DYNAMICS OF INTERDISCIPLINARY RESEARCH AND DEVELOPMENT IN HIGHER EDUCATION

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Abstract

The role of interdisciplinarity becomes complex in the increasingly competitive landscape of higher education. Addressing global social issues necessitates interdisciplinary approaches, widely employed in higher education for holistic learning and adaptable graduates. While discipline boundaries persist, they are crucial for universities navigating intense competition. This article critically examines the growing need for interdisciplinarity in higher education and research. It underscores its importance in social policy research and teaching and presents a model framework outlining the interdisciplinary research process, including its steps, advantages, and disadvantages.

Keywords: Interdisciplinary, Research, Higher Education.

INTRODUCTION

In response to critiques about the specialization of research universities, institutions are embracing interdisciplinary education as a means to cultivate future leaders in interdisciplinary research (**Manathunga, Lant, and Mellick, 2006**). It is not surprising that many research universities, including the one in our study, have incorporated multidisciplinary education into their institutional strategies (**Lyall et al., 2015**). The research institution in focus considers interdisciplinary education a strategic goal. In pursuit of this, the institution has established small-scale interdisciplinary research programs. These programs aim to develop and test multidisciplinary teaching approaches, foster the professional growth of lecturers, and explore the practical implications of interdisciplinary research within the framework of a predominantly disciplinary organized comprehensive research university.

What is Research?

Research is a systematic process aimed at discovering new knowledge. According to the Code of Federal Regulations (**45 CFR 46.102d**), which pertains to the protection of human subjects, research is defined as "A systematic investigation (i.e., the gathering and analysis of information) designed to develop or contribute to generalizable knowledge." The National Academy of Sciences further emphasizes that the objective of research is to "extend human knowledge of the physical, biological, or social world beyond what is already known." What sets research apart from other knowledge acquisition methods, such as reading a book, is its reliance on the Scientific Method, a

systematic approach. The accompanying figure illustrates the stages of the scientific method.
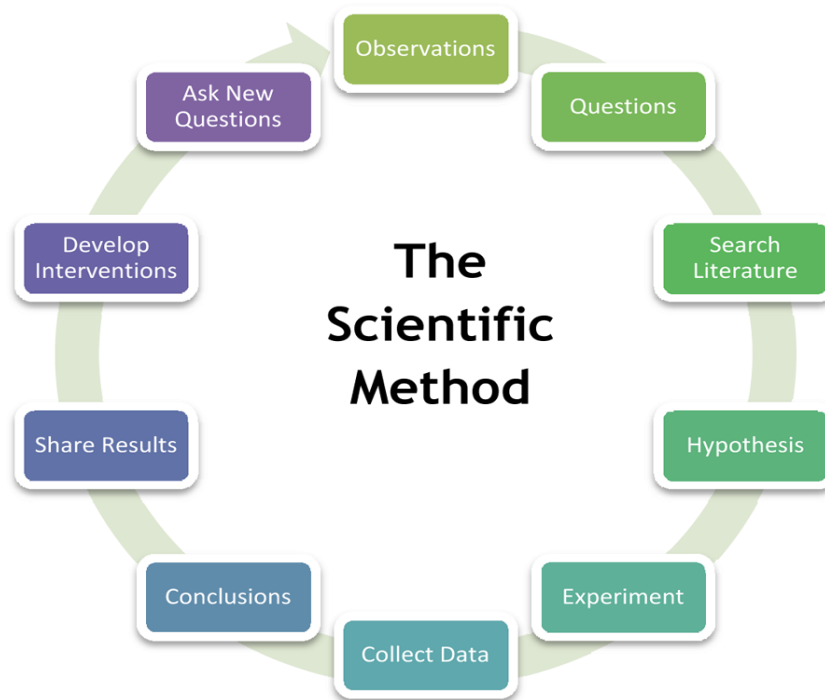

Fig 1: The Process of Scientific Method

The scientific method involves observing one's surroundings and creating a hypothesis regarding the relationships between elements. A hypothesis is an educated and well-informed prediction or explanation. Testing the hypothesis and analyzing the results in connection to both the hypothesis and the external environment are integral steps in the research process.

