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The Use of Strategies and How They Influence Strategies in Learning Physics

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Abstract
Every individual has their own learning strategies. The utilization of learning strategies always give a significant impacts on students' academic performance and conceptual understanding. The objective of this study is to explore the perception of learners on their use of learning strategies particularly for physics subjects in higher institutions. This research uses quantitative methodology with data collection using a questionnaire which consisted of 3 sections: cognitive component, metacognitive component and resource management component. A total of 104 students of the Foundation in Science and Foundation in Engineering from the Centre of Foundation Studies, UiTM Selangor