforward, but achieving excellence in this field is truly challenging. Determining effect sizes is one of the most daunting aspects of conducting a meta-analysis.

The first step in a meta-analysis involves systematic literature review and data extraction. Researchers use database searches, reference lists, and expert consultations to identify relevant studies. Inclusion and exclusion criteria are applied to ensure that only studies addressing the research question and meeting quality standards are included.

By combining data from various sources, meta-analysis can increase statistical power, provide more precise estimates of effect sizes, and identify patterns or moderators across studies. This essay explores the quantitative methods used in meta-analysis, including data collection, effect size estimation, model selection, and assessment of heterogeneity (Haddaway et al., 2022).

The focus of any meta-analysis is the effect size, which measures the strength of how one variable or group of variables influences another. Effect sizes are crucial for understanding the impact of experimental treatments or the relationship between variables in nonexperimental studies. However, calculating effect sizes can be challenging due to the wide range of research designs and the inadequate reporting of statistical information in primary research reports. The d and r measures are commonly used and practical for calculating effect sizes, providing researchers with valuable tools for meta-analysis.

Once relevant studies are identified, extracting and standardizing effect sizes is next. The effect size is a numerical measure that indicates the strength of the experimental outcome. Common effect size metrics include:

a. Cohen's d: Measures the difference between two means divided by the pooled standard deviation.
b. Odds Ratio (OR): Used in binary outcomes to measure the odds of an event occurring in one group compared to another.
c. Correlation Coefficient (r): Analyse the intensity and orientation of the connection between two variables.

Standardization of effect sizes is crucial because it allows combining results from studies that use different scales or outcome measures.

10.1.10 Model Selection: Fixed-Effect vs. Random-Effects Models

Please remember that There are two distinct aggregation models: fixed effects and random effects models. The fixed effects model presupposes that all studies in the meta-analysis come from the same population and that the true effect size remains consistent across all studies. Thus, the variation in effect size is presumed to stem from differences within each study, such as sampling error. In contrast, the random effects model is more intricate, if the effects on the population vary from study to study. This assumption is based on the idea that the observed studies are a selection of samples drawn from a broader universe of studies. Random effects models encompass two sources of variation in a given effect size: within and between studies. (Kaufmann & Reips, 2024).

When conducting meta-analyses, effect sizes are combined using either fixed-effect or random-effects models. The choice to utilize one of these models relies on the assumption about the distribution of the effect sizes:

a. Fixed-Effect Model: This model assumes that all studies estimate the same true effect size and that observed variations are due to sampling error alone. It gives more weight to more extensive studies and is appropriate when studies are very similar regarding participants, interventions, and outcomes.
b. Random-Effects Model: This model assumes that effect sizes vary across studies due to both within-study sampling error and between-study heterogeneity. It incorporates an additional variance component, allowing for a more generalized inference about the effect size. The random effects model will likely produce a more cautious estimate, with a wider confidence interval, prompting a mindful approach to the results. However, the conclusions from the two models typically align when there is no heterogeneity. It is more appropriate when there is significant heterogeneity among the included studies.

10.1.11 Addressing Heterogeneity

Heterogeneity denotes the variation in effect sizes among studies. Assessing heterogeneity is a critical step in meta-analysis as it influences model choice and interpretation of results (Kepes et al., 2023).

Understanding and addressing heterogeneity in meta-analysis is essential for drawing accurate and generalizable conclusions. One key method for exploring the sources of heterogeneity is moderator analysis, which involves identifying variables that may influence the effect sizes observed in different studies. This approach explains why studies might yield different results and under what conditions specific effects are stronger or weaker.

Heterogeneity in meta-analysis can manifest in three ways: clinical heterogeneity, methodological heterogeneity, and statistical heterogeneity. Clinical heterogeneity involves variability in participants, interventions, and outcomes; methodological heterogeneity includes differences in study design, quality, and execution; and statistical heterogeneity refers to variability in effect sizes that cannot be attributed to chance alone.

10.1.12Conducting Moderator Analysis to Address Heterogeneity

Step 1: Identifying Potential Moderators

Potential moderators should be selected based on theoretical grounds, previous empirical findings, and practical relevance. These could include demographic characteristics (e.g., age, gender), methodological factors (e.g., study quality, sample size), or intervention specifics (e.g., dosage, duration).

Step 2: Coding Moderators

Systematically extract and code information about potential moderators from each study included in the meta-analysis. This involves creating a detailed coding sheet where each study is evaluated and assigned values for each moderator.

Step 3: Assessing Heterogeneity

Before conducting moderator analysis, it is essential to assess the presence and extent of heterogeneity in the effect sizes. This can be done using several statistical measures:

a. Cochran's Q Test: Assesses whether observed variability in effect sizes is greater than expected by chance. Q is the weighted sum of squares on a standardized scale. It is reported with a P value with low P-values indicating presence of heterogeneity. This test however is known to have low power to detect heterogeneity and it is suggested to use a value of 0.10 as a cut-off for significance. Conversely, Q has too much power as a test of heterogeneity if the number of studies is large. A significant Q test suggests the presence of heterogeneity.

b. I^2 Statistic: It is the percentage of observed total variation across studies that is due to real heterogeneity rather than chance. It is calculated as $I2 = 100\% \times (Q - df)/Q$, where Q is Cochran's heterogeneity statistic and df the degrees of freedom. Negative values of I2 are put equal to zero so that I2 lies between 0% and 100%. It measures the fraction of overall variation in effect sizes attributed to differences rather than random sampling errors. Values range from 0% (no heterogeneity) to 100% (substantial heterogeneity).

c. Tau-squared (τ^2): Estimates the variance of true effect sizes across studies in a random-effects model.

High heterogeneity may warrant subgroup analyses or meta-regression to explore potential moderators, such as study design, sample characteristics, or intervention specifics (Jak, 2015).

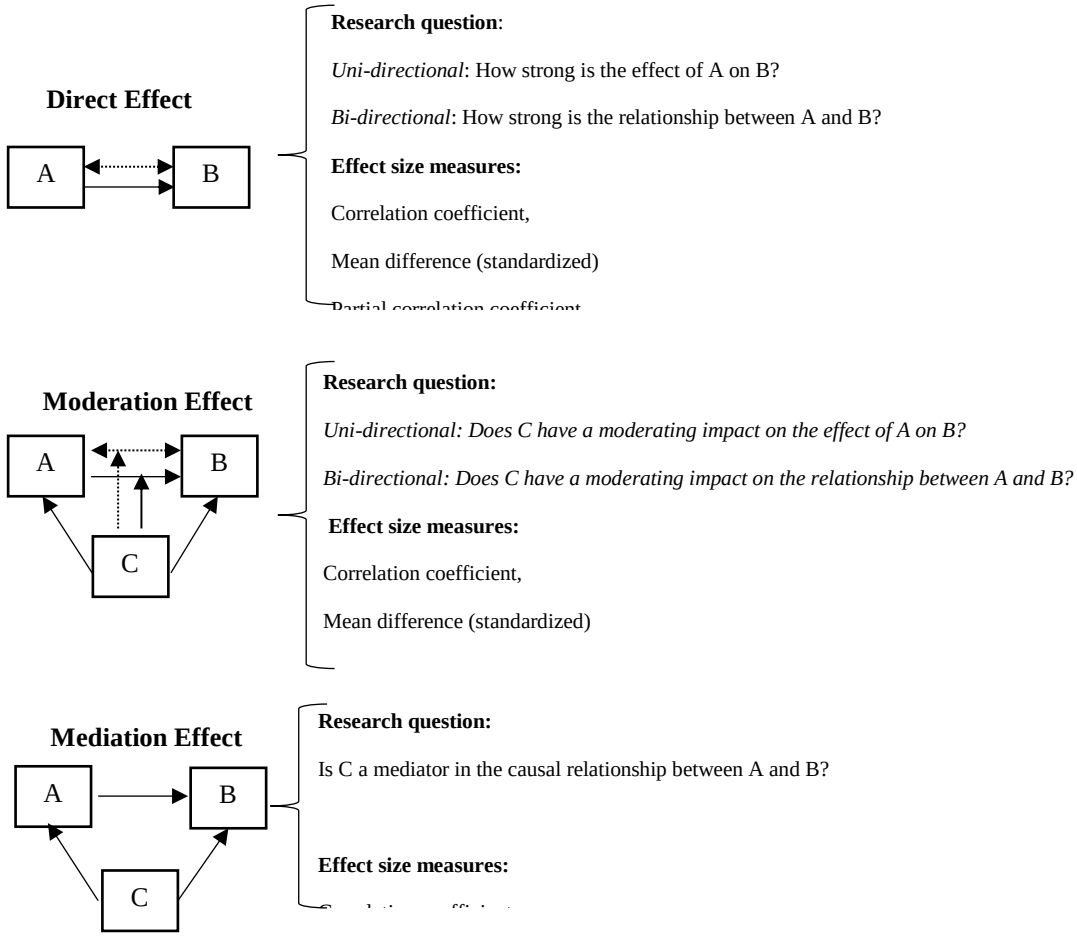


Figure 6. *Types of Research Questions and Appropriate Methods* (Hansen et al., 2022).

11 Part IV. Publication Bias and Quality Assessment

11.1 Content, Types and Sources

What are the potential biases associated with publication bias in meta-analyses?

Publication bias arises when studies with significant or positive results are more likely to be published than those with inconclusive or negative results, potentially distorting meta-analytical findings.

If a meta-analysis fails to use up-to-date methods, it can be as misleading as a good meta-analysis enlightens policymakers and researchers. A fundamental issue is publication selection bias and 'p-hacking ', which refers to manipulating data analysis until it produces statistically significant results, compromising the truthfulness of the findings. Out of the 107,000 meta-analyses published in 2022, more than half do not discuss publication bias at all. Because publication bias or p-hacking can easily exaggerate the typical reported effect size by two or more, meta-analyses that ignore publication bias may cause more harm than good (Irsova et al., 2023).

The exclusion of unpublished studies in systematic reviews may lead to the exclusion of critical evidence and result in biased, overly positive outcomes. This is a significant concern, as prior studies have suggested that meta-analyses that do not consider grey literature could overstate the effectiveness of interventions, potentially leading to misguided policies and ineffective interventions.

Numerous sophisticated methods with robust theoretical underpinnings have recently been developed for addressing publication selection bias. These approaches have been validated through extensive Monte Carlo simulations and are applicable in numerous studies. The Trim and Fill technique, Egger's regression test, and the Copas selection model are among these methods. Recent advancements also encompass the management of observed and unobserved systematic heterogeneity within the framework of model uncertainty and certain types of p-hacking[9]. Together, these method advances constitute essential steps forward in understanding and interpreting contemporary research.

When conducting a meta-analysis, it is crucial to consider various sources of Bias that can impact the study's conclusions. This thorough approach is essential to ensure the validity and reliability of the findings. The common sources of Bias to be mindful of include:

- *Selection Bias:* This can occur when studies or participants are not selected randomly, leading to a skewed population representation.
- *Reporting Bias*, also known as publication bias, arises when available results systematically differ from missing results, often favouring significant, positive outcomes.
- *Performance Bias and Detection Bias:* These biases can affect the *implementation* and outcomes of interventions in studies, influencing the results.
- *Attrition Bias:* This Bias occurs when there is a differential loss of participants from the study groups, potentially impacting the validity of the findings.
- *Omitted Variable Bias:* This Bias can lead to distorted average estimates in a meta-analysis, particularly when correcting for the wrong Bias.
- *Publication bias in meta-analyses* can introduce a range of potential biases, as demonstrated by the following insights from academic abstracts. These biases, which can significantly impact the validity and generalization of conclusions in the field, are a key research focus.
- *Publication Bias Influence:* The influence of publication bias on meta-analytic results is a critical issue that cannot be overstated. It can potentially suppress unfavourable studies, thereby biasing results towards artificially favourable outcomes, a concern that research must address.
- *Detection Methods:* Various statistical tests have been proposed to detect publication bias, but their effectiveness depends on their assumptions about the cause, leading to varying power across different scenarios. Although publication bias is acknowledged in meta-analyses, there is a pressing need for formal assessment and correction of its effects. Currently, only a small percentage of meta-analyses attempt to address publication bias, highlighting the urgency of this issue.
    - *Impact on Validity:* The prevalence of potential publication bias in meta-analyses, particularly in specific disciplines, raises concerns about the validity and generalization of conclusions.

[9] The manipulation of data analysis until it produces statistically significant results, compromising the truthfulness of the findings

- *Methodological Challenges:* Standard meta-analysis methods are vulnerable to bias from incomplete reporting of results and poor study quality, and there are no clear guidelines for assessing this bias.
- *Test Limitations:* Some tests for publication bias, such as Egger's test and weighted regression tests, may have inflated Type I error rates or low statistical power, especially in the presence of heteroscedasticity. The phenomenon happens when research studies with statistically significant findings are published more frequently than those with non-significant results. It is crucial to keep in mind that this could cause an overestimation of the actual effect size.

Following Harrer et al. (2021 and Page et al. (2021), it is important to understand that there are several other factors that can distort the evidence in our meta-analysis. These factors can have a significant impact and include:

- Citation bias occurs when studies with negative or inconclusive findings, even if published, are less likely to be referenced by other related literature. This can make it more challenging to identify these studies through reference searches.
- Time-lag bias: Studies with positive results are often published earlier than those with unfavourable findings. This means that findings of recently conducted studies with positive findings are often already available, while those with non-significant results are not.
- Multiple publication bias: The results of "successful" studies are more likely to be reported in several journal articles, which makes it easier to find at least one of them. The practice of reporting study findings across several articles is also known as "salami slicing."
- Language bias: In most disciplines, the primary language in which evidence is published is English. Publications in other languages are less likely to be detected, especially when the researchers need translation to understand the contents. The possibility of bias exists when studies in English systematically differ from those published in other languages.
- Outcome reporting bias: Many studies and experimental designs, in particular, measure more than one outcome of interest. Some scientists take advantage of this by only disclosing the results supporting their hypothesis and disregarding those not confirming it. This can also lead to bias: Technically speaking, the study has been published, but its (unfavourable) result will still be missing in our meta-analysis because it is not reported.