The researcher's hypothesis acts as a guide for the research endeavor, outlining the key variables to investigate and how they might be interconnected or affected by a research-induced change, such as a program, treatment, or environmental alteration.

What is Interdisciplinary Approach to Research?

Interdisciplinary understanding, defined as knowledge and skills enabling cognitive enhancements beyond the scope of monodisciplinary programs, is increasingly offered as degree programs at comprehensive research universities (**Creswell, 2020**). Scientific research spanning multiple disciplines plays a crucial role in advancing science and the social sciences, leading to numerous studies on interdisciplinary research from various perspectives (**Ledford, 2015**).

Interdisciplinary understanding encompasses six key elements: knowledge of different disciplinary paradigms, knowledge of interdisciplinarity, reflection skills, critical reflection skills, communication skills, and collaboration skills. However, there is a lack of empirical

evidence to support this conceptualized model. Interdisciplinary education emerges as a promising teaching approach, equipping students to navigate a complex world.

In higher education, interdisciplinary learning outcomes have been conceptualized in diverse ways. The majority of these conceptualizations underscore the integration of ideas, information, and techniques from multiple academic fields to enhance students' understanding of a phenomenon or issue. We have embraced the concept of interdisciplinary understanding as a learning outcome in interdisciplinary education, as defined by **Boix Mansilla, Miller, and Gardner (2000):**

"The capacity to integrate knowledge and modes of thinking in two or more disciplines or established areas of expertise to produce a cognitive enhancement—such as explaining a phenomenon, solving a problem, or creating a product—in ways that would have been impossible or unlikely through single disciplinary means".

The term "interdisciplinary" is employed in education and training pedagogies to describe studies that utilize methods and insights from multiple established disciplines or traditional fields of study.

Interdisciplinary approaches are often applied in areas where the subject is perceived to be neglected or misrepresented within the traditional disciplinary structure of research institutions. Interdisciplinary programs integrate knowledge from two or more academic disciplines, fostering a robust learning experience that emphasizes integrative learning, critical thinking, and creative problem-solving.

This approach allows students to learn by establishing connections between ideas and concepts across different disciplines, enabling them to apply knowledge gained in one discipline to deepen their learning experiences in another. The primary objective of interdisciplinary research is to develop a comprehensive and inclusive understanding of a topic, offering diverse perspectives that can lead to unique intellectual discoveries.

Interdisciplinary Research Process

Interdisciplinary research is a research process where the investigator explores two or more academic disciplines in their studies. The term "interdisciplinary" denotes the involvement of multiple disciplines, each defined as a distinct field of study or branch of knowledge. In interdisciplinary research, various disciplines—whether academic, artistic, or scientific—are combined to enhance the perspective of the project.

