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Exploring The Students' Difficulties in Physics Subject among Secondary School Students During Learning in Class

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Abstract

This research explores the students' difficulties in physics subject among secondary school students during learning in class. The study aims to address the primary research objective which is to examine the reasons for selecting physics subject between genders. To achieve these objectives, a comprehensive examination of students' difficulties in learning physics subject was conducted, considering various factors that contribute to the difficulties and the student's coping mechanism. The method approach was done using quantitative analysis. Quantitative data was analyzed using Statistical Packages for Social Science (SPSS), the software programs that calculate all the data run. The study also aims to provide evidence-based suggestions for teachers, students, and policymakers to improve the effectiveness of physics subject in secondary schools. The ultimate objective is to support the development of curriculum design and teaching methodologies, resulting in a more supportive learning environment that meets the various needs of secondary school physics students. The larger educational community as well as teachers and administrators who are interested in raising the standard of secondary school physics instruction are expected to find this research to be significant.

Keywords: Students' Difficulties, Coping Mechanism, Cognitive Learning Theory, Problem-Solving, Physics Subject

Introduction

Background of Study

The importance of physics in understanding the world and driving technological advancement is undeniable. Despite this, research indicates that many students struggle with physics concepts and problem-solving skills. Snetinova (2011) found that only 35% of students consider physical concepts while working through physics problems, with a significant portion hardly ever drawing physics diagrams. Moreover, students often struggle to connect various physical concepts. Holubova (2015) suggests that integrating real-world issues into physics questions can enhance student learning. However, challenges persist, including teacher reluctance to adopt new teaching methods and the impact of large class sizes on student attention and engagement (Nava, 2017). Additionally, there is evidence suggesting that girls may find physics more challenging than boys, possibly due to various factors such as classroom environment and teaching quality.

Despite its crucial role in technological advancement and economic development, physics remains a challenging subject for many students, particularly girls. The difficulties come from a combination of factors, including inadequate teacher content knowledge, ineffective teaching techniques, and issues with classroom management. Addressing these challenges requires a concerted effort to improve teaching methods, integrate real-world applications into lessons, and create supportive learning environments that cater to the needs of all students, regardless of gender. This research underscores the importance of enhancing physics education to ensure all students can effectively engage with and understand this fundamental scientific discipline.

Statement of Problem

Students find physics difficult, as compared to Chemistry or Biology subject. The commonassumption is that this subject is more challenging for girls than for boys. This is surprising, because in academics there are an almost equal number of women and men teachers of physics. Many of the justifications for girls' lack of interest in physics focus on the contribution of the educational system to this issue. Girls do not develop a physics curiosity to the same extent asboys do when they become older. The initial interest gap is thus unlikely to be due to factors associated to education, but its widening in later years most likely is. Science education has a strong gender-related dimension, since boys in general have a greater interest in science than girls Gardner (1975, 1998); Miller et al (2006), as well as more positive attitudes towards studying and having a career in science. According to several research, young girls are actually more interestedin science-related issues than boys are (Craig and Ayres, 1988; Matthews, 2007). However, if science courses are offered as electives, girls' interest levels sharply decline (Craig and Ayres, 1988). However, the stereotyped impression of science as a boy area is visible years before the actual engagement with disciplinary school science. Many studies have demonstrated that the gender-gap in interest, attitudes, and achievements in science expands with age (Farenga and Joyce, 1999).

According to Tekwani (2020), a subject like biology requires memorization of many facts. There is a lot to explain and understand, but most students find that memorizing helps them do well in biology classes. At least in the higher secondary classes, there are almost no calculations, graphs, or numerical problems to be answered. Memorization is crucial in chemistryas well, though less so than in biology. The electron structure, chemical equations,

and other concepts must be understood. However, many students also think that chemistry is "manageable". Even math may be simpler because memorizing is rarely beneficial and if you know how to solvea particular kind of problem, plenty of experience makes it likely that you will succeed in arithmetic as well. physics builds upon itself. If you failed to grasp the fundamental ideas but stillpassed your examinations, your lack of understanding will soon become apparent as you continueto study physics. So you must not overlook the basics. Competitive exams challenge you on applications as well as textbook knowledge. Application-oriented issues can only be resolved if the basics are understood and you develop your mathematical, graphing, logical, and interpretative skills.