11.2 Addressing Publication Bias

It is important to note that while some degree of bias is nearly inevitable in studies, understanding these biases and their manifestations in study designs is crucial to mitigate their impact on the conclusions of a meta-analysis. Publication bias can distort meta-analyses by amplifying effects requiring identification and correction. To mitigate the influence of publication and reporting bias, as

well as questionable research practices (QRPs), various techniques can be employed in meta-analyses. These approaches encompass methods for study search as well as statistical methods.

a. *Study search:* If publication bias exists, this step is important because it means that a search of the published literature may yield data that is only partially representative of all the evidence. We can counteract this by searching for grey literature, including dissertations, preprints, government reports, or conference proceedings. Fortunately, pre-registration is also becoming more common in many disciplines. This makes it possible to search study registries for studies with unpublished data and ask the authors if they can provide data that has not been made public (yet). Grey literature search can be tedious and frustrating, but it is worthwhile. One large study has found that including grey and unpublished literature can help avoid overestimating the true effects.

b. *Statistical methods:* Statistical procedures can also examine the presence of publication. It is important to note that none of these methods can directly pinpoint publication bias. However, they can scrutinise particular properties of the data that might serve as potential indicators of its presence. Some methods can also quantify the true overall effect when correcting for publication bias.

11.2.1 Forest Plots

Forest plots, while not explicitly designed to identify publication bias, are commonly used in meta-analyses to visually present the individual study effect sizes and confidence intervals (AJE Team, 2023; Harrer et al., 2021)[10]. The role of forest plots in promoting transparency and reproducibility is significant, as they allow researchers to use the spread and distribution of the effect sizes to evaluate whether there is a shortage of smaller studies with null or negative results, which might indicate potential publication bias. This key function of forest plots underscores their importance in research. Forest plots are the typical method for displaying meta-analyses. They visually present the observed effect, confidence interval, and typically the weight of each study. Additionally, they show the combined effect that we have computed in a meta-analysis. This enables others to promptly assess the accuracy and range of the included studies and the relationship between the combined effect and the observed effect sizes.

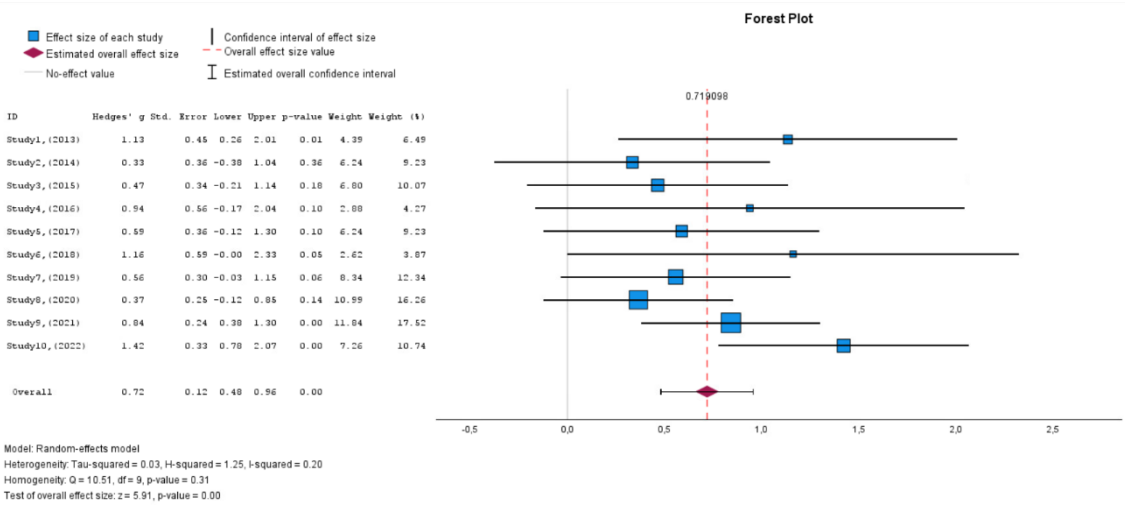
Figure 4 provides a visual representation of the primary elements of a forest plot. On the left side of the forest plot, individual study tests, as well as the overall heterogeneity and effect size values, are presented in a user-friendly, visual format.

A visual depiction on the right side illustrates the effect size of each study, typically positioned at the centre of the plot. This graphical representation illustrates the study's point estimate of the effect size on the x-axis, serving as a crucial indicator of the effect size. The point estimate is accompanied by a line that depicts the confidence interval range calculated for the observed effect size. This line visually represents the uncertainty associated with the point estimate. Remember that the point estimate is typically represented by a square, with the size of the square being determined by the weight of the effect size; studies with a larger weight (7th, 8th, and 9th) are depicted by a larger square, while studies

[10] You can view the results of the meta-analysis in SPSS in Appendix 1.

with lower weight have a smaller square. A conventional forest plot should also include the effect size data used in the meta-analysis to allow others to replicate our results.

Forest plots are commonly utilized in meta-analyses to represent individual study effect sizes and confidence intervals visually. Researchers can identify potential publication bias by examining the



ID	Hedges' g	Std. Error	Lower	Upper	p-value	Weight	Weight (%)
Study1, (2013)	1.13	0.45	0.26	2.01	0.01	4.39	6.49
Study2, (2014)	0.33	0.36	-0.38	1.04	0.36	6.24	9.23
Study3, (2015)	0.47	0.34	-0.21	1.14	0.18	6.80	10.07
Study4, (2016)	0.94	0.56	-0.17	2.04	0.10	2.88	4.27
Study5, (2017)	0.59	0.36	-0.12	1.30	0.10	6.24	9.23
Study6, (2018)	1.16	0.59	-0.00	2.33	0.05	2.62	3.87
Study7, (2019)	0.56	0.30	-0.03	1.15	0.06	8.34	12.34
Study8, (2020)	0.37	0.25	-0.12	0.85	0.14	10.99	16.26
Study9, (2021)	0.84	0.24	0.38	1.30	0.00	11.84	17.52
Study10, (2022)	1.42	0.33	0.78	2.07	0.00	7.26	10.74
Overall	0.72	0.12	0.48	0.96	0.00		

Model: Random-effects model
Heterogeneity: Tau-squared = 0.03, H-squared = 1.25, I-squared = 0.20
Homogeneity: Q = 10.51, df = 9, p-value = 0.31
Test of overall effect size: z = 5.91, p-value = 0.00

spread and distribution of effect sizes. These plots provide a graphical display of observed effects, confidence intervals, and the weight of each study, offering a quick way to assess the precision and spread of included studies and how the pooled effect relates to the observed effect sizes (Harrer et al., 2021). Additionally, the main components of a forest plot are illustrated, providing an overview of the individual study tests and effect size values. Furthermore, the point estimate of a study is visualized along with a line representing the confidence interval. The size of the square around the point estimate reflects the weight of the effect size. It is also conventional for a forest plot to contain the effect size data used in the meta-analysis, allowing others to replicate the results.

FIGURE 6. FOREST PLOT (OWN WORK WITH SPSS 29).

Funnel Plots

Funnel plots serve as a visual tool for assessing publication bias, with any asymmetry in the plot potentially indicating bias. Additionally, statistical tests such as Egger's regression test or Begg's test can be employed to identify publication bias.

Sensitivity analysis involves conducting the meta-analysis under different assumptions or excluding specific studies to ascertain the robustness of the results. For instance, researchers may opt to exclude lower-quality studies or those with extreme effect sizes to evaluate the consistency of overall conclusions (Blackhall & Ker, 2007).

Funnel plots and Egger's Test are powerful tools in assessing and addressing biases in meta-analytical estimates. However, it's important to note that the trim-and-fill method, while useful, has its limitations. Sensitivity analyses are crucial in understanding and mitigating biases, and researchers should approach these methods with caution and awareness of potential challenges (AJE Team, 2023).

The funnel plot, a technique used to evaluate the possibility of publication bias (Harbord et al., 2006), is based on the premise that smaller studies, despite their size, play a significant role in detecting publication bias. The probability of publication bias affecting smaller studies is higher than that of more extensive studies. This detectable difference is attributable to the disparity in susceptibility to publication bias. If a researcher completes a large, randomized trial, they are likely to want to see it published even if the result is negative because of the effort involved. However, for minor experiments,

the scenario might vary. If publication bias exists, it is most likely due to small negative trials not being published. This underscores the importance of smaller studies in the detection of publication bias, making the process more engaging and interesting for researchers.

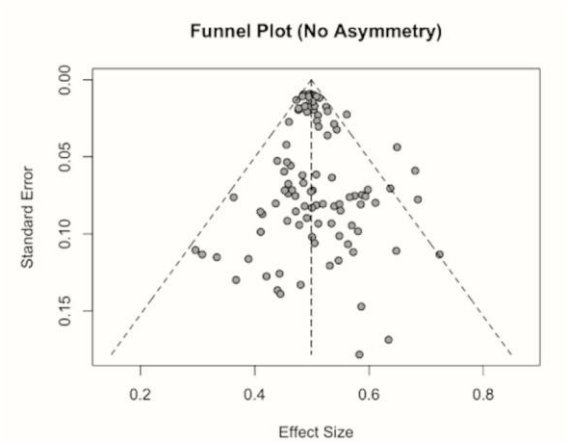
The funnel plot, a visual depiction of trial sizes plotted against the effect size they present, serves as a tool to assess publication bias. As the trial size increases, trials are likely to converge around the true underlying effect size. One would expect an even scattering of trials on either side of this true underlying effect (Fig. 6 - Graph A). When publication bias has occurred, one expects an asymmetry in the scatter of small studies, with more studies showing a positive result than those showing a negative result (Fig. 6 - Graph B).

Funnel plot asymmetry can be visually evaluated using the funnel plot, but the following methods are used to quantify it.:

- 1. Egger's Test (Egger et al., 1997): This test involves weighted regression analysis of the effect size estimates on their precision measures (i.e., standard errors). The focus is on the intercept line, indexed by b. A statistically significant intercept (with $p < 0.05$) suggests publication bias.
- 2. Rank correlation Begg test: Establishes if a notable relationship exists between the rankings of standardized effect sizes and the rankings of their variances.

In conclusion, meta-analysis represents a potent quantitative method that amalgamates findings from multiple studies to yield more resilient conclusions. Researchers can derive more precise and generalizable insights through systematic data collection, effect size estimation, model selection, heterogeneity assessment, and publication bias scrutiny. Despite its strengths, meticulous planning and execution are imperative in meta-analysis to circumvent biases and misinterpretations. When rigorously conducted, it furnishes invaluable contributions to evidence-based practice and policymaking across diverse scientific domains.

Graph A



Graph B

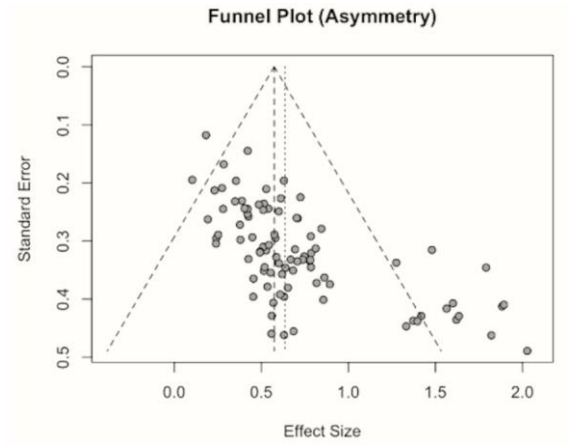


Figure 7. Funnel Plots (Aje Team, 2023).

11.2.2 Consequences on the Validity of Meta-Analyses

Familiarity with the methodological framework of meta-analysis is essential to assess its validity in achieving research objectives.

What are the potential consequences of publication bias on the validity of meta-analyses? Publication bias can significantly impact the validity of meta-analyses in several ways:

- Influence on Meta-Analytic Results: Publication bias can suppress unfavourable studies, biasing meta-analytic results towards an artificially favourable direction.
- Detection Challenges: Various statistical tests have been proposed to detect publication bias. However, they often make different assumptions and may have low power in many cases, making it challenging to select the optimal test for real-world meta-analyses.
- Low Rates of Assessment: A review of meta-analyses in plastic surgery and psychology journals revealed low rates of proper publication bias assessment, with only a small percentage attempting to correct for its effect.

- Impact on Conclusions: Studies have shown that publication bias can lead to overestimated effects and false-positive results, affecting the validity of meta-analytic conclusions.
- Detection Method Limitations: P value–driven tests for publication bias may underestimate its presence, mainly when the number of studies in the meta-analysis is small.
- In conclusion, publication bias can have significant consequences on the validity of meta-analyses, including biasing results, impacting conclusions, and posing challenges for detection. The low rates of proper assessment and the limitations of detection methods further emphasize the need for careful consideration of publication bias in meta-analytic research.

11.2.3 Strategies to Mitigate the Impact

To enhance the validity of meta-analyses, Mathur (2024) proposes employing certain strategies to counter publication bias.

First, Hybrid Test for Publication Bias has been suggested to detect publication bias by combining different methods and leveraging their strengths to achieve consistent high sensitivity across different types of publication bias.

Second, Sensitivity analyses can determine the effect of internal and publication biases on meta-analytic findings by evaluating the typical internal bias across studies and the level of publication bias.

Third, Objective statistical tests are crucial for assessing publication bias and ensuring high-quality literature in various fields, including psychology and surgery.

Fourth, State-of-the-Art Adjustment Methods: Meta-analyses in education should employ advanced adjustment methods, such as selection models, to address publication bias.

These strategies are supported by evidence from academic abstracts, showcasing their relevance and effectiveness in reducing the impact of publication bias on the validity of meta-analyses. However, it is important to note that no single method is consistently superior. The application of these strategies should be tailored to the specific characteristics of the meta-analytic data and the nature of the publication bias.

Therefore, a combination of these strategies, customized to the context of the meta-analysis, can help mitigate the effects of publication bias and improve the validity of meta-analytic results.