The primary objective of interdisciplinary research is to cultivate a broad and inclusive understanding of a topic, offering diverse perspectives that can lead to unique intellectual discoveries. Most academic or scientific fields can incorporate an interdisciplinary approach. For instance, in business, interdisciplinary research might integrate economics, management, ethics, and communication. The accompanying figure clearly outlines the design of interdisciplinary research.
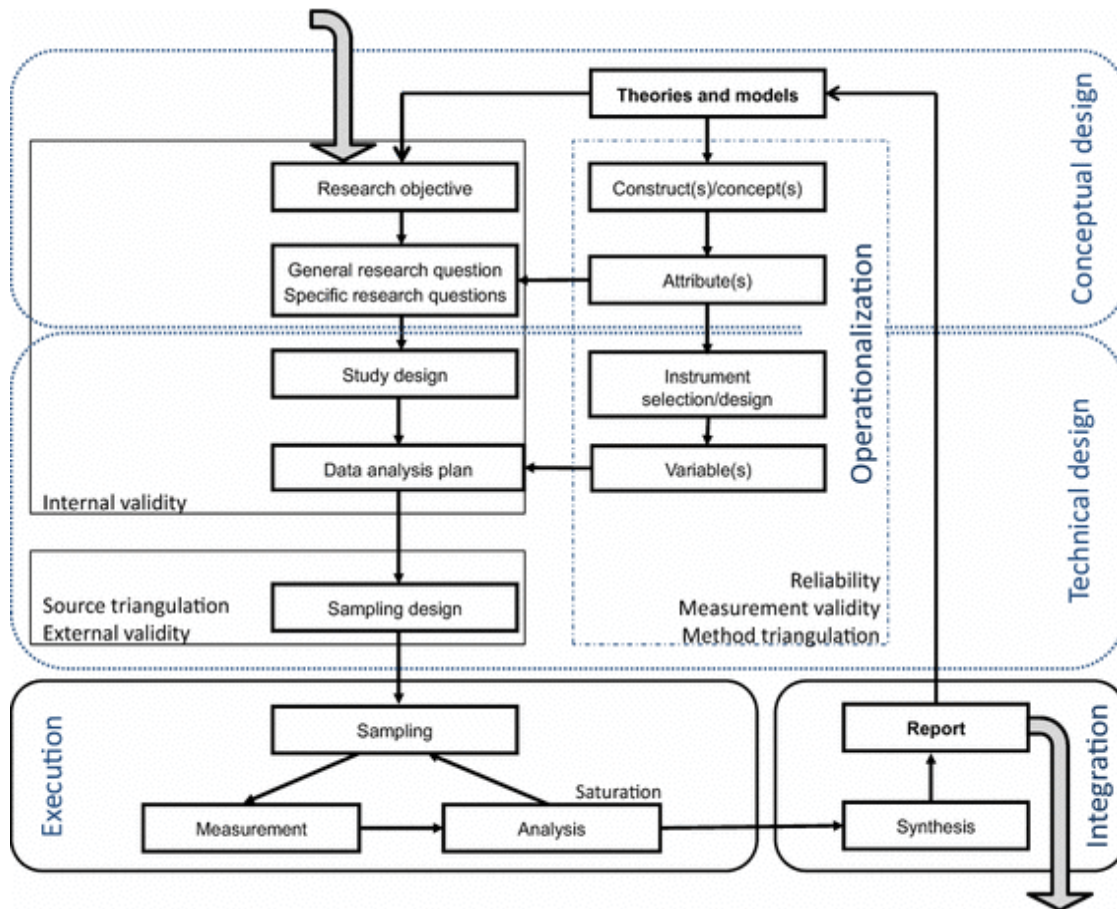
Fig 2: Interdisciplinary Research Design

Interdisciplinary research involves the integration of two or more disciplines related to the research subject (**Jones, C. 2009**). This research process often combines quantitative (numerical information) and qualitative (non-numerical information) research methods. For example, in a study on the effects of modern agriculture on society, the researcher may examine quantitative studies to understand how many people are fed by modern agriculture, and also explore qualitative sources, such as interviews, to understand the effects of living near industrial animal farming facilities. In interdisciplinary research, the investigator formulates a question, consults information from multiple disciplines, and synthesizes the information to create a comprehensive explanation.

Interdisciplinary research involves a comprehensive process, as outlined by **Allen F. Repko (2020)** in his book "Interdisciplinary Research: Process and Theory" (2020). The process consists of ten key steps, briefly summarized as follows: determining the problem or question, selecting relevant disciplines, conducting research, comparing insights to the problem while eliminating biases or conflicts, and finally, synthesizing and testing the information.

In the contemporary landscape, interdisciplinary research is recognized as the most effective approach to address complex socio-economic problems and is increasingly acknowledged as the optimal method for cultivating new streams of knowledge. This collaborative form of research brings together experts from diverse disciplines to collaboratively tackle shared challenges and catalyze scientific breakthroughs.

An exemplary instance of interdisciplinary research is found in the field of neuroeconomics. This discipline merges economic concepts with insights from neuroscience to gain a more profound understanding of the neural mechanisms influencing economic behavior and, consequently, human decision-making. Another illustration is seen in materials science, where interdisciplinary collaboration across engineering, physics, and chemistry leads to the development of innovative materials with unique properties. These interdisciplinary studies yield groundbreaking findings with the potential to revolutionize socio-economic development, transform industries, and enhance our understanding of complex systems.