Students' ability to cope with the difficulties they encounter in learning physics can significantly impact their academic success and overall well-being. This research problem aims to investigate the coping mechanisms employed by students to navigate these challenges and enhance their learning experiences. Several past studies have shed light on students' coping mechanisms in managing difficulties related to learning the physics subject. These studies have identified various strategies that students employ to address the challenges they face. Smith (2018) state that students cope with anxiety related to learning physics. The research found that students often employ cognitive strategies such as breaking complex problems into smaller, manageable parts and seeking help from peers or instructors to alleviate their anxiety. Students with high self-efficacy tend to use self-regulation and positive self-talk as coping mechanisms when encountering difficulties.

Research Questions

Based on the above problem statement, this research has formulated a research question as follows

(i) What are the reasons for selecting physics subject between genders?

Literature Review

Cognitive Learning Theory

The goal of cognitive learning where known as an active learning method, is to teach how to use a brain to its fullest potential. The ability to deepen a memory and retain knowledge is improved since it is easier to connect new information with previously existing beliefs. Valamis (2022) stated that the ability of the brain's mental processes to absorb and retain information through experience, senses, and thought is known as cognition. Memorization is the main objective of traditional learning rather than trying to become an expert in a particular subject.

For the memory level, cognitive learning discourages overflowing of information, which is very ineffective in education. The capacity to connect new knowledge with prior experiences or information is enhanced by having a comprehensive understanding of a subject. Next, for the application level, newly learned knowledge or abilities in real-world situations by using cognitive learning strategies can be used. It supports to improve the problem-solving skills.

When cognitive processes are not functioning consistently, learning can take longer than what is expected or be more challenging. These include activities like paying attention, observing, obtaining information from long-term memory, and categorization. Several researchers have madesignificant contributions to this theory. Jerome Bruner focused on how

mental processes are linkedto teaching. Jean Piaget acknowledged the importance of the environment and focused on changesthat occur within the internal cognitive structure.

Problem-solving

Science teaching involves far more than the mere transmission of facts and information, rather it seeks to achieve a more important objective where teaching students to use basic scientificconcepts or facts in a flexible way so they can deal with unexpected situations, correctly identify effects, and solve problems (Reif et al., 1976). The literature provides different definitions of the notion of problem-solving and therefore there is no clear definition of this concept (Jerwan, 2012). For example, Malik et al (2019) described problem-solving as a complexand crucial talent that is learned in all specialties. Some people define problem solving as the process of overcoming the knowledge gap that exists between people and the specific goal they are attempting to accomplish when they are presented with a problem and do not know how to solve it (Hayes, 1981).

According to Zewdie (2014), "a process that incorporates the use of high-level cognitive skills, and involves multiple actions ranging from trial and error, gaining insight, and establishing cause-effect relationship" is what is meant by problem-solving. However, if students are aware of how to approach a problem, this is no longer a difficulty, rather it is an opportunity for them to practice what they have learned.

Problems solving procedures typically involve three steps where problem definition, problem analysis and synthesis, and solution generation. Students do a problem assessment, analyze relevant criteria and limitations, and build a plan for solving the problem during the problem definition process. Students use information gathered from the problem definition to create numerous solutions to the problem during the problem analysis and synthesis stage. They do this by collecting, testing, analyzing, and synthesizing data based on the particular problem and any relevant restrictions.

Conceptual Framework

A conceptual framework is a framework that the researcher thinks best explains the development of the topic being researched (Camp, 2001). It is related to the theories, concepts, and empirical research that the researcher used to support and organize information that she espoused. The conceptual framework is found on theoretical framework which is based on the existing knowledge.

Student’s difficulties in physics subject have a direct effect on the reasons for selecting physics subject between genders. Gender equity in the classroom may mean more than providingthe same physics classes to males and females. The same educational experience may appeal to boys' interests more than those of girls, which leads to a lack of equity. The supposedly equal treatment provided by coeducation in schools turns out to be a very subtle type of discrimination in the so-called "challenging" physics topics. This is because the interests, skills, and knowledge of the boys have a significant influence on the curriculum and behavior patterns of both male andfemale teachers.