12 Part VIII. Conclusion

In summary, meta-analysis involves several key steps, including formulating the research question, designing a search strategy, screening, and extracting data, critical appraisal and analysis, and reporting and disseminating findings. While it offers a high level of evidence and helps establish recommendations for clinical practice, it is important to be aware of methodological weaknesses and challenges in interpretation. Common challenges and limitations include complexity, bias, and the need for methodological familiarity. Meta-analysis contributes significantly to evidence-based practice by establishing evidence-based practice and synthesizing research findings in various disciplines.

Table 4 contains a checklist you should follow when conducting a meta-analysis to avoid producing irrelevant knowledge.

Table 2. *Cautions When Producing A Meta-Analysis*

1.	The first and crucial step is to select a topic within your area of expertise that can potentially be the subject of a meta-analysis. This decision is pivotal as it sets the foundation for your entire research journey. Once you have chosen a suitable topic, embark on a thorough search using Google Scholar, examining the first 500 search results. Following this, you will focus on the 30 most frequently cited studies and collect all relevant estimates and their standard errors.
2.	It's worth noting that you will not dismiss any studies based on publication outlet or perceived quality, ensuring a comprehensive and unbiased approach. To enhance the reliability of your study, you will collaborate with a co-author. This collaboration will involve independent data gathering and comparison, thereby ensuring the accuracy of the data. In cases where the original effect size measures are comparable, you will use them directly. However, if the measures differ, you will transform them into a standard metric to facilitate comparison.
3.	Observing outliers and influence points is crucial while cautioning when considering their exclusion or winsorization.
4.	As part of your rigorous methodology, you will conduct robustness checks. These checks are crucial as they help validate the robustness of your findings. Additionally, you will carefully consider the heterogeneity among primary studies. This consideration is important as it allows you to address the diversity within the studies, thereby enhancing the validity of your study. In reporting summary statistics, you will employ the unrestricted weighted least squares weighted average, correcting for publication bias and utilizing advanced statistical techniques such as RoBMA-PSMA and various model groups.
5.	Furthermore, you will cluster standard errors at the study level and implement the wild bootstrap method when dealing with fewer than 40 studies.
6.	Additionally, you will use study-level dummy variables in meta-regressions to filter out unobserved heterogeneity.
7.	Finally, you will estimate the multiple meta-regression model using the Bayesian model averaging with the dilution prior, a sophisticated technique that demonstrates the depth and complexity of your research. This approach enhances the credibility of our findings, making our research stand out in the academic landscape. If collinearity is not an issue, consider frequentist model averaging or the general-to-specific approach, further showcasing the breadth of your statistical knowledge. You aim to provide conditional means for effect sizes in various scenarios, correcting for publication bias and potential methodological weaknesses in some studies.

Source: Irsova Et Al. (2023, P.13).

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14 Appendices

14.1 Publication Bias exercise (SPSS 29)

Researchers undertaking a meta-analysis using correlation data should pay special attention to the calculation of the variance or standard error of the Fisher's z values. This is a critical part of the process, as is the conversion of the Pearson correlation coefficients to Fisher's z values. The pre-calculated effect size and its variance or standard error can then be computed and stored in a dataset for continuous and binary data (Sen & Yildirim, 2022).

14.1.1 An example Meta-Analysis: Continuous Outcomes with Raw Data

Meta-Analysis Summary

Data Type	Raw
Outcome Type	Continuous
Effect Size Measure	Hedges' g
Model	Random effects
Weight	Inverse-variance[a]
Estimation Method	REML
Standard Error Adjustment	None

a. Random-effects weights including both within- and between-study variance.

Case Processing Summary

	N	Percent
Included	10	100,0%
Missing	0	0,0%
Invalid[a]	0	0,0%
Total	10	100,0%

a. Nonpositive variance or standard error, or insufficient study size.

Effect Size Estimates

					95% Confidence Interval		95% Prediction Interval[a]
	Effect Size	Std. Error	Z	Sig. (2-tailed)	Lower	Upper	Lower
Overall	,719	,1216	5,913	<,001	,481	,957	,236

Effect Size Estimates

	95% Prediction Interval
	Upper
Overall	1,202

a. Based on t-distribution.

Effect Size Estimates for Individual Studies

ID	Effect Size	Std. Error	Z	Sig. (2-tailed)	95% Confidence Interval	
					Lower	Upper
Study1, (2013)	1,135	,4458	2,546	,011	,261	2,009
Study2, (2014)	,334	,3623	,923	,356	-,376	1,044
Study3, (2015)	,465	,3433	1,355	,175	-,208	1,138
Study4, (2016)	,939	,5636	1,667	,096	-,165	2,044
Study5, (2017)	,588	,3622	1,624	,104	-,122	1,298
Study6, (2018)	1,162	,5940	1,956	,050	-,002	2,326
Study7, (2019)	,557	,3014	1,850	,064	-,033	1,148
Study8, (2020)	,365	,2488	1,469	,142	-,122	,853
Study9, (2021)	,842	,2353	3,578	<,001	,381	1,303
Study10, (2022)	1,422	,3296	4,315	<,001	,776	2,068

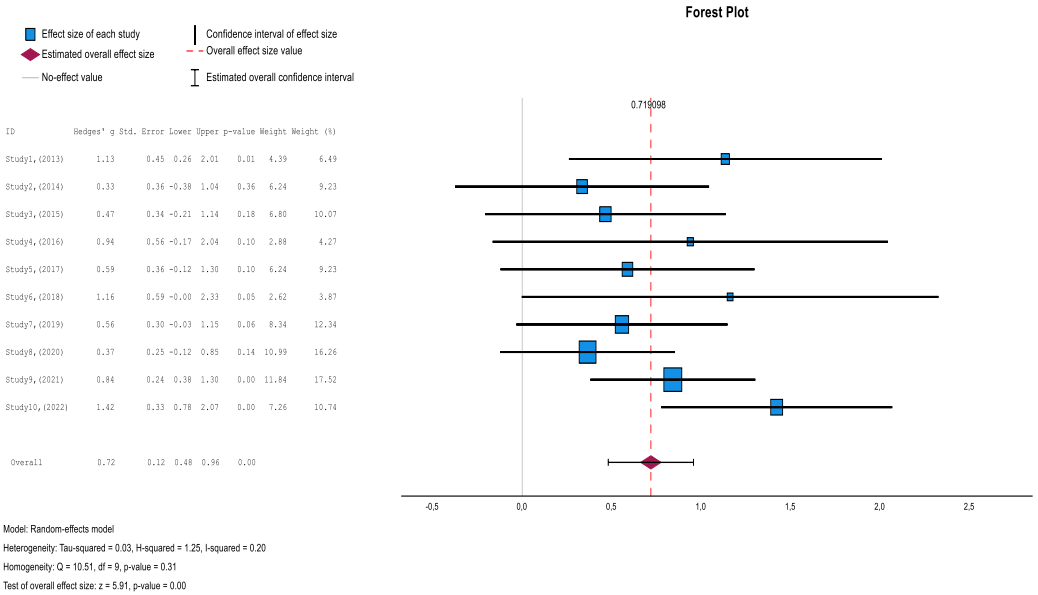
Effect Size Estimates for Individual Studies	
Weight	Weight (%)
4,389	6,5
6,237	9,2
6,805	10,1
2,884	4,3
6,240	9,2
2,618	3,9
8,340	12,3
10,990	16,3
11,841	17,5
7,261	10,7

Test of Homogeneity

	Chi-square (Q statistic)	df	Sig.
Overall	10,507	9	,311

Heterogeneity Measures

Overall	Tau-squared	,029
	H-squared	1,251
	I-squared (%)	20,1



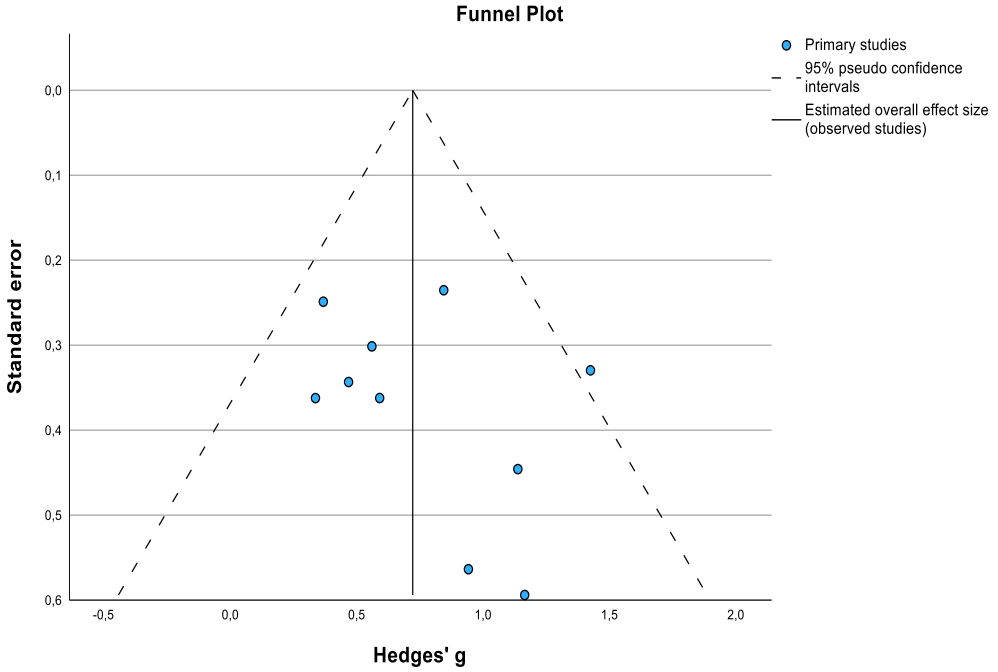
ID	Hedges' g	Std. Error	Lower	Upper	p-value	Weight	Weight (%)
Study1,(2013)	1.13	0.45	0.26	2.01	0.01	4.39	6.49
Study2,(2014)	0.33	0.36	-0.38	1.04	0.36	6.24	9.23
Study3,(2015)	0.47	0.34	-0.21	1.14	0.18	6.80	10.07
Study4,(2016)	0.94	0.56	-0.17	2.04	0.10	2.88	4.27
Study5,(2017)	0.59	0.36	-0.12	1.30	0.10	6.24	9.23
Study6,(2018)	1.16	0.59	-0.00	2.33	0.05	2.62	3.87
Study7,(2019)	0.56	0.30	-0.03	1.15	0.06	8.34	12.34
Study8,(2020)	0.37	0.25	-0.12	0.85	0.14	10.99	16.26
Study9,(2021)	0.84	0.24	0.38	1.30	0.00	11.84	17.52
Study10,(2022)	1.42	0.33	0.78	2.07	0.00	7.26	10.74
Overall	0.72	0.12	0.48	0.96	0.00		

Model: Random-effects model

Heterogeneity: Tau-squared = 0.03, H-squared = 1.25, I-squared = 0.20

Homogeneity: Q = 10.51, df = 9, p-value = 0.31

Test of overall effect size: z = 5.91, p-value = 0.00



QUANTITATIVE ANALYSIS: R TRAINING

Modules overview

Module 1: Introduction to R and Data Import/Manipulation

Introduction to R programming and RStudio.
Basics of R programming: data types, variables, basic operations.
Data import and manipulation in R: reading data into R, data manipulation using dplyr, tidyr, and other packages.
Basic graphics in R: creating scatterplots, bar plots, and line graphs using ggplot2.

Module 2: Descriptive and Inferential Statistics

Descriptive statistics in R: measures of central tendency, measures of variability, and graphical displays such as histograms and boxplots.
Inferential statistics in R: hypothesis testing, confidence intervals, and p-values.
Conducting t-tests and chi-square tests in R.
Linear regression in R: modeling the relationship between two variables and interpreting regression output.

Module 3: Advanced Data Manipulation and Graphics

Advanced data manipulation using tidyr and dplyr packages.
Creating complex and advanced plots using ggplot2, including customizing plot aesthetics such as colors and themes.
Specialized packages for data manipulation and visualization such as lubridate, forcats, and gridExtra.

Module 4: Multiple Regression and Basic Programming Concepts

Multiple regression in R: modeling the relationship between multiple independent variables and one dependent variable.
Basic programming concepts in R: loops, if-else statements, and functions.
Using packages such as car and stargazer for more advanced modeling tasks such as diagnostic tests and model comparison.

Module 5: Advanced Statistical Analysis and Time Series Analysis

Advanced statistical analysis in R: factor analysis, cluster analysis, and time series analysis.
Introduction to time series analysis: modeling and forecasting time-dependent data.
Applications of time series analysis in various fields.

15 Module 1: Introduction to R and Data Import/Manipulation

Introduction to R programming and RStudio.
Basics of R programming: data types, variables, basic operations.
Data import and manipulation in R: reading data into R, data manipulation using dplyr, tidyr, and other packages.
Basic graphics in R: creating scatterplots, bar plots, and line graphs using ggplot2.

16 Introduction to R and Data Import/Manipulation

In today's data-driven world, the ability to extract meaningful insights from data is a highly sought-after skill. For researchers, data scientists, and analysts, the R programming language and RStudio stand as indispensable tools in their arsenal. R is renowned for its flexibility in statistical computing and data analysis, while RStudio offers a user-friendly integrated development environment (IDE) that enhances the R experience. This module serves as a foundational steppingstone, acquainting participants with the essential aspects of R, from its syntax to its powerful data manipulation capabilities and basic data visualization techniques. Furthermore, we will delve into the critical importance of efficient data import and management in the context of statistical analysis. By the end of this module, participants will have gained proficiency in the following areas (R Core Team, 2021).

16.1.1 Navigating R and RStudio: Your Gateway to Data Mastery

R for Data Science, an influential book authored by Hadley Wickham and Garrett Grolemund, asserts that "R is a tool, not a magic box that spits out results" (Grolemund & Wickham, 2016). Understanding and harnessing the potential of R starts with familiarity and comfort in its environment. That's where RStudio comes into play.

RStudio: RStudio is an integrated development environment that enhances the R programming experience. It provides an interactive platform for working with R, making it accessible to users of all levels. To embark on your journey with R, it's essential to become acquainted with RStudio.