Allen F. Repko's Ten Steps to the Interdisciplinary Research Process

The interdisciplinary research process, as outlined by **Repko (2020)**, is a comprehensive ten-step approach:

1) Define the research problem and/or create a focus question.

2) Ensure there is justification for using an interdisciplinary approach.

3) Identify and select disciplines that are relevant to the problem/question.

4) Search for literature that relates to both the disciplines and the problem/question.

5) Develop understanding and adequacy in the chosen research disciplines.

6) Analyse the problem/question under each insight gained during steps 4 and 5.

7) Identify any conflicts in the insights and find the source of the conflicts.

8) Find or create common ground between the disciplines and insights.

9) Integrate the insights from the disciplines used.

10) Produce an interdisciplinary understanding of the problem/question and check it for validity.

This systematic process ensures a thorough and cohesive interdisciplinary research endeavour.

Steps of Interdisciplinary Research

1. Identify the research problem and formulate the common goal or objective.

The research question must be clearly stated, taking into account the topic at hand, any related problems, and the approach that will be applied. This will assist in creating a structured framework that addresses the prevalent issues and helps to define the project's target goals or objective.

2. Develop IDR Proposal

In this stage of crafting an IDR (Interdisciplinary Research) proposal, it is critical to articulate the rationale for employing IDR, elucidate the functions of other disciplines, outline methods for seamlessly integrating these diverse disciplines, provide a succinct overview of the skills possessed by the involved researchers, lay out a well-defined plan for engaging stakeholders, elucidate the anticipated benefits along with the roles and contributions expected from stakeholders, and include a detailed mention of the budget, incorporating any additional expenditures that may be necessary. This comprehensive approach ensures clarity and transparency in the interdisciplinary research proposal.

3. Form and develop a Team

Selecting capable researchers who are eager to collaborate truly in an interdisciplinary team as team members is crucial when putting together a coherent IDR team. Individual traits, areas of competence, and a supportive attitude towards multidisciplinary teamwork should all be taken into account when choosing team members.

4. Reviewing IDR Proposal

When submitting the IDR proposal for review, it is essential to engage a competent reviewer. The reviewer's assessment should focus on the nature of the research project and its interdisciplinary aspects. This examination includes evaluating the methodology's capacity to address novel issues or span multiple disciplines, assessing the technical or policy relevance, and scrutinizing the strategies outlined for fostering a shared research vision and identity among the team members. This comprehensive review ensures that the interdisciplinary nature of the research is robustly considered, fostering a stronger and more impactful research endeavour.

5. Select a competent leader to select partners for collaboration

Selecting a strong team leader for an interdisciplinary research (IDR) project is paramount. The leader should possess the willingness and ability to coordinate and collaborate across different disciplines, regional, national, and international networks. Key attributes for an effective IDR leader include:

- The ability to mobilize and coordinate a diverse team effectively.
- Capability to build and maintain networks, both within and outside the team.
- Proficiency in negotiation and a broad understanding of various disciplines.
- Capacity to recruit personnel from diverse disciplines and institutes for projects.
- Excellent interpersonal skills and the ability to build a cohesive team.
- A dynamic approach to problem-solving and adaptability to diverse situations.
- Ability to interact productively with research partners.
- Possession of leadership skills with an IDR vision and interest in various subjects.

- Openness to new methods and data from different disciplines.

- Ability to organize team functioning and allocate responsibilities based on team members' expertise.

- Capability to assign appropriate roles to team members and foster a supportive team environment.

In essence, the IDR leader should be approachable, open to new ideas, and able to create an environment that encourages collaboration and innovation within the interdisciplinary team.