Second, the students’ coping mechanisms in managing the difficulties were discovered. Students found it difficult to understand the given problem. Physics students' ability to solve problems may be affected by various of factors, such as their failure to

properly understand the problem. When answering a specific physics problem, weaker students struggle to describe concepts and find it challenging to explain additional aspects of the laws because they have a poorunderstanding of what they read in the physics problem. Despite this problem, students need to understanding the problem first. In order to engage their cognitive processes in relation to problem solving, students need to ask themselves critical questions in this approach. Problem solving involves engaging high-level cognitive skills (Zewdie, 2014). Therefore, it is crucial to emphasizecognitive and metacognitive skills in order to increase students' awareness of their learning processes when solving physics problems.

Using quantitative approach in research may result in a more thorough and comprehensive knowledge of the research by integrating both quantitative method. In order to provide a more nuanced interpretation of study findings, it offers helpful advice on how to effectively integrate quantitative data collection and analyzing data approaches. It also highlights the fact that in comparison to utilizing one method, this approach can result in a greater comprehension of the subject matter. The validity and reliability of the study findings are improved by this validation. Incorporating both qualitative and quantitative methods into the research on students' coping mechanisms in learning physics allows for a more holistic understanding.

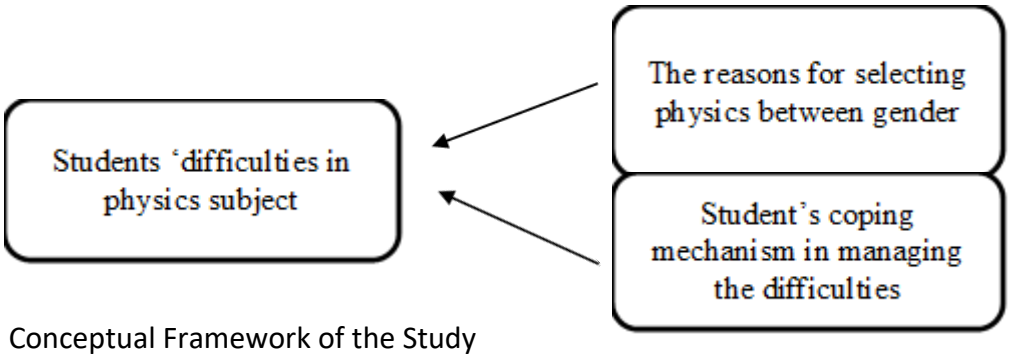

Figure 1: Conceptual Framework of the Study

Methodology

This study was intended to explore the student's difficulties in physics subject among secondary school students during learning in class. As the research objectives was to explore the difficulties in physics subject among secondary school students during learning in class, a survey was conducted as the quantitative design. In this case, Science Stream students were given a set of questionnaires for a survey research to get the data. The researcher chooses to conduct a questionnaire through online platform which is a Google Form. The instrument for quantitative method was align to the first research objective which is to examine the reasons for selecting physics subject between genders. Researcher divided this instrument into two section where the first section is 'Personal Information' of the respondents. This section will record the personal data of the respondents in this research. The second section was the questionnaire about reasons for selecting physics subject between genders. In this study, the researchers used a different source of instrument comprised of Likert-type items. Likert-type items will be arranged from "strongly disagree," "disagree," "undecided," "agree," to "strongly agree" in the order of agreement. Table 1shows the distribution of items in survey.