Here's how to get started:

Installation: Before you begin your adventure with R, you'll need to install both R and RStudio. Both are freely available and are compatible with various operating systems, including Windows, macOS, and Linux.

RStudio Interface: Once you have R and RStudio installed, open RStudio. The RStudio interface consists of four panes: the Script Editor (where you'll write your code), the Console (where code is executed and results are displayed), the Environment/History pane (which shows your current workspace and command history), and the Files/Plots/Packages/Help pane, which allows you to navigate files, view plots, manage packages, and access help documentation.

R Script: In the Script Editor, you can write, edit, and save your R code. It's a good practice to create and save R scripts for your projects, as this makes it easier to reproduce your work and share it with others.

Executing Code: To execute R code, simply type it into the Script Editor and press Ctrl+Enter (or Command+Enter on macOS) or click the "Run" button. The code will run in the Console, and any output or results will be displayed there.

Workspace: The Environment/History pane shows your current R workspace, which includes objects like data frames, variables, and functions that you create during your R sessions. It's a helpful way to keep track of your data and variables.

Help: When you need assistance with a function or package, you can use the Help tab to access R documentation and find information about specific functions or packages.

16.1.2 Getting to Know R: The Essentials

With RStudio as your interface, you're now ready to dive into the world of R programming. The following are some essential aspects you need to grasp:

Data Types: R offers several fundamental data types, including numeric, character, logical, and factors (Grolemund & Wickham, 2016). Understanding these data types is crucial for effective data manipulation.

Variables: In R, variables are used to store data. You can think of a variable as a container that holds a specific value, such as a number, a character, or a logical (true or false) value. Variables are used extensively in R for data analysis.

Basic Operations: R allows you to perform a wide range of operations on your data. This includes arithmetic operations (addition, subtraction, multiplication, and division), logical operations (comparisons), and more. Mastering these operations is essential for data manipulation.

Vectors: In R, a vector is a basic data structure that holds elements of the same data type. You can create vectors with functions like `c()` (combine) or by using a colon `:` to generate a sequence of numbers. Vectors are fundamental for data analysis and manipulation.

16.1.3 Data Import and Manipulation: The Power of dplyr and tidyr

Efficient data import and manipulation are the bedrock of effective data analysis. R provides a myriad of packages and functions to help you read data from external sources and prepare it for analysis. Two indispensable packages for data manipulation are dplyr and tidyr.

dplyr: Developed by Hadley Wickham, dplyr is a package that offers a grammar for data manipulation. It provides a set of functions to perform common data manipulation tasks with a consistent and intuitive syntax. The key functions in dplyr include filter() (for filtering rows), select() (for selecting columns), arrange() (for sorting), mutate() (for creating new variables), and summarize() (for summarizing data). Understanding and using dplyr functions will empower you to efficiently manipulate and transform your data.

tidyr: While dplyr focuses on data manipulation, tidyr is all about data tidying. Data is considered "tidy" when it is organized in a way that makes it easy to work with. tidyr provides functions like gather() (to convert wide data to long data) and spread() (to convert long data to wide data). By tidying your data with tidyr, you make it more amenable to analysis and visualization.

16.1.4 Bringing Your Data to Life: Basic Graphics with ggplot2

Effective data analysis extends beyond just manipulating and summarizing data. Data visualization plays a pivotal role in understanding and communicating your findings. R offers a wealth of packages for data visualization, with ggplot2 being one of the most popular and versatile choices.

ggplot2: Developed by Hadley Wickham, ggplot2 is a package for creating complex and customized data visualizations. It employs a layered grammar of graphics that allows you to build up visualizations step by step. With ggplot2, you can create a wide range of visualizations, including scatterplots for exploring relationships between variables, bar plots for comparing categories, and line graphs for displaying trends over time. Understanding ggplot2 will enable you to craft informative and aesthetically pleasing visualizations that breathe life into your data.

16.1.5 Setting the Stage for Data Exploration

As you embark on your journey into the world of R and data manipulation, you've taken the first step toward mastering a versatile and powerful tool for data analysis. R and RStudio, when used in harmony, offer an interactive and efficient environment for data manipulation and visualization. By understanding data types, variables, basic operations, and the capabilities of dplyr, tidyr, and ggplot2, you've equipped yourself with the foundational knowledge required for successful data analysis. With this knowledge, you can start exploring, analyzing, and visualizing data to unearth valuable insights and communicate your findings effectively.

16.2 Introduction to R Programming and RStudio

R, a free and open-source programming language, is renowned for its versatility in statistical computing and data analysis (Gentleman & Temple Lang, 2004). RStudio, an integrated development environment (IDE), provides an interactive platform for working with R, making it accessible to users of all levels. Participants will become familiar with the RStudio interface, learn how to navigate R scripts, and understand the workflow of loading, processing, and visualizing data.

16.3 Basics of R Programming: Data Types, Variables, Basic Operations

A fundamental grasp of R programming necessitates a comprehension of data types, variables, and basic operations. R offers various data types, including numeric, character, logical, and factors (Grolemund & Wickham, 2016). Participants will learn how to declare and manipulate variables, perform arithmetic operations, and use functions to execute specific tasks. By mastering these basics, participants can perform data-related tasks efficiently.

To embark on a journey into the realm of R programming is to embrace the core elements that underpin data analysis and statistical computing. A foundational grasp of R programming

necessitates a comprehensive understanding of data types, variables, and basic operations. In this module, we will unravel the essence of these foundational concepts, equipping participants with the essential knowledge and skills to manipulate data efficiently and execute tasks effectively (Grolemund & Wickham, 2016).

16.3.1 Demystifying Data Types: The Building Blocks of R

At the heart of R programming lies the notion of data types. In essence, data types define how R interprets and interacts with the information you provide. R offers a versatile array of data types, and comprehending their nature is fundamental to harnessing the language's capabilities. Let's delve into the most essential data types:

- Numeric: Numeric data types encompass a wide range of numerical values. These may include integers (whole numbers) and real numbers (decimals). Understanding numeric data types is crucial for performing mathematical and statistical operations.
- Character: Character data types consist of text and are used to represent words, sentences, or any other form of textual information. The ability to handle character data is invaluable when working with text or labels.
- Logical: Logical data types are binary in nature, representing true or false values. They are pivotal for creating conditions and making decisions in your R code.
- Factors: Factors are a unique data type in R, representing categorical data. They are particularly useful when dealing with variables that have a finite number of categories or levels.

16.3.2 Variables: Containers of Information

Variables in R are akin to containers that hold data. They serve as the fundamental building blocks for any R program. You can think of a variable as a labeled storage location for a specific piece of information. Variables in R should be given informative names that reflect the type of data they store. For example, a variable named "age" might store the ages of individuals in a dataset.

In R, you declare a variable by assigning a value to it using the assignment operator <-. For example, to declare a variable "x" with a value of 5, you would write:

```
x <- 5
```

Variables can store data of different data types. For example, you can declare a character variable like this:

```
name <- "John"
```

Once a variable is declared, you can use it in your R code for various operations and calculations. The ability to manipulate variables is central to data analysis and programming in R.

16.3.3 Basic Operations: The Language of Data Manipulation

R empowers you to perform a wide range of operations on your data. These operations include:

- Arithmetic Operations: R allows you to perform basic arithmetic operations like addition (+), subtraction (-), multiplication (*), and division (/). These operations are particularly useful for working with numeric data.
- Logical Operations: You can use logical operators like greater than (>), less than (<), equal to (==), and not equal to (!=) to compare values and create logical conditions. Logical operations are essential for decision-making in your code.
- Functions: Functions are a fundamental concept in R. R provides a vast number of built-in functions that serve various purposes. Functions are pre-defined operations that you can use to perform specific tasks. For example, the mean() function calculates the mean of a set of numbers, and the paste() function combines character strings. Understanding how to use functions is crucial for automating tasks and performing complex operations.

A solid grasp of data types, variables, and basic operations is the foundation upon which you can build your proficiency in R programming. With this fundamental knowledge, you're equipped to handle a wide range of data-related tasks, from performing simple arithmetic operations to creating complex logical conditions and utilizing functions to streamline your code.

As you continue your journey into the world of R programming, these basics will serve as your guiding light, allowing you to efficiently manipulate data, make informed decisions, and automate tasks. With each step, you'll inch closer to data mastery, uncovering the potential for in-depth data analysis and exploration.

16.4 Data Import and Manipulation in R: Reading Data into R, Data Manipulation using dplyr, tidyr, and other packages

Efficient data import and manipulation are the cornerstone of effective data analysis. In this module, we delve into the realm of data handling within the R environment, equipping participants with the skills necessary to retrieve, manipulate, and prepare data for analysis. A robust understanding of data import and manipulation is pivotal for ensuring that your data is in a suitable form for analysis and for streamlining the entire data preprocessing workflow (Wickham et al., 2021).

16.4.1 Importing Data: The Gateway to Analysis

The initial step in any data analysis endeavor is data acquisition. R offers a vast array of tools and packages to facilitate the seamless import of data from various external sources. Whether your data resides in a CSV file, an Excel spreadsheet, a database, or other formats, R provides the means to access it. This module will explore the common data import tools and methods in R:

- read.csv() and read.table(): These functions enable you to read data from CSV and tab-delimited files, respectively. They offer a multitude of options for customizing the import process, such as specifying delimiters and handling missing values.
- readxl Package: When dealing with Excel files, the readxl package is your go-to tool. It simplifies the extraction of data from Excel workbooks, sheets, and ranges.
- readr Package: The readr package, also by Hadley Wickham, offers a set of functions for fast and efficient data import. It enhances the data import process by providing functions like read_csv() and read_delim() that optimize the reading of text-based data.

Database Connections: R can connect to databases using packages like DBI and RODBC, allowing you to retrieve data directly from database systems. This is particularly useful when working with large datasets stored in databases.

16.4.2 Data Manipulation with dplyr: A Grammar for Data

Data manipulation often entails tasks like filtering, summarizing, grouping, and joining datasets. The dplyr package, authored by Hadley Wickham, simplifies these operations by providing a consistent and intuitive grammar for data manipulation. It introduces five core verbs:

- filter(): Use this verb to extract specific rows from your dataset based on certain conditions.
- arrange(): Arrange the rows of your dataset based on one or more variables, either in ascending or descending order.
- select(): Choose a subset of columns from your dataset, making it easier to focus on the relevant data.
- mutate(): Create new variables or modify existing ones by applying functions or operations to your data.
- summarize(): Condense your data into summary statistics, aggregating information in a meaningful way.

16.4.3 Data Transformation with tidyr: Reshaping Your Data

Data isn't always in the format most conducive to analysis. The tidyr package steps in to help reshape your data into a tidy, organized format. Tidy data is structured in a way that each variable forms a column, each observation forms a row, and each type of observational unit forms a table. This structured format simplifies data analysis and visualization. With tidyr, you can perform operations such as gathering columns into key-value pairs and spreading them back into separate columns.

By the end of this module, you will have acquired the skills to efficiently import, manipulate, and transform data using R. Data import and manipulation are the initial building blocks of data analysis, and these skills are essential for preparing your data for deeper exploration and analysis. As you proceed in your journey of data analysis with R, you will find these capabilities invaluable for ensuring the quality and suitability of your data for your research or analysis objectives.

16.5 Basic Graphics in R: Creating Scatterplots, Bar Plots, and Line Graphs using ggplot2

In the realm of data analysis, the ability to effectively visualize data is a skill of paramount importance. Data visualization not only aids in understanding the underlying structure and patterns within data but also serves as a powerful means of conveying findings to others. In this module, we will journey into the world of data visualization using the ggplot2 package, a versatile tool for creating a wide range of visualizations (Wickham, 2016).

16.5.1 Introducing ggplot2: A Versatile Graphics Package

Hadley Wickham's ggplot2 is a widely acclaimed package in the R ecosystem, known for its flexibility and elegant syntax. Unlike base R graphics, which can sometimes be cumbersome and less intuitive, ggplot2 introduces a grammar of graphics, which simplifies the process of creating complex and aesthetically pleasing visualizations.

One of the fundamental principles of ggplot2 is the layering approach. You add layers to your plot step by step, gradually building the visualization. This approach is particularly beneficial when you want to create intricate graphics with multiple components. Let's delve into the types of plots we will explore in this module:

16.5.2 Scatterplots: Revealing Relationships

Scatterplots are invaluable when you need to understand the relationships between two continuous variables. They allow you to visualize how changes in one variable affect the other. In ggplot2, creating scatterplots is a straightforward process. You'll specify the data, map variables to aesthetic properties (such as position on the x- and y-axes) and add points or other geometries to represent the data.

Bar plots are a fantastic choice for comparing categories or groups. They are commonly used to display counts or proportions of categorical data. You can create both vertical and horizontal bar plots, depending on your preferences. In ggplot2, crafting bar plots is intuitive and highly customizable. You can control the appearance of bars, axis labels, and colors to effectively convey your data.

Line graphs are your go-to choose when you want to visualize trends and changes over time. These graphs are particularly useful for time series data or any data that has a natural sequence. In ggplot2, creating line graphs is both simple and highly customizable. You can plot multiple lines on the same graph, customize line types and colors, and add informative labels and annotations.

By the conclusion of this module, you will have a solid understanding of how to create scatterplots, bar plots, and line graphs using ggplot2. The skills acquired here will empower you to visually explore and communicate your data effectively. Data visualization is a universal language that transcends disciplinary boundaries, and your proficiency in creating compelling and informative visualizations will be a valuable asset in your data analysis journey.

This module provides the foundation for proficient utilization of R and RStudio, empowering participants to embark on their journey in data analysis, manipulation, and visualization.

17 Module 2: Descriptive and Inferential Statistics

Descriptive statistics in R: measures of central tendency, measures of variability, and graphical displays such as histograms and boxplots.
Inferential statistics in R: hypothesis testing, confidence intervals, and p-values.
Conducting t-tests and chi-square tests in R.
Linear regression in R: modeling the relationship between two variables and interpreting regression output.

18 Descriptive and Inferential Statistics

Whether you're a seasoned data scientist or just embarking on your data analysis journey, this module will provide you with a comprehensive understanding of both descriptive and inferential statistics, using the versatile R environment. We'll cover a wide range of statistical techniques and visualization tools, equipping you with the skills needed to unravel patterns and relationships within your data.