6. Management of IDR Teams

Indeed, effective management is crucial for the success of an interdisciplinary team. A leader's management-related responsibilities encompass the ability to negotiate with stakeholders from diverse disciplines and navigate across disciplinary boundaries and issues. Additionally, the leader plays a vital role in fostering the formation of a cohesive team identity. This involves ensuring that all researchers collaborate as a unified team, transcending the differences in their respective disciplines and recognizing the unique roles each discipline plays in the research process. Building a sense of shared purpose and identity within the team is fundamental to achieving collective success in interdisciplinary research endeavors.

7. Collection and Analysis of Data

In an interdisciplinary research (IDR) project, data collection should align with the stated objectives and follow a predetermined schedule that includes active participation from all team members representing different disciplines. The collected data should undergo analysis through collaborative efforts, involving discussions and consultations among participants from diverse disciplines. This approach is crucial in the IDR process, which seeks to integrate results from various disciplinary perspectives. By fostering communication and collaboration during data analysis, the team can leverage the diversity of expertise to gain a comprehensive understanding of the research problem and generate nuanced insights.

IDR data should be collected according to the listed objectives and it should be organized on a scheduled timetable with the inclusion of all participants from all disciplines. The collected data then should be analysed with due consultation and discussion of the different aspects of the listed research problem since the IDR process aims at integrating the results of various disciplinary participants.

8. Integrate research findings, presentation, and publication

Successful integration of IDR needs to have a common language, goal, adaptability, and respect for each discipline along with the ability to interact and collaborate with researchers from other disciplines, such as learning new from other disciplines and learning the art of integrating other disciplinary knowledge. The quality of this integration is influenced by certain variables as shared IDR practices, interaction, understanding,

questions, and answers, solving differences in boundaries, social learning, the intensity of communication, consultation and exchange of data, and finally the tentative result and conclusions **(Carr et al., 2018)**. During the report writing stage of the interdisciplinary research, it is essential to integrate the result from various research components.

Further, there needs integration and synthesis of different theories of both the researchers and the stakeholders. In other words, the result should not be presented as a collection of disciplinary inputs but be an integrated input from the various participating disciplines related to the research issue.

For this, IDR supervisors have a great role in encouraging genuine integration and at the same time, students and supervisors are required to discuss regularly on a routine schedule for effective communication to solve common research issues, such as what methodologies or format to be used.

Advantages of Interdisciplinary Research

Interdisciplinary research brings forth several benefits and advantages, as highlighted by **Jones (2009)**. Here are some key advantages:

- Interdisciplinary research allows for a holistic and comprehensive understanding of complex phenomena by drawing connections between various thoughts and ideas.

- It fosters creativity and innovation by bringing diverse perspectives to problem-solving, leading to novel and innovative solutions.

- The approach is well-suited for addressing real-world challenges that often require insights from multiple disciplines to develop effective solutions.

- It promotes effective problem-solving by combining the strengths and expertise of different disciplines, offering a more robust and nuanced approach.

- Interdisciplinary research offers flexibility in adapting to new and emerging challenges, making it particularly relevant in dynamic and evolving fields.

- Findings from interdisciplinary research are more likely to have a broader impact, reaching across various fields and influencing diverse sectors.

- It provides a rich educational experience for researchers and students, allowing them to develop a broader skill set and a more nuanced understanding of their field.

- Interdisciplinary research promotes collaboration and networking among researchers from different disciplines, fostering a sense of community and shared goals.

- It facilitates research that is directly relevant to policy-making and societal issues, contributing to positive social change.

- Many contemporary issues are inherently complex and multifaceted. Interdisciplinary research is well-suited to address these complexities by considering various dimensions of a problem.

In summary, interdisciplinary research provides a range of advantages that contribute to a more holistic, innovative, and impactful approach to understanding and addressing complex challenges.

Complex Global Challenges Are Addressed

Real-world issues that call for an interdisciplinary approach can be addressed with the aid of interdisciplinary research. Climate change, being a complex and multifaceted challenge, requires the collaboration of specialists from various fields such as environmental sciences, geology, economics, and politics.