Table 1
Distribution of Items in Survey

		ITEM
SECTION A	DEMOGRAPHIC INFORMATION	NAME
		AGE
		GENDER
		REGION
SECTION B	THE REASONS FOR SELECTING PHYSICS SUBJECT BETWEEN GENDERS	Do boys love Physics subject more than girls?
		Physics has a connection with my daily life.
		Some subjects in Physics are difficult, and they require memorization.
		Physics experiments are useful, because I can work with my friends.
		Do boys wished to learn more about the aspects of physics subject?
		Physics is easy and exciting.
		Physics is too abstract.
		There are too many difficult formulas in physics subject.
		Do girls prefer to choose Biology than Physics subject?
		I have difficulty in doing interpretations about Physics.
Total Items		14

Table 2
Reliability Statistics for the Survey

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.797	.836	10

Table 2 shows the alpha coefficient value using Cronbach's alpha reliability method. The Cronbach's alpha coefficient measures the internal consistency or reliability of a set of items or variables in a scale. In this case, the alpha coefficient value of 0.797 indicates a moderate to high level of internal consistency within the dataset. Generally, a Cronbach's alpha value above 0.7 is considered acceptable for research purposes. The reliability analysis suggests that the items or variables included in the dataset related to students' difficulties in the physics subject demonstrate a satisfactory level of consistency. This implies that the dataset

is reliable for assessing and understanding the challenges faced by secondary school students during the learning of physics subject in a classroom.

Findings

Table 3

Percentage for gender (n=118)

Gender	Frequency	Percent	Cumulative Percent
Male	57	48.3	48.3
Female	61	51.7	100.0
Total	118	100.0	

Table 3 shows the distribution of gender of the respondents who were involved in answering the survey questions that aimed for research question 1. Out of the four classes in science stream class in form 4, a total of 57 (48.3%) students are male while another 61 (51.7%) of the students are females.

Table 4

Descriptive analysis (n=118)

Questions	Mean	Std. Deviation	N
Do boys love physics subject more than girls?	4.14	.972	118
Physics has a connection with my daily life.	4.67	.556	118
Some subtopics in physics are difficult, and they require memorization.	4.48	.737	118
physics experiments are useful, because I can work with my friends.	4.40	.786	118
Do boys wished to learn more about the dramatic aspects of physics?	4.04	1.041	118
Physics is easy and exciting.	2.97	1.307	118
Physics is too abstract.	4.27	.864	118
There are too many difficult formulas in physics subject.	4.42	.831	118
Do girls prefer to choose biology than physics subject?	4.15	1.043	118
I have difficulty in doing interpretations about physics.	4.37	.913	118

From Table 4, the highest mean (mean= 4.67, SD= 0.556) shows that students agree that physics has a connection with their daily life. Students also most agree with the statement that some subtopics in physics are difficult, and they require memorization (mean= 4.48, SD= 0.737). Students find that there are too many difficult formulas in physics subject (mean= 4.42, SD= 0.831) and thought that physics experiments are useful so that they can work with their friends (mean= 4.40, SD= 0.786). Students have difficulty in doing interpretations about physics though they believe that physics is a tough subject (mean= 4.37, SD= 0.913). Students found that physics subject is too abstract (mean= 4.27, SD= 0.864) and a large amount of students agree that girls prefer to choose Biology than physics subject (mean= 4.15, SD= 1.043). An average number of students also agree that boys love physics subject more than

girls (mean= 4.14, SD= 0.972). Students give a high rating for boys who wished to learn more about the dramatic aspects of physics subject (mean= 4.04, SD= 1.041). The lowest rating by students is that physics is easy and exciting (mean= 2.97, SD= 1.307).

The findings indicate that students agree that the reason for selecting physics subject is because physics has a connection with their daily life. The most disagree statement by the students is that physics is easy and exciting.

Conclusion

Findings and Discussion

The findings suggest that students generally perceive a high level of connection between physics and their daily lives, reflecting a positive attitude towards the subject. However, a notable concern emerges as students acknowledge the difficulty of certain physics subtopics, indicating a tendency to associate the subject with memorization challenges. The sentiment is aligned in their observation of a multitude of complex formulas within the discipline.

Interestingly, students express a positive view of physics experiments, emphasizing their utility in collaborative learning experiences. Despite acknowledging physics as a challenging subject, students reveal difficulties in interpreting its concepts, suggesting a relationship with the perceived difficulties of the subject.

The abstraction of physics appears to be a common perception among students, reflecting a potential barrier to engagement. Furthermore, the data suggests a convincing belief that girls might lean towards biology over physics, while a similar sentiment is expressed regarding boys' purported preference for physics. This gender-related perception might have implications for the gender balance within the physics discipline.