18.1.1 Descriptive Statistics in R: Unveiling Data's Secrets

Descriptive statistics are the bedrock of data analysis, allowing us to summarize and comprehend datasets. In this section, we will explore various measures that characterize the central tendency, variability, and distribution of data. R offers a myriad of functions to compute these measures, and you will become proficient in calculating:

- Measures of Central Tendency: You will learn how to compute the mean, median, and mode, each offering unique insights into the center of your data's distribution. We will discuss when and why each measure is valuable.
- Measures of Variability: Understanding the spread or variability within your data is crucial. We will delve into calculating the range, variance, and standard deviation, equipping you with the tools to assess data dispersion effectively.
- Graphical Displays: Numbers only tell part of the story. Visualizations are paramount for grasping the distribution of your data. We'll explore how to create histograms and boxplots, visualizing data distributions and identifying potential outliers or skewness.

To perform descriptive statistics in R, you'll need to use various functions and packages. Here's how you can calculate measures of central tendency, measures of variability, and create graphical displays in R:

18.1.2 Measures of Central Tendency

Mean: To calculate the mean (average) of a numeric variable, you can use the mean() function. For example, if you have a vector of data called data_vector, you would compute the mean like this:

```
mean_result <- mean(data_vector)
```

Median: To find the median (middle value) of a dataset, you can use the median() function. Similar to the mean, if you have your data in data_vector:

```
median_result <- median(data_vector)
```

Mode: Unlike mean and median, R does not have a built-in function to calculate the mode directly. You may need to create a custom function to find the mode if required.

18.1.3 Measures of Variability

Range: You can calculate the range (the difference between the maximum and minimum values) of your data using the range() function. It returns a vector containing the minimum and maximum values.

```
range_result <- range(data_vector)
```

Variance and Standard Deviation: The var() function computes the variance, while the sd() function calculates the standard deviation. Both are used to assess the spread of data.

```
variance_result <- var(data_vector)

sd_result <- sd(data_vector)
```

Skewness and Kurtosis: You can use the moments package to calculate skewness and kurtosis. First, you need to install and load the package:

```
install.packages("moments")

library(moments)
```

Then, you can use skewness() for skewness and kurtosis() for kurtosis:

```
skewness_result <- skewness(data_vector)

kurtosis_result <- kurtosis(data_vector)
```

Graphical Displays

Histogram: To create a histogram, you can use the hist() function. It visualizes the distribution of your data by dividing it into bins. For example:

```
hist(data_vector, main = "Histogram of Data", xlab = "Values", ylab = "Frequency")
```

Boxplot: The boxplot() function is used to create boxplots, which provide information about the distribution's central tendency and spread, as well as any potential outliers.

```
boxplot(data_vector, main = "Boxplot of Data", ylab = "Values")
```

By following these steps and utilizing R's built-in functions and packages, you can effectively calculate and visualize descriptive statistics for your dataset. This provides a solid foundation for understanding your data's characteristics and preparing it for further analysis.

Inferential Statistics in R: Unlocking the Secrets of Data Inference

Inferential statistics elevate your analytical abilities to the next level by enabling data-driven decisions and hypothesis testing. Here's what you can expect in this section:

- Hypothesis Testing: Learn the foundations of hypothesis testing in R. You'll understand the logic behind hypothesis testing, the significance level (alpha), and the p-value. We will explore common hypothesis tests, including the t-test and chi-square test, and walk through the step-by-step process of conducting these tests.
- Confidence Intervals: Discover the power of confidence intervals in quantifying the uncertainty surrounding point estimates. You will not only learn how to calculate confidence intervals for means and proportions but also how to interpret them in a real-world context.
- p-Values Unveiled: Unravel the mysteries of p-values, a vital component in hypothesis testing. We will discuss their meaning, interpretation, and the role they play in determining the statistical significance of results.

Inferential statistics in R is a crucial part of data analysis, enabling data-driven decision-making and hypothesis testing. Here's a step-by-step guide on how to perform hypothesis testing, calculate confidence intervals, and understand the significance of p-values in R:

18.1.3.1 1. Hypothesis Testing

Logic of Hypothesis Testing: The first step in hypothesis testing is to understand the logic behind it. You start with a null hypothesis (H0), which represents a default assumption, and an alternative hypothesis (Ha), which represents what you want to test. For example, H0: $\mu = 100$ (population mean is 100) vs. Ha: $\mu \neq 100$ (population mean is not 100).

Choosing the Significance Level (Alpha): The significance level, denoted as alpha (α), is the probability of making a Type I error (incorrectly rejecting a true null hypothesis). Common values for alpha are 0.05 or 0.01. You can set alpha using alpha <- 0.05.

Performing Hypothesis Tests: R provides various functions for hypothesis testing, such as t.test() for t-tests and chisq.test() for chi-square tests. For a two-sample t-test, you can use:

```
t_test_result <- t.test(x, y, alternative = "two.sided")
```

18.1.3.2 2. Confidence Intervals

Calculating Confidence Intervals: Confidence intervals help quantify the uncertainty around point estimates. You can calculate a confidence interval for the mean using the t.test() function. For a 95% confidence interval:

```
ci_result <- t.test(data_vector, conf.level = 0.95)$conf.int
```

Interpreting Confidence Intervals: A 95% confidence interval for a mean, say (8.5, 9.5), means that if you were to sample from the population many times and calculate intervals, approximately 95% of those intervals would contain the true population mean.

18.1.3.3 3. P-Values Unveiled

Understanding P-Values: P-values are essential in hypothesis testing. They quantify the strength of evidence against the null hypothesis. Smaller p-values indicate stronger evidence against the null. In R, p-values are typically calculated and returned by hypothesis testing functions.

Interpreting P-Values: If your p-value is less than alpha (α), you reject the null hypothesis. For example, if $p < 0.05$ (with $\alpha = 0.05$), you have evidence to reject H0. If $p > \alpha$, you fail to

reject H0. Keep in mind that p-values do not prove a null hypothesis; they provide evidence for or against it.

By following these steps and using R's built-in functions for hypothesis testing, confidence intervals, and p-value calculations, you can unlock the secrets of inferential statistics. This allows you to make data-driven decisions, draw meaningful conclusions, and test hypotheses based on your data analysis in R.

18.1.4 T-Tests and Chi-Square Tests in R: Practical Applications

In this hands-on section, we will delve deeper into specific statistical tests and how to perform them in R:

- T-Tests: Explore the world of t-tests, a fundamental tool for comparing the means of two groups. You will learn how to conduct independent and paired t-tests, accompanied by examples and interpretation of the results.
- Chi-Square Tests: Chi-square tests are invaluable for analyzing categorical data. You will master the chi-square goodness-of-fit test and the chi-square test of independence. Through practical examples, you will grasp their significance and application.

Performing t-tests and chi-square tests in R is essential for comparing means and analyzing categorical data. Here's a practical guide on how to conduct these tests in R:

18.1.4.1 1. T-Tests

Independent T-Test: This test is used to compare the means of two independent groups. You can perform it using the t.test() function. For example, comparing the exam scores of two different groups:

```
t_test_result <- t.test(group1_scores, group2_scores)
```

Paired T-Test: Use this test when you have paired or matched data points. It assesses the difference between paired observations. You can perform it using the t.test() function. For example, comparing pre- and post-treatment scores:

```
paired_t_test_result <- t.test(before_treatment, after_treatment, paired = TRUE)
```

18.1.4.2 2. Chi-Square Tests

Chi-Square Goodness-of-Fit Test: This test checks if the observed frequencies match the expected frequencies in a categorical variable. Use the chisq.test() function. For example, testing the distribution of eye colors in a population:

```
chisq_test_result <- chisq.test(observed_frequencies, p = expected_probabilities)
```

Chi-Square Test of Independence: This test examines the association between two categorical variables. It helps determine if there's a relationship between the two. Use the chisq.test() function. For example, testing the association between gender and preferred car color:

```
chi_square_test_result <- chisq.test(table(gender, car_color))
```

18.1.5 Practical Examples and Interpretation

In your t-test results, pay attention to the p-value. If it's less than your chosen alpha level (e.g., 0.05), you can reject the null hypothesis. A small p-value indicates a significant difference between the groups.

In chi-square tests, focus on the p-value and the test statistic. A small p-value (usually < 0.05) indicates a significant difference or association, while a larger p-value suggests no significant difference or association.

Always interpret your results in the context of your research question. What does a significant result mean for your study?

By following these steps and using the appropriate R functions for t-tests and chi-square tests, you'll be equipped to analyze and draw meaningful conclusions from your data, whether you're comparing means or exploring relationships between categorical variables.

18.1.6 Linear Regression in R: Modeling Relationships and Drawing Insights

- Linear regression is a cornerstone of statistical modeling, allowing us to understand the relationships between variables and make predictions. In this section, we will cover:
- Understanding Linear Regression: A comprehensive introduction to linear regression, its assumptions, and its applications. You will learn when to use simple linear regression and multiple linear regression.
- Modeling Relationships: We will explore how to build regression models in R. You will become proficient in defining predictor and response variables, fitting the model, and interpreting the results.
- Interpreting Regression Output: Linear regression output can be complex. We will break it down, explaining how to assess the model's goodness of fit, understand coefficients and their significance, and make predictions using the regression equation.

Linear regression is a powerful statistical technique for modeling relationships between variables and making predictions. Here's how to perform linear regression in R:

18.1.6.1 1. Understanding Linear Regression

Simple Linear Regression: It's used when you want to understand the relationship between two variables, one as the predictor (independent variable) and the other as the response (dependent variable). For example, assessing the relationship between the number of hours studied and exam scores.

Multiple Linear Regression: This method allows you to examine the relationship between the response variable and multiple predictor variables. It's ideal for situations where the outcome depends on more than one factor. For example, predicting a person's income based on their education, years of experience, and age.

18.1.6.2 2. Modeling Relationships

In R, you can perform linear regression using the lm() function. For simple linear regression, you'd do:

lm_model <- lm(response_variable ~ predictor_variable, data = your_data_frame)

And for multiple linear regression:

mlm_model <- lm(response_variable ~ predictor1 + predictor2 + predictor3, data = your_data_frame)

You can visualize your regression model using scatterplots and add the regression line for simple linear regression. For multiple linear regression, partial regression plots help visualize relationships between predictor variables and the response.

18.1.6.3 3. Interpreting Regression Output

Linear regression output in R can seem complex, but it provides valuable insights.

Assessing Model Fit: Pay attention to R-squared (R^2) to understand how well the model fits the data. A higher R-squared indicates a better fit.

Coefficients: The coefficients of the predictor variables help interpret the relationship's strength and direction.

Hypothesis Testing: Utilize hypothesis tests on coefficients to determine their significance.

Residuals: Examine residual plots and histograms to check for homoscedasticity and normality.

Making Predictions: Use your regression equation to make predictions based on the coefficients.

By mastering these steps and using R's lm() function, you can create, interpret, and draw valuable insights from linear regression models. Whether you're exploring simple relationships between two variables or more complex scenarios with multiple predictors, linear regression in R is a powerful tool for data analysis and prediction.

By the end of Module 2, you will not only be well-versed in the fundamental concepts of descriptive and inferential statistics but also equipped with the practical skills to implement them in R. This knowledge will prove invaluable in making data-driven decisions, drawing meaningful insights, and solving real-world problems using data.

19 Module 3: Advanced Data Manipulation and Graphics

Advanced data manipulation using tidyr and dplyr packages. Creating complex and advanced plots using ggplot2, including customizing plot aesthetics such as colors and themes. Specialized packages for data manipulation and visualization such as lubridate, forcats, and gridExtra.

20 Advanced Data Manipulation and Graphics

In the ever-expanding realm of data science, the ability to efficiently manipulate and visualize data is indispensable. Module 3 serves as a steppingstone to propel your data analysis skills to the next level by delving into advanced data manipulation techniques and the creation of complex, customized data visualizations. Here, we explore the advanced capabilities of the tidyr and dplyr packages for data manipulation and introduce you to the world of advanced

plotting using ggplot2. Additionally, we'll venture into specialized packages like lubridate, forcats, and gridExtra to further enhance your data analysis toolkit.

21 Advanced Data Manipulation with tidyr and dplyr

The Power of tidyr

The tidyr package, developed by Hadley Wickham, is designed to tidy up messy datasets, making them more amenable to analysis. Tidying data involves reshaping it from a wide format to a long format, ensuring each variable has its own column, and each observation has its own row (Wickham & Henry, 2018). Participants will master the art of data tidying, enabling them to prepare their datasets for effective analysis.

The tidyr package, developed by Hadley Wickham, focuses on tidying up untidy datasets, allowing data analysts and scientists to work with data in a more structured and organized manner (Wickham & Henry, 2018). The primary goal is to transform data from a wide format to a long format, ensuring that each variable has its own column, and each observation has its own row.

Here's a step-by-step guide on how to harness the power of tidyr in R

Install and Load the tidyr Package

Before you can use tidyr, you need to install and load the package. You can do this using the following commands:

install.packages("tidyr")

library(tidyr)

Understanding Data Tidying

Tidying data means restructuring it to meet the principles of tidy data, as defined by Hadley Wickham. In a tidy dataset:

Each variable forms a column.

Each observation forms a row.

Each value is in its cell.

The data is organized in a way that simplifies data manipulation, analysis, and visualization.

Reshaping Data with gather()

The gather() function is a fundamental tool for converting data from a wide format to a long format. This function takes multiple columns and collapses them into key-value pairs. It's especially useful when dealing with datasets where multiple columns represent different time points, categories, or variables.

The basic syntax of gather() is as follows:

gathered_data <- gather(original_data, key = "new_key_column", value = "new_value_column", columns_to_gather)

original_data: Your original dataset.

new_key_column: The name of the new column that will contain the variable names.

new_value_column: The name of the new column that will contain the values.

columns_to_gather: The columns you want to reshape into key-value pairs.

Spreading Data with spread()

Conversely, you might need to spread data from a long format to a wide format when you want variables that are stored as key-value pairs to be separate columns again. The spread() function is used for this purpose.