Tackling the impacts of climate change on natural resources, agricultural productivity, and overall planetary life necessitates an integrated and holistic perspective. The interdisciplinary research approach allows for a more comprehensive understanding and effective solutions to mitigate the negative consequences of climate change. It underscores the importance of bringing together diverse expertise to address the interconnected and multifaceted challenges posed by such global issues.

An active Exchange of Knowledge is Facilitated

Interdisciplinary research facilitates active knowledge and idea sharing among academics and researchers from various fields. Through collaboration and the blending of diverse expertise, researchers can attain novel insights, innovative solutions, and groundbreaking discoveries. This collaborative approach goes beyond the limitations of traditional, discipline-specific methodologies, allowing for a more holistic exploration of complex issues.

Interdisciplinary research becomes a catalyst for creativity and innovation, encouraging the synthesis of different perspectives to tackle challenges that may require a comprehensive and integrated understanding. The exchange of knowledge and ideas across disciplines enhances the potential for transformative and impactful outcomes in research endeavours.

Creation of New Scientific Fields can be Leaded

Interdisciplinary research plays a pivotal role in addressing global concerns and fostering the creation of new scientific disciplines. Collaborating with subject matter experts from diverse fields can lead to the identification and exploration of novel areas of study. The synergy of interdisciplinary research often sparks the development of entirely new disciplines, delving into unexplored territories that require insights from various domains.

A prime example is the field of bioinformatics, where the collaboration between computer science and biology has given rise to innovative approaches for analysing biological data. This interdisciplinary fusion has not only led to advancements in understanding biological processes but has also paved the way for the establishment of a distinct scientific

discipline, showcasing the transformative potential of interdisciplinary collaboration in shaping the landscape of research and knowledge creation.

Disadvantages of Interdisciplinary Research

While interdisciplinary research offers numerous advantages, it also comes with potential disadvantages. Here are some challenges associated with interdisciplinary research:

It is Resource Intensive and Time Consuming

Interdisciplinary research typically demands more time and resources compared to traditional, discipline-specific research. Several factors contribute to this:

- Researchers need to invest additional time in understanding the perspectives, methodologies, and language of collaborators from diverse disciplines. Building a common ground for effective collaboration takes time.

- Acquiring a fundamental understanding of other fields often involves a steep learning curve, which can prolong the initiation and execution phases of the research.

- Coordinating efforts among researchers with varied expertise and schedules can be complex, leading to potential delays in project timelines.

- Obtaining funding for interdisciplinary projects can be challenging due to traditional funding structures favouring discipline-specific research. Securing the necessary resources may take more time and effort.

- Managing an interdisciplinary team requires additional effort to ensure effective communication, collaboration, and alignment of goals, which can extend the project timeline.

Despite these challenges, the potential benefits of interdisciplinary research, such as innovative solutions and a more comprehensive understanding of complex issues, often outweigh the drawbacks. Addressing these challenges through strategic planning, effective communication, and tailored funding mechanisms can enhance the efficiency and success of interdisciplinary research initiatives.

Challenges in Finding Common Ground

Finding common ground among researchers from different disciplines is a common challenge in interdisciplinary research. The differences in ways of thinking, methodologies, and problem-solving approaches can create communication difficulties and disagreements. Some specific points related to this challenge include:

- Researchers from different disciplines bring unique perspectives shaped by the methodologies and paradigms of their respective fields. Bridging these diverse viewpoints requires effort and understanding.

- Varied disciplinary vocabularies and communication styles can lead to misunderstandings and misinterpretations, hindering effective collaboration.

- Differences in research goals and objectives may emerge due to varying disciplinary priorities, potentially causing conflicts regarding the purpose and direction of the research.

- Researchers may need time to familiarize themselves with the terminology, theories, and methods of other fields, adding a learning curve that can slow down the initial phases of collaboration.

- Coordinating efforts and aligning goals across disciplines may require additional effort, and conflicts may arise when trying to integrate diverse perspectives.

Mitigating these challenges often involves fostering open communication, promoting a shared understanding of the research objectives, and establishing frameworks for collaboration that respect and integrate the diverse perspectives brought by each discipline.