One intriguing aspect is the positive perceptions of boys interested in exploring the facts and concepts of physics. However, the most noteworthy finding is the students' lowest rating for the perception that physics is easy and exciting, indicating a prevailing challenge in fostering enthusiasm and ease among the student population. This result underscores the importance of addressing the perceived difficulty and abstraction associated with physics to enhance overall interest and engagement in the subject.

The research findings shed light on the factors influencing students' choices in selecting physics as a subject, particularly between genders. The observation that a significant number of students believe girls are more inclined to choose Biology than physics and that boys express a greater affinity for physics. This perception aligns with existing literature that explores gender disparities in STEM (Science, Technology, Engineering, and Mathematics) fields. Research has shown that societal stereotypes and biases can influence students' subject preferences based on gender (Eccles, 2009). The notion that girls may lean towards Biology could be indicative of gender-related expectations and perceptions regarding certain disciplines being more "suitable" for one gender over the other. Previous studies have indicated that perceptions of difficulty can be significant factors influencing students' subject choices (Archer et al., 2012). It is conceivable that these perceptions, as highlighted in the study, contribute to the observed gender-related trends in subject selection.

The complex nature of students' difficulties with physics subject within the framework of secondary school education have been examined in this study. The results highlight how complex the problems that students encounter when studying physics in the classroom. Furthermore, it is impossible to overestimate the importance of teachers in recognizing and correcting the misconceptions that students had. One of the biggest ways to improve a student's physics foundation is to effectively identify and correct the misconceptions. Identifying and correcting student misconceptions should be a key component of professional development opportunities for teachers. In conclusion, this research advocates for a holistic and collaborative approach involving educators, curriculum developers, and policymakers to address the identified difficulties in physics learning among secondary school students.

Exploring students' difficulties in the physics subject among secondary school students during class learning is a crucial endeavor with several motivations and potential contributions such as identifying learning gaps where understanding students' difficulties can help pinpoint specific areas where students struggle the most. This can help educators tailor their teaching methods and materials to address these gaps effectively. Besides, improving teaching strategies by identifying common challenges faced by students and educators can develop innovative teaching strategies that cater to diverse learning styles and abilities. This could involve incorporating more hands-on experiments, visual aids, or interactive simulations to enhance comprehension. Lastly, encouraging student engagement when educators are aware of the specific challenges that students face, they can actively involve the students in the learning process by addressing their concerns and providing targeted support. This can lead to increased student engagement and motivation in learning physics.

Future Works

In this section, suggestions are made for how research could be done better in the future. Consider diving deeper into a single data or variable that surfaced as crucial in the analysis were important. Further investigation into this topic could provide a more sophisticated understanding of its role and implications. In order to better understand the dynamics involved in Exploring the Students' Difficulties in Physics Subject Among Secondary School Students During Learning in Class, longitudinal studies that track changes and developments over an extended period of time can be conducted. This method would help determine connections between variables and provide insights into temporal patterns. The sample size is one of the recommendation the researcher will make. The study must be conducted with a larger population in order to be more effective. This guarantees that additional data can be gathered to enhance the data collection process. Combining qualitative and quantitative methods might help the researcher have a more comprehensive grasp of the topic. The next recommendation for future improvement is to extend the research's duration. It is recommended that the 14-week research period be increased to a minimum of one year. This is to guarantee that the researcher has sufficient time to employ every recommended technique, particularly if multiple approaches are recommended. Because of the time allocated, the researcher will also be able to cover other related concerns.

Furthermore, the researcher can examine practical applications and solutions that results from this study. This can involve developing strategies, regulations, or interventions based on the research to deal with issues that arise in the actual world. To get deeper insights from the data, applying modern analytical approaches like network analysis, or other complex statistical methods can be used. This can improve our future research's quality and depth. Remembering to take into account the ethical consequences of upcoming research projects

and making sure that the study complies with moral norms and regulations also have to be considered. It can further the comprehension of the study and make a valuable contribution to the continuing discourse in the field related by following these suggested approaches.

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References

Adams, J., & Garcia, M. (2023). Examining the Relationship Between Exam Anxiety and Academic Avoidance in Physics Education. *Journal of Educational Psychology*, 115(2), 245-257.