The basic syntax of spread() is as follows:

spread_data <- spread(original_data, key = "new_key_column", value = "new_value_column")

original_data: Your original dataset in long format.

new_key_column: The column containing the variable names.

new_value_column: The column containing the values.

Handling Missing Data

When tidying data, you may encounter missing values. Tidyr provides functions like drop_na() to remove rows containing missing values.

Example of Data Tidying

Let's say you have a dataset where the columns represent different years, and you want to convert it into a long format to work with it more efficiently. You can use gather() as follows:

long_data <- gather(original_data, key = "Year", value = "Value", 2000:2020)

This code takes the original dataset (original_data) and transforms it into a long format, with two new columns, "Year" and "Value." The "Year" column will contain the years (2000 to 2020), and the "Value" column will contain the corresponding values.

Tidying for Analysis

Tidying your data is a crucial step in data analysis. Once your data is tidy, you can efficiently use the dplyr package for data manipulation and generate insightful visualizations with ggplot2.

Now that we've explored the power of tidyr in R, let's move on to the next section, where we'll delve into advanced data manipulation using the dplyr package.

Efficiency with dplyr

The dplyr package, another creation of Hadley Wickham, is a grammar of data manipulation. It provides a set of functions for data transformation, including filtering, arranging, grouping, summarizing, and more (Wickham et al., 2021). Participants will discover how to wield the power of dplyr to efficiently wrangle and transform data to extract meaningful insights.

As mentioned, dplyr, developed by Hadley Wickham, is a powerful toolkit for data transformation, offering a range of functions that make data manipulation more intuitive and efficient (Wickham et al., 2021).

Here's a comprehensive guide on how to harness the efficiency of dplyr in R

Install and Load the dplyr Package

Before you can use dplyr, you need to install and load the package. You can do this with the following commands:

```
install.packages("dplyr")

library(dplyr)
```

The Basic Verbs

Dplyr focuses on several essential verbs that serve as the building blocks for data manipulation. These verbs include:

filter(): Selects rows that meet specific conditions.

arrange(): Sorts rows based on one or more columns.

select(): Picks specific columns.

mutate(): Creates new variables based on existing ones.

summarize(): Aggregates data for summarization.

Chaining Operations with %>%

Dplyr's syntax allows for chaining multiple operations together using the %>% operator (pronounced "pipe"). This enables you to create a sequence of data manipulation steps, making your code more readable and concise. For example:

```
result <- dataset %>%

filter(condition) %>%

select(columns) %>%

arrange(order) %>%

group_by(grouping) %>%

summarize(summary)
```

Filtering Data with filter()

The filter() function allows you to select rows based on specific conditions. For instance:

```
filtered_data <- dataset %>% filter(column > value)
```

Arranging Data with arrange()

The arrange() function is used to sort rows based on one or more columns. For example:

```
sorted_data <- dataset %>% arrange(column1, column2)
```

Selecting Columns with select()

select() enables you to pick specific columns from your dataset. For example:

```
selected_columns <- dataset %>% select(column1, column2)
```

Creating New Variables with mutate()

mutate() is used to create new variables by transforming existing ones. For instance:

```
mutated_data <- dataset %>% mutate(new_variable = old_variable * 2)
```

Summarizing Data with summarize()

The summarize() function allows you to aggregate data, which is particularly useful for generating summary statistics. For example:

```
summary_data <- dataset %>% group_by(grouping_column) %>% summarize(mean = mean(value), sd = sd(value))
```

Grouping Data with group_by()

Grouping data with group_by() is essential when you want to perform operations on subsets of data. It's often used in conjunction with summarize() to calculate statistics for different groups.

Efficiency and Data Verbosity

One of the key advantages of dplyr is its efficiency, as operations are optimized for speed. Additionally, the clear and concise syntax reduces data verbosity, making your code more readable and maintainable.

Error Handling

Dplyr provides meaningful error messages, which can help you quickly identify and rectify issues in your data manipulation code.

Practice and Application

To become proficient in using dplyr, practice on real datasets and explore various data transformation scenarios. The more you use it, the more you'll appreciate its efficiency and versatility.

By mastering dplyr, you'll unlock the ability to efficiently wrangle, manipulate, and extract insights from your data, enhancing your data analysis and decision-making capabilities.

21.1 Complex Data Visualization with ggplot2

Unlocking the Potential of ggplot2

ggplot2, a comprehensive data visualization package developed by Hadley Wickham, is known for its flexibility and elegance (Wickham, 2016). It allows you to create intricate and informative plots. You will journey into the heart of data visualization with ggplot2, learning how to construct complex plots that depict relationships, trends, and patterns within your data.

As mentioned, ggplot2, developed by Hadley Wickham, is a powerful and flexible toolkit for data visualization, offering a structured and layered approach to creating complex plots (Wickham, 2016).

Here's a detailed guide on unlocking the potential of ggplot2 in R

Install and Load the ggplot2 Package

If you haven't already, you need to install and load the ggplot2 package. You can do this with the following commands:

```
install.packages("ggplot2")

library(ggplot2)
```

Basic Grammar of ggplot2

ggplot2 is built on the concept of a "grammar of graphics," which provides a structured way to create plots. The essential components of a ggplot2 plot include data, aesthetic mappings, geometric objects (geoms), and facets. The basic structure of a ggplot2 plot looks like this:

```
ggplot(data = your_data, aes(x = x_variable, y = y_variable)) +

geom_point()
```

Data and Aesthetics

The data argument specifies the dataset you're working with.

The aes() function (aesthetic mappings) is used to define how variables are mapped to visual elements in the plot. For example, you can map your data's x and y variables to the x and y axes of the plot.

Geometric Objects (Geoms)

Geometric objects, or geoms, define the type of plot you want to create. Some common geoms include:

geom_point(): Creates a scatterplot.

geom_line(): Generates line plots.

geom_bar(): Constructs bar charts.

geom_boxplot(): Produces boxplots.

Customizing Your Plot

ggplot2 offers extensive options for customizing your plot's appearance. You can modify the plot title, axis labels, legend, colors, and themes. For example:

```
ggplot(data = your_data, aes(x = x_variable, y = y_variable)) +
  geom_point() +
  labs(title = "Your Plot Title", x = "X-Axis Label", y = "Y-Axis Label") +
  theme_minimal()  # Apply a minimal theme
```

Multiple Geoms and Layers

You can create complex plots by adding multiple geoms and layers to the same plot. This allows you to represent different aspects of your data in a single visualization. For example:

```
ggplot(data = your_data, aes(x = x_variable, y = y_variable)) +
geom_point() +
geom_smooth(method = "lm", color = "red")  # Add a linear regression line
```

Faceting

Faceting enables you to create multiple plots, each showing a different subset of your data. You can use the facet_wrap() or facet_grid() functions to achieve this. For example:

```
ggplot(data = your_data, aes(x = x_variable, y = y_variable)) +
geom_point() +
facet_wrap(~category_variable)  # Create multiple plots based on a category variable
```

Saving Your Plot

You can save your plot to a file using the ggsave() function. For instance:

```
ggsave("your_plot.png", width = 6, height = 4, dpi = 300)
```

Practice and Exploration

To become proficient in ggplot2, practice with your own datasets and explore the multitude of options and geoms available. The more you experiment, the better you'll become at creating rich and informative visualizations.

Community and Resources

Join the vibrant R and ggplot2 communities to seek help and share your visualizations. There are numerous online resources, tutorials, and books dedicated to ggplot2 to further your knowledge.

By mastering ggplot2, you'll have the tools to create complex and insightful visualizations, enhancing your ability to convey data-driven insights effectively.

Customizing Plot Aesthetics

In data visualization, customization is key to producing impactful visuals. We will explore how to fine-tune plot aesthetics, including colors, themes, and fonts, to ensure your visualizations are not only informative but also visually appealing.

In data visualization, customization plays a vital role in creating visually appealing and informative plots. ggplot2, the powerful visualization package in R, provides extensive options for customizing plot aesthetics, including colors, themes, and fonts.

Themes

ggplot2 offers various themes that control the overall appearance of your plots. The default theme is quite minimalist, but you can choose from themes like theme_minimal(), theme_bw(), or theme_classic() to change the look of your plot.

```
ggplot(data = your_data, aes(x = x_variable, y = y_variable)) + geom_point() + theme_minimal()
```

Colors

You can customize colors in your plot, from the fill and border colors of data points to the background and text colors. The scale_fill_manual() and scale_color_manual() functions allow you to define custom color palettes.

```
ggplot(data = your_data, aes(x = x_variable, y = y_variable, color = category_variable)) +
geom_point() +
scale_color_manual(values = c("red", "blue", "green"))
```

Fonts and Text

You can adjust text-related aesthetics, such as font size, font family, and text orientation. The theme() function can be used for this purpose.

```
ggplot(data = your_data, aes(x = x_variable, y = y_variable, label = data_labels)) +
geom_text(size = 12, family = "Arial", angle = 45) +
theme(text = element_text(family = "Arial", size = 14))
```

Legends and Axes

Customizing legends, titles, and axis labels is essential. You can use functions like labs() to change the plot title and axis labels. The theme() function is also handy for adjusting axis text.

```
ggplot(data = your_data, aes(x = x_variable, y = y_variable)) +
  geom_point() +
  labs(title = "Customized Plot Title", x = "X-Axis Label", y = "Y-Axis Label") +
  theme(axis.text.x = element_text(size = 12, angle = 45))
```

Saving Customized Plots

Once you've tailored your plot aesthetics, you can save your plot to a file using the ggsave() function.

```
ggsave("custom_plot.png", width = 6, height = 4, dpi = 300)
```

Specialized Data Manipulation and Visualization

The Time Traveler's Toolkit: lubridate

Time-related data can be a challenge to work with, but with the lubridate package, you can easily handle dates and times in R (Spinu et al., 2021). Participants will gain expertise in manipulating and analyzing temporal data, opening up a new dimension in data analysis.

The Time Traveler's Toolkit: lubridate

Working with time-related data can be challenging, but the lubridate package in R makes it significantly easier (Spinu et al., 2021). It provides functions for parsing, formatting, and manipulating date and time data. Here's how you can utilize lubridate:

Installing and Loading lubridate

If you haven't already, install the lubridate package and load it into your R environment.

```
install.packages("lubridate")

library(lubridate)
```

Parsing Dates

lubridate allows you to parse character strings into date objects using functions like ymd() (year, month, day) or dmy() (day, month, year). For example:

```
date_string <- "2022-12-31"

date <- ymd(date_string)
```

Date Arithmetic

You can perform various operations on date objects, such as calculating time intervals, adding or subtracting days, and finding the difference between two dates.

```
today <- ymd("2023-03-15")

future_date <- today + days(30)

time_difference <- difftime(future_date, today)
```

Extracting Components

lubridate allows you to extract specific components from date objects, such as year, month, day, hour, minute, and second.

```
year(today)

month(today)
```

Formatting Dates

You can format date objects into custom strings for presentation.

```
format(today, format = "%B %d, %Y")
```

Dealing with Time Zones

The package also handles time zones and daylight-saving time, ensuring accurate temporal calculations across different time zones.

lubridate is an invaluable toolkit for any data analyst or researcher working with temporal data, as it simplifies the often-complex tasks associated with time series analysis and data manipulation.

By mastering customization in ggplot2 and effectively managing time-related data with lubridate, you'll be well-equipped to create sophisticated visualizations and handle temporal data efficiently.

Mastering Categorical Data with forcats

The forcats package, developed by Hadley Wickham, equips you with a variety of functions to effectively manipulate and visualize categorical data.

Installation and Loading

If you haven't already, install the forcats package and load it into your R environment.

```
install.packages("forcats")
library(forcats)
```

Reordering Factor Levels

The forcats package allows you to reorder factor levels based on certain criteria, making it easier to control the order in which categorical variables are displayed in plots.

```
your_data$your_factor <- fct_reorder(your_data$your_factor, your_variable)
```

Changing Factor Levels

You can modify factor levels, merging or recoding them for better clarity in your visualizations.

your_data$your_factor <- fct_collapse(your_data$your_factor, "New Level" = c("Old Level 1", "Old Level 2"))

Visualizing Categorical Data

forcats provides functions like fct_count() to efficiently visualize the frequency of each level in a categorical variable.

```
ggplot(data = your_data, aes(x = fct_reorder(your_factor, your_variable))) +
  geom_bar() +
  coord_flip()
```

Dealing with Overlapping Labels

In some cases, you may encounter overlapping labels when visualizing categorical data. The fct_lump() function allows you to group infrequent levels into an "Other" category, reducing clutter.

```
your_data$your_factor <- fct_lump(your_data$your_factor, n = 5)
```

Expanding Horizons with gridExtra

The gridExtra package enhances your data visualization capabilities by enabling you to arrange multiple plots created with ggplot2 into a single visual display. This is invaluable for conveying complex information in a structured and comprehensive manner.

Installation and Loading

If you haven't already, install the gridExtra package and load it into your R environment.

```
install.packages("gridExtra")
library(gridExtra)
```

Creating Composite Plots

With gridExtra, you can create composite plots by arranging individual ggplot2 plots in various layouts, such as rows or columns.

```
composite_plot <- grid.arrange(plot1, plot2, ncol = 2)
```

Customizing Layouts

You have control over the arrangement, spacing, and alignment of the plots within the composite display, allowing you to design visuals that suit your specific needs.

```
composite_plot <- arrangeGrob(plot1, plot2, ncol = 2, top = "Composite Plot Title")
```

Saving Composite Plots

Once you've created a composite plot, you can save it as an image or incorporate it into reports and presentations.

```
ggsave("composite_plot.png", composite_plot, width = 8, height = 6, dpi = 300)
```

By mastering the forcats package for categorical data manipulation and the gridExtra package for advanced visualization, you'll have the tools needed to efficiently manage and visualize your data, especially when dealing with complex categorical information.