Importance of Interdisciplinary Research in Higher Education

Interdisciplinary studies should foster several intellectual skills. Deductive reasoning is required to identify the disciplinary assumptions underlying a theory and reasoning by analogy is require to see the application of an idea from one discipline to the problem of another. More important, however is the synthetic thinking demanded by the integrative process **(Newell, W. & Green, W. 1998).**

- Students learn the significance of combining the study of different academic fields that are appropriate for their enduring interests.

- Students discover original answers to some of today's most difficult issues of research.

- Students develop as multidisciplinary thinkers who are open to new ideas both analytically and creatively.

- Students are prepared for graduate and professional studies, as well as professions in new and emerging industries.

- Students learn collaborative skills while working with individuals who have different perspectives.

- Students are highly motivated as they have a vested interest in pursuing topics that are interesting to them. As a result, the content is often rooted in life experiences, giving an authentic purpose for learning and connecting it to a real-world context. Consequently, the learning becomes meaningful, purposeful and deeper resulting in learning experiences that stay with the student for a lifetime.

- Students cover topics in more depth because they are considering the many and varied perspectives from which a topic can be explored and researched.

- Critical thinking skills are used and developed as students look across disciplinary boundaries to consider other viewpoints and also begin to compare and contrast concepts across subject areas.

- Students begin to consolidate learning by synthesizing ideas from many perspectives and consider an alternative way of acquiring knowledge.

- Exploring topics across a range of subject boundaries motivates students to pursue new knowledge in different subject areas.

- Transferable skills of critical thinking, synthesis, and research are developed and are applicable to future learning experiences.

- Interdisciplinary studies require deductive reasoning to identify disciplinary assumptions underlying theories.

- Analogical reasoning helps in applying ideas from one discipline to solve problems in another.

- Integrative processes demand synthetic thinking, which is crucial for connecting ideas across disciplines.

- Students learn the significance of combining the study of different academic fields aligned with their enduring interests.

- Students discover original answers to complex research issues, fostering creative problem-solving skills.

- Development as multidisciplinary thinkers who are open to new ideas both analytically and creatively.

- Preparation for graduate and professional studies, as well as professions in new and emerging industries.

- Learning collaborative skills while working with individuals holding different perspectives.

- High motivation due to a vested interest in pursuing topics interesting to them, rooted in real-life experiences.

- Learning experiences are meaningful, purposeful, and deeper, connecting to real-world contexts.

- In-depth exploration of topics considering varied perspectives, leading to a richer understanding.

- Development and use of critical thinking skills as students compare and contrast concepts across subject areas.

- Consolidation of learning through the synthesis of ideas from various perspectives.

- Exploration of topics across subject boundaries motivates students to pursue new knowledge in different areas.

- Development of transferable skills in critical thinking, synthesis, and research applicable to future learning experiences.

This comprehensive list emphasizes the multifaceted and enriching nature of interdisciplinary education.

CONCLUSION

Despite challenges, interdisciplinary research is expected to continue growing, presenting numerous opportunities and benefits. Interdisciplinary research remains crucial for tackling challenging scientific problems and finding innovative solutions for real-world difficulties. The approach is being actively used to develop innovative solutions for increasingly complex and multifaceted problems in a rapidly evolving world. Interdisciplinary research has demonstrated its potential to lead to ground breaking discoveries, showcasing its impact on advancing knowledge. It involves the synthesis of two or more disciplines, aiming to learn something new or enhance perspectives by combining contributions from different fields. The contributions of diverse disciplines are combined to produce holistic or systemic results, offering a more comprehensive understanding of complex challenges. Given the challenges of addressing complicated research problems within a single discipline, incorporating Interdisciplinary Research (IDR) into educational institutions' research curricula is becoming increasingly important. In modern society, complex issues require collaborative efforts, communication, and sharing among disciplinary participants, utilizing various approaches and procedures to achieve shared goals. In essence, interdisciplinary research stands as a crucial approach in navigating the complexities of contemporary challenges, encouraging collaboration and the integration of diverse perspectives for more effective problem-solving.

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