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). "Not Girly, Not Sexy, Not Glamorous": Primary school girls' and parents' constructions of science aspirations. *Pedagogy, Culture & Society*, 20(3), 373-396.

Bandura, A. (2019). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191-215.

Brown, A., & Davis, R. (2021). Fostering Epistemic Humility in Physics Education: A Reflective Approach. *Journal of Physics Education*, 36(2), 147-165.

David, B., Resnik, J. D. (2020). What Is Ethics in Research & Why Is It Important? https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm

Deci, E. L., & Ryan, R. M. (2020). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry,* 11(4), 227-268.

Dewi, S., & Nur, A. H. (2018). Analyzing Students' Problem Solving Difficulties on Modern Physics. https://iopscience.iop.org/article/10.1088/1742-6596/1028/1/012205/pdf

Eccles, J. S. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist*, 44(2), 78-89.

Fe, J. N., & Michael, K. C. (2017). High School Students' Difficulties in Physics. https://www.researchgate.net/publication/320980117_HIGH_SCHOOL_STUDENTS'_DIFFICULTIES_IN_PHYSICS

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, 111(23), 8410–8415.

Garcia, M., and Lee, S. (2023). "Building Confidence through External Tuition: A Qualitative Analysis of Student Experiences in Physics Learning." *International Journal of Science Education*, 38(1), 56-73.

Hsu, Y., & Wang, C. (2020). Role ambiguity and its impact on collaborative learning in physics experiments. *Journal of Research in Science Teaching*, 57(3), 358-376.

Johnson, A., Smith, B., & Williams, C. (2020). Enhancing Physics Education Through Interactive Simulations. *Journal of Educational Technology*, 43(2), 145-162.

Lee, S., & Wang, Y. (2022). Mindfulness Interventions in Physics Education: A Meta-analysis of Effects on Stress and Anxiety. *Journal of Educational Psychology*, 118(4), 567-580.

Majed A. & Naif A. (2020, March 3). Constructivism as a Learning Theory Applied to Thinking in Solving Physics Problems: An Interpretive Study. http://www.ijern.com/journal/2020/March-2020/06.pdf

Martin, A., Johnson, B., & Garcia, T. (2020). The Impact of Social Connectivity on Academic

Performance: A Meta-Analysis. *Journal of Educational Psychology*, 112(3), 483–498.

McCombes, S. (2023). Sampling methods: Types, techniques & examples. Scribbr. https://www.scribbr.com/methodology/sampling-methods/

Mukesh T. (2020). Why is Physics considered to be a Difficult Subject? https://mukeshntekwani.medium.com/why-is-physics-considered-to-be-a-difficult-subject-ed4bd05a5c2f

Research guides: Organizing academic research papers: Types of research designs. Types of Research Designs - Organizing Academic Research Papers - Research Guides at Sacred Heart University. (n.d.). https://library.sacredheart.edu/c.php?g=29803&p=185902

Ruchika, K. (2019). Problems Faced by Students While Studying Physics During their HighSchool Years. https://viurrspace.ca/bitstream/handle/10613/13925/Kaushal.pdf?sequence=1&isAllowed

Smith, A. B., & Johnson, C. D. (2023). Enhancing Physics Learning Through Strategic Practice. *Journal of Science Education*, 45(2), 123-145.

Tegan, G. (2022). Semi-Structured Interview | Definition, Guide & Examples. https://www.scribbr.com/methodology/semi-structured-

Valamis. (2022). Cognitive Learning. https://www.valamis.com/hub/cognitive-learning

Villegas, F. (2023). Sampling frame: Definition, examples & how to use it. QuestionPro. https://www.questionpro.com/blog/sampling-frame/

Wang, H., Zhang, L., & Chen, D. (2022). Overcoming Challenges in Integrating Technology in Physics Education: A Case Study of High School Implementation. *Educational Technology Research and Development,* 70(1), 251-269.

Wang, L., & Sun, Q. (2019). Exploring the Difficulty of Physics Learning: A Comparative Study. *Educational Psychology Review*, 36(2), 201-215.