Throughout this module, you'll acquire advanced skills in data manipulation and visualization. The knowledge and tools gained here will empower you to tackle complex data analysis tasks, transform messy data into valuable insights, and create impactful visualizations. As you delve into the world of tidyr, dplyr, ggplot2, and specialized packages, your ability to work with diverse datasets and produce informative visuals will become second nature. These skills will serve as a solid foundation for advanced data analysis and exploration in your data science journey.

22 Module 4: Multiple Regression and Basic Programming Concepts

Multiple regression in R: modeling the relationship between multiple independent variables and one dependent variable.
Basic programming concepts in R: loops, if-else statements, and functions.
Using packages such as car and stargazer for more advanced modeling tasks such as diagnostic tests and model comparison.

In Module 4, we embark on a journey into the world of multiple regression and fundamental programming concepts within the R environment. Multiple regression is a powerful statistical method for modeling the relationships between multiple independent variables and a single dependent variable. Alongside this, we will explore essential programming concepts in R, such as loops, if-else statements, and the creation of functions. To elevate our analytical skills

further, we will introduce the use of specialized packages like car and stargazer for advanced modeling tasks including diagnostic tests and model comparison.

Multiple Regression in R: A Comprehensive Guide

Understanding Multiple Regression

Multiple regression is a statistical technique used to examine the relationships between a single dependent variable and multiple independent variables. It allows us to analyze how various factors influence the dependent variable and predict outcomes. In R, this technique is readily accessible through the lm() function, which fits linear regression models.

Performing Multiple Regression

To perform multiple regression in R, follow these key steps:

Data Preparation: Organize your dataset with the dependent variable and all independent variables. Ensure the data is clean and structured.

Model Fitting: Use the lm() function to create a linear regression model. The formula should include the dependent variable and all independent variables.

model <- lm(dependent_variable ~ independent_variable_1 + independent_variable_2 + ... + independent_variable_n, data = your_data)

Model Summary: Obtain a summary of the model to assess its significance and fit. You can use the summary() function to get an overview of the model's statistics.

summary(model)

Interpretation: Examine coefficients, p-values, and R-squared values to understand the relationships between variables and the model's predictive power.

In R, you can interpret the results of a multiple regression analysis by examining various statistics, including coefficients, p-values, and R-squared values. These statistics provide valuable insights into the relationships between variables and the predictive power of the regression model. Let's break down how to interpret these results step by step:

Coefficients (Beta Values)

Coefficients, often referred to as beta values, represent the estimated impact of each independent variable on the dependent variable.

A positive coefficient suggests a positive relationship: as the independent variable increases, the dependent variable is expected to increase.

A negative coefficient suggests a negative relationship: as the independent variable increases, the dependent variable is expected to decrease.

The magnitude of the coefficient indicates the strength of the relationship. Larger coefficients have a more significant impact.

For example, if you have an independent variable "X1" with a coefficient of 2.5, it implies that for every one-unit increase in "X1," the dependent variable is expected to increase by 2.5 units, holding other variables constant.

*P-Values*P-values (or significance levels) are associated with each coefficient. They indicate the probability of observing the coefficient's value by random chance, assuming there's no relationship between the independent variable and the dependent variable.

Lower p-values (typically below a significance level, e.g., 0.05) suggest that the independent variable is statistically significant and has a meaningful impact on the dependent variable.

Higher p-values imply that the independent variable may not be significant in explaining the variation in the dependent variable.

For instance, a p-value of 0.03 indicates that there is a 3% chance of observing the coefficient's value by random chance, which is considered statistically significant.

Adjusted R-squared Value

The R-squared value (R^2) measures the proportion of variance in the dependent variable that is explained by the independent variables in the model.

A higher R-squared value (closer to 1) indicates that the model explains a larger portion of the variance, suggesting a better fit.

A lower R-squared value (closer to 0) implies that the model doesn't explain much of the variance, indicating a weaker fit.

The adjusted R-squared value adjusts the R-squared value for the number of independent variables in the model. It accounts for overfitting by penalizing models with too many variables.

When interpreting R-squared values, consider the context of your data. In some cases, a lower R-squared value may still be meaningful if the dependent variable is influenced by numerous factors.

Overall Model Fit

The overall model fit is assessed by examining the ANOVA table (Analysis of Variance) or F-statistic.

The F-statistic tests the null hypothesis that all coefficients are equal to zero, indicating that the independent variables do not collectively influence the dependent variable.

A significant F-statistic (with a low p-value) suggests that at least one independent variable is relevant in explaining the variance in the dependent variable. It validates the overall model's significance.

If the F-statistic is not significant, it may indicate that your model does not adequately explain the variance in the dependent variable.

Interpreting multiple regression results in R involves a comprehensive understanding of these statistics. Consider both the individual coefficients and the overall model fit to draw meaningful conclusions about the relationships between variables and the predictive power of the model.

It's important to note that interpretation may vary based on the specific context and research questions, so always consider the practical implications of your findings.

Diagnosing Multiple Regression Models

Multiple regression is a powerful tool, but it's crucial to assess the model's assumptions and evaluate its performance. This is where the car package comes in handy. The car package provides functions for diagnosing assumptions and conducting various tests.

Using the car Package

To diagnose and enhance multiple regression models, follow these steps:

Installation and Loading

If you haven't already, install the car package and load it into your R environment.

```
install.packages("car")
library(car)
```

Checking Assumptions

Use the crPlots() function to create component-plus-residual (partial residual) plots, which help identify potential outliers and influential data points.

```
crPlots(model)
```

Outlier Tests

The outlierTest() function detects influential outliers in your model. It can be especially useful in ensuring the reliability of your results.

```
outlierTest(model)
```

Overall Model Fit

Assess the overall fit of the model with the Anova() function, which performs an analysis of variance.

```
Anova(model)
```

Basic Programming Concepts in R

Loops in R

Loops are fundamental for automating repetitive tasks. In R, you can use different types of loops, such as for and while loops, to iterate through data or perform computations.

For Loop

A for loop is used to repeat a set of statements for a specific number of times or for each element in a sequence, such as a vector.

```
for (i in 1:10) {
  print(paste("This is iteration", i))
}
```

While Loop

A while loop continues as long as a specified condition is met. It is particularly useful when the number of iterations is not known in advance.

```
count <- 1
while (count <= 5) {
  print(paste("This is iteration", count))
  count <- count + 1
}
```

If-Else Statements in R

Conditional statements, like if-else, are essential for controlling the flow of your R code. They allow you to execute specific code based on whether a condition is met.

If Statement

The if statement evaluates a condition and executes a block of code if the condition is TRUE.

```
x <- 5
if (x > 4) {
  print("x is greater than 4")
}
```

If-Else Statement

The if-else statement provides an alternative block of code to execute if the initial condition is FALSE.

```
x <- 3
if (x > 4) {
  print("x is greater than 4")
} else {
  print("x is not greater than 4")
}
```

Creating and Using Functions in R

Functions in R allow you to encapsulate a set of operations into a reusable block of code. This makes your code more organized and easier to maintain.

Defining Functions

To create a function in R, you use the function() keyword, specifying arguments and the code to execute.

```
my_function <- function(arg1, arg2) {
  result <- arg1 + arg2
```

```
  return(result)
}
```

Calling Functions

Once you've defined a function, you can call it with specific arguments to perform the desired computations.

```
output <- my_function(3, 5)
print(output)  # Output: 8
```

Advanced Modeling Tasks with the stargazer Package

The stargazer package is a powerful tool for presenting the results of multiple regression models in a clear and standardized manner. It creates LaTeX or HTML tables that display the coefficients, R-squared values, and other relevant statistics.

Using stargazer

To enhance your model comparison and reporting, utilize the stargazer package:

Installation and Loading:

Install the stargazer package and load it into your R environment.

```
install.packages("stargazer")
library(stargazer)
```

Generate Regression Tables

Use the stargazer() function to create regression summary tables for multiple models. You can specify which models to include in the table.

```
stargazer(model1, model2, model3, type = "html")
```

Customization

Customize the appearance and content of your regression tables with various options available in stargazer. You can change table titles, add notes, and select which statistics to display.

```
stargazer(model1, model2, type = "html",
 title = "Regression Model Comparison",
notes = "Table notes and descriptions.")
```

In Module 4, you delved into the world of multiple regression, sharpen your programming skills, and learn to use the car and stargazer packages for advanced modeling and diagnostics. These essential skills will equip you to tackle complex data analysis tasks and communicate your results effectively.

23 Module 5: Advanced Statistical Analysis and Time Series Analysis

Advanced statistical analysis in R: factor analysis, cluster analysis, and time series analysis. Introduction to time series analysis: modeling and forecasting time-dependent data. Applications of time series analysis in various fields.

Welcome to Module 5, where we embark on an exciting journey into the realm of advanced statistical analysis and delve into the intriguing domain of time series analysis. In this comprehensive tutorial, we will explore various statistical techniques that extend your analytical capabilities and enable you to extract valuable insights from complex data. Additionally, we will introduce the fundamentals of time series analysis, a crucial tool for modeling and forecasting time-dependent data, with practical applications in diverse fields. By the end of this module, you will have a strong grasp of the mentioned topics (Dagum, 2001; Lévy & Parzen, 2013).

Advanced Statistical Analysis in R

Unveiling Hidden Patterns with Factor Analysis

Factor analysis is a powerful statistical technique that enables you to uncover latent structures within a dataset. By identifying patterns among observed variables, it simplifies complex data and reduces dimensionality. In R, we will guide you through the process of conducting factor analysis, from understanding factor rotation methods to interpreting factor loadings. You will gain expertise in:

- Determining the adequacy of your data for factor analysis.
- Extracting factors and understanding their significance.
- Using factor scores for dimension reduction.
- Implementing exploratory and confirmatory factor analysis techniques.
- Unveiling Hidden Patterns with Factor Analysis

Factor analysis is a robust and widely used statistical technique that empowers analysts and researchers to discover underlying structures or latent factors within a dataset. This method is invaluable for simplifying complex data, uncovering relationships among observed variables, and reducing data dimensionality. In this section, we will guide you through the process of conducting factor analysis in R, equipping you with the knowledge and skills to unveil hidden patterns within your data.

Step 1: Data Adequacy Assessment

Before diving into factor analysis, it's crucial to evaluate whether your dataset is suitable for this technique. Factor analysis relies on the assumption that observed variables are linearly related to latent factors, which implies multivariate normality. You can perform the following checks to ensure the adequacy of your data:

Bartlett's Test of Sphericity: This test assesses whether the correlation matrix of your variables is an identity matrix, which is required for factor analysis. In R, you can use the cortest.bartlett() function to conduct this test.

Kaiser-Meyer-Olkin (KMO) Measure: The KMO measure evaluates the proportion of variance in your variables that may be caused by underlying factors. A higher KMO value (usually above 0.6) indicates better suitability for factor analysis. You can calculate KMO using the KMO() function.

Step 2: Factor Extraction

Factor extraction involves identifying and extracting latent factors from your dataset. There are various extraction methods available, with principal component analysis (PCA) and maximum likelihood (ML) being among the most common. The choice of method depends on your data and research objectives.

Principal Component Analysis (PCA): This method aims to capture as much variance as possible in a few factors. It's particularly useful for data reduction. In R, you can perform PCA using the prcomp() function.

Maximum Likelihood (ML): ML estimation assumes a specific distribution (usually multivariate normal) and is more suitable when the normality assumption is met. You can run ML factor analysis using the factanal() function.

Step 3: Factor Rotation

Factor rotation is an essential step to simplify the interpretation of extracted factors. It aims to produce a clear and interpretable factor structure. There are different rotation methods available, including Varimax, Promax, and Oblimin. The choice of method depends on your research goals and the relationships you expect between factors.

Varimax Rotation: Varimax is an orthogonal rotation method that aims to maximize the variance of factor loadings, resulting in non-correlated factors. You can apply Varimax rotation in R using the varimax() function.

Promax and Oblimin: These are oblique rotation methods that allow factors to be correlated. Use the promax() or oblimin() functions for oblique rotation.

Step 4: Interpretation of Factor Loadings

Interpreting factor loadings is the crux of factor analysis. These loadings represent the strength and direction of the relationship between observed variables and the extracted factors. A high loading indicates a strong connection. Researchers typically interpret loadings above 0.3 as meaningful.

Step 5: Factor Scores

Factor scores are values that represent the influence of each latent factor for each observation. They are valuable for further analyses and data reduction. You can compute factor scores using the factanal() function in R.

Step 6: Exploratory vs. Confirmatory Factor Analysis

Factor analysis can be exploratory or confirmatory. Exploratory Factor Analysis (EFA) is used to discover underlying structures within the data without preconceived hypotheses. In contrast, Confirmatory Factor Analysis (CFA) tests a specific model based on predefined

hypotheses. R offers various packages for both EFA and CFA, such as 'psych' for EFA and 'semTools' for CFA.

By following these steps and leveraging R's capabilities, you will become proficient in factor analysis, from assessing the adequacy of your data to interpreting extracted factors and factor loadings. This technique is an invaluable tool for uncovering the hidden patterns and relationships within your datasets.

Clustering for Data Segmentation

Cluster analysis is your gateway to discovering natural groupings within your data. R offers a multitude of clustering algorithms, and we will help you navigate through them. You will become proficient in:

- Identifying the types of clustering methods and their appropriate applications.
- Preparing data for cluster analysis.
- Conducting hierarchical and k-means clustering.
- Interpreting and visualizing clustering results.

Cluster analysis, often referred to as clustering, is a powerful statistical technique that aims to uncover natural groupings or clusters within a dataset. By identifying and grouping data points with similar characteristics, cluster analysis simplifies data exploration, pattern recognition, and decision-making. In this section, we will guide you through the process of conducting cluster analysis in R, empowering you to identify meaningful clusters within your data.

Step 1: Types of Clustering Methods

Before delving into cluster analysis, it's essential to understand the various types of clustering methods and their appropriate applications. The main types of clustering methods include:

Hierarchical Clustering: This method creates a tree-like structure (dendrogram) that represents the relationship between data points. Hierarchical clustering is ideal for identifying hierarchical structures within the data.

K-Means Clustering: K-means clustering partitions the data into a predefined number (k) of clusters. It's suitable for identifying non-hierarchical clusters.

DBSCAN (Density-Based Spatial Clustering of Applications with Noise): DBSCAN is a density-based clustering method that identifies clusters of data points based on their density within the dataset. It's effective in detecting clusters with irregular shapes.

Agglomerative Clustering: Agglomerative clustering is a hierarchical method that starts with each data point as a single cluster and gradually merges clusters to form larger ones.

Model-Based Clustering: Model-based clustering uses probabilistic models to identify clusters. The expectation-maximization (EM) algorithm is often used in this approach.

The choice of clustering method depends on the nature of your data, the number of clusters you wish to identify, and the characteristics of the clusters you expect.

Step 2: Data Preparation

Proper data preparation is essential before conducting cluster analysis. Key data preparation steps include:

Data Scaling: Ensure that variables are on the same scale to prevent certain variables from dominating the clustering process. Standardization (z-score scaling) is commonly used for this purpose.

Missing Data Handling: Address missing data, either through imputation or removal.

Outlier Treatment: Identify and handle outliers that may adversely affect the clustering results.

Step 3: Hierarchical Clustering

Hierarchical clustering is particularly useful when you want to explore hierarchical relationships in your data. The steps involved in hierarchical clustering include:

Data Distance Calculation: Calculate the distance between data points. Common distance metrics include Euclidean distance, Manhattan distance, and correlation distance.

Linkage Method Selection: Choose a linkage method that determines how clusters are merged. Common linkage methods include single linkage, complete linkage, and average linkage.

Dendrogram Visualization: Create a dendrogram to visualize the hierarchical relationships within the data.

Step 4: K-Means Clustering

K-means clustering partitions the data into k clusters. The steps involved in K-means clustering include:

K Determination: Decide on the number of clusters (k) based on your research goals or by using methods like the elbow method or silhouette analysis.

Initialization: Select initial cluster centroids, which can affect the clustering results. R's kmeans() function performs this task.

K-Means Clustering: Execute K-means clustering using R's kmeans() function. This process assigns each data point to the nearest centroid, iteratively updating the centroids.

Interpretation and Visualization: Interpret and visualize the clustering results to gain insights into the identified clusters.

Step 5: Interpretation and Visualization

After performing hierarchical or K-means clustering, it's crucial to interpret and visualize the results. Common techniques for interpretation include assessing the characteristics of each cluster, comparing cluster means, and identifying features that distinguish clusters. Visualization techniques include scatterplots, cluster profiles, and silhouette plots.

By following these steps and leveraging R's capabilities, you will become proficient in cluster analysis, from selecting appropriate clustering methods to data preparation, clustering execution, and interpretation of results. Cluster analysis is an invaluable tool for discovering inherent structures within your data, aiding in segmentation, classification, and pattern recognition.

Introduction to Time Series Analysis

The Time-Dependent Data Universe

Time series data is ubiquitous, and it provides invaluable insights into the dynamics of phenomena that evolve over time. We will lay the groundwork for understanding time series data and its significance in various domains. Key concepts include:

- Recognizing the structure of time series data.
- Understanding the different components of time series: trend, seasonality, and noise.
- Identifying the applications of time series analysis in fields like finance, economics, and environmental science.

Time series data is a specialized form of data that records observations at different points in time. It's particularly valuable for studying phenomena that evolve over time, such as stock prices, weather patterns, and economic indicators. In this section, we will explore the basics of handling time series data in R, including recognizing its structure, understanding its components, and identifying its applications in various domains.

Step 1: Recognizing the Structure of Time Series Data

Time series data has a distinct structure that sets it apart from cross-sectional data. When working with time series data in R, it's important to recognize this structure. Here are the key characteristics of time series data:

Temporal Order: Data points are ordered chronologically, with each observation associated with a specific time or date.

Equidistant Time Intervals: Ideally, time series data has a constant time interval between observations. For example, data may be recorded every hour, day, month, or year.

Temporal Dependence: Observations in a time series dataset are often correlated or dependent on previous observations. This autocorrelation is a fundamental aspect of time series analysis.

Step 2: Understanding the Components of Time Series

Time series data can be decomposed into three main components:

Trend: The long-term movement or pattern in the data. Trends can be upward (increasing), downward (decreasing), or flat (stable).

Seasonality: The short-term, repetitive patterns or cycles in the data. For example, retail sales often exhibit a seasonal pattern with increased sales during holidays.

Noise: The random fluctuations or irregular components of the data that are not explained by the trend or seasonality.

Understanding these components is crucial for modeling and analyzing time series data effectively.

Step 3: Identifying the Applications of Time Series Analysis

Time series analysis has a wide range of applications across various fields:

- Finance: In finance, time series analysis is used to predict stock prices, analyze market trends, and assess investment risks.
- Economics: Economists use time series data to study economic indicators like GDP, inflation rates, and unemployment rates.
- Environmental Science: Time series analysis helps environmental scientists monitor climate data, pollution levels, and ecological changes over time.
- Epidemiology: Epidemiologists rely on time series data to track the spread of diseases, analyze health trends, and evaluate public health interventions.
- Operations Research: Time series analysis is used to optimize inventory management, production scheduling, and demand forecasting in operations research.

Step 4: Time Series Analysis in R

R offers a range of packages and functions for time series analysis. Some of the core packages include:

xts: This package provides an extensible time series class, which is a crucial data structure for working with time series data in R.

zoo: The zoo package is designed for ordered observations and provides various methods for handling time series data.

forecast: The forecast package is particularly useful for time series forecasting, including methods like exponential smoothing and ARIMA.

ggplot2: While ggplot2 is a data visualization package, it's invaluable for creating insightful time series plots to visualize trends and patterns.

TTR (Technical Trading Rules): This package contains functions for technical analysis of financial time series data.

By understanding the structure of time series data, recognizing its components, and knowing its diverse applications, you'll be well-equipped to harness the power of time series analysis in various domains using R. Whether you're exploring financial data, tracking environmental changes, or forecasting economic trends, time series analysis is a vital tool for unlocking the secrets hidden within your temporal data.

Time Series Modeling and Forecasting

Time series analysis encompasses modeling and forecasting, allowing us to make predictions based on historical data. We will delve into the following essential topics:

- Selecting and fitting time series models, including ARIMA (AutoRegressive Integrated Moving Average).
- Assessing model adequacy and diagnostic checks.
- Forecasting future values and understanding prediction intervals.

Time series modeling and forecasting are essential tasks for understanding and making predictions based on historical data. In this section, we'll explore key concepts and techniques for modeling and forecasting time series data in R.

Step 1: Selecting and Fitting Time Series Models

Choosing the Right Model: The first step in time series modeling is to select an appropriate model. A common choice is the ARIMA model, which stands for AutoRegressive Integrated Moving Average. ARIMA models encompass autoregressive (AR) and moving average (MA) components, and differ by the orders of differencing (I).

Stationarity: To fit an ARIMA model, you'll often need to ensure that your time series data is stationary, meaning that its statistical properties remain constant over time. Stationarity can be achieved through differencing (I component) and other transformation techniques.

Model Identification: The next step is identifying the orders of AR, I, and MA components of the ARIMA model. This can be done using diagnostic tools like ACF (AutoCorrelation Function) and PACF (Partial AutoCorrelation Function) plots.

Fitting the Model: Once the model orders are determined, you'll fit the ARIMA model to your data. R provides functions like arima() or auto.arima() from the forecast package to estimate the model parameters.

Step 2: Assessing Model Adequacy and Diagnostic Checks

Diagnostic Checks: After fitting the model, it's essential to conduct diagnostic checks. These checks include examining the residuals to ensure they meet the assumptions of white noise (independent, identically distributed errors).

Ljung-Box Test: The Ljung-Box test can help you assess the absence of serial correlation in the residuals, which is a critical assumption of ARIMA models.

Step 3: Forecasting Future Values and Prediction Intervals

Forecasting: The primary goal of time series modeling is to make forecasts. R provides functions like forecast() that can generate forecasts for future values based on your ARIMA model.

Prediction Intervals: In addition to point forecasts, it's crucial to provide prediction intervals to quantify the uncertainty of your forecasts. These intervals account for the range within which future observations are likely to fall.

Visualization: Visualizing your forecasts and prediction intervals using plots and charts is essential for effective communication of results. R offers visualization packages like ggplot2 for creating insightful time series plots.

By selecting and fitting an appropriate time series model, assessing its adequacy through diagnostic checks, and generating forecasts with prediction intervals, you'll be well-prepared to conduct time series modeling and forecasting in R. These skills are invaluable for various applications, including financial forecasting, demand prediction, and understanding the temporal patterns in your data.

Practical Applications of Time Series Analysis

We will conclude our journey by exploring real-world applications of time series analysis across various domains. You will discover how time series analysis:

- Facilitates economic forecasting, helping governments and businesses plan for the future.
- Enhances environmental research by analyzing climate data and ecological trends.
- Supports stock market prediction and portfolio management in the world of finance.
- Optimizes supply chain management, ensuring efficient resource allocation.

Time series analysis is a versatile and powerful tool with numerous practical applications across various domains. In this section, we'll delve into some of the real-world applications of time series analysis:

1. Economic Forecasting

Why It Matters: Economic forecasting plays a pivotal role in helping governments, businesses, and financial institutions plan for the future. Understanding economic trends and predicting key indicators, such as GDP growth, unemployment rates, and inflation, is essential for making informed decisions.

Application: Time series analysis is used to analyze historical economic data to forecast future trends. This includes understanding business cycles, seasonal patterns, and identifying potential turning points in the economy.

2. Environmental Research

Why It Matters: Environmental research relies on the analysis of time series data to monitor and understand changes in climate, weather patterns, and ecological trends. This information is crucial for making informed decisions related to conservation, resource management, and climate change mitigation.

Application: Time series analysis is used to assess long-term climate data, study the effects of natural disasters, analyze ecological changes over time, and predict future environmental trends. It can also be used to model the impact of climate change on various ecosystems.

3. Finance and Stock Market Prediction

Why It Matters: The financial world heavily depends on time series analysis to predict stock prices, optimize portfolios, and make investment decisions. Accurate predictions are essential for portfolio management, risk assessment, and financial planning.

Application: Time series analysis is used in finance to model stock price movements, analyze historical stock returns, and forecast future price trends. It's employed in algorithmic trading, risk assessment, and the development of trading strategies.

4. Supply Chain Management

Why It Matters: Efficient supply chain management is critical for businesses to optimize resource allocation, minimize waste, and meet customer demands. Time series analysis is instrumental in understanding demand patterns, identifying peak seasons, and streamlining the allocation of resources.

Application: Time series analysis helps businesses predict future demand for products, manage inventory effectively, and optimize production schedules. It can also be used to understand seasonal variations in demand, allowing for better resource allocation.

5. Psychological Evaluation

Why It Matters: Psychological evaluation relies on the analysis of time series data to understand and predict changes in psychological and emotional states over time. This is essential in clinical psychology, where patient progress and mental health assessments often involve longitudinal data.

Application: Time series analysis is employed to track changes in psychological variables, such as mood, stress levels, or mental health symptoms over time. It aids in the development of predictive models for patient outcomes and supports evidence-based decision-making in clinical and counseling settings.

In each of these practical applications, time series analysis provides valuable insights into historical data and empowers decision-makers to anticipate future trends and make informed choices. The ability to extract meaningful information from time-dependent data is a fundamental skill that enhances planning, resource allocation, and problem-solving across diverse fields.

Time series analysis in R involves several steps to examine and model time-dependent data. Here is a basic guide to help you get started:

1. Loading Necessary Libraries

Begin by launching R or RStudio and loading the required libraries. Common packages for time series analysis include stats, forecast, and TSA.

```
library(stats)
library(forecast)
library(TSA)
```

2. Data Preparation

Import your time series data. Ensure that the data is in a format compatible with R. You can use read.csv(), read.table(), or specific packages like readr for data import.

```
# Example data import
data <- read.csv("your_data.csv")
```

3. Time Series Object

Convert your dataset into a time series object using the ts() function. Specify the frequency of observations if necessary (e.g., daily, monthly, etc.).

```
# Create a time series object
time_series_data <- ts(data, frequency = 12)
```

4. Visualize Data

Plot the time series data to explore its characteristics. Use plot() to create a basic plot.

```
# Plot the time series
plot(time_series_data)
```

5. Decomposition

Examine the time series components. Decompose it into trend, seasonality, and noise using the decompose() function. This helps you understand underlying patterns in the data.

```
# Decompose the time series
decomposed <- decompose(time_series_data)
plot(decomposed)
```

6. Model Selection

Choose an appropriate time series model. Common options include ARIMA (AutoRegressive Integrated Moving Average) and exponential smoothing. Use functions like auto.arima() to automatically select the best model.

```
# Fit an ARIMA model
model <- auto.arima(time_series_data)
```

7. Model Diagnostics

Assess the adequacy of your time series model using diagnostic plots, such as ACF (AutoCorrelation Function) and PACF (Partial AutoCorrelation Function). These can be generated with the Acf() and Pacf() functions.

```
# Model diagnostics
Acf(residuals(model))
Pacf(residuals(model))
```

8. Model Forecasting

Use your selected model for time series forecasting. The forecast() function can help with this.

```
# Forecasting
forecasted_data <- forecast(model, h = 12)  # Example: forecasting the next 12 time points
```

9. Visualization of Forecasts

Plot the forecasts along with prediction intervals to visualize future values.

```
# Plot forecasts
plot(forecasted_data)
```

10. Evaluation

Evaluate the forecast accuracy using measures such as Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and others.

This is a simplified overview of time series analysis in R. More advanced techniques and specific models may be applied depending on your data and research goals. Remember to consult documentation and tutorials for the specific packages you are using, as well as to continually refine your analysis based on the characteristics of your data.

This module was designed to equip you with advanced analytical skills that are invaluable in understanding complex data structures, identifying patterns, and making informed predictions based on time-dependent information. Whether you're engaged in academic research, data science, or industry-specific analysis, the knowledge gained here will empower you to tackle intricate data analysis challenges with confidence.

Note: This module assumes a foundational understanding of statistical concepts and data analysis in R. If you are new to these topics, we recommend starting with our introductory modules on statistical analysis and R programming.

24 References

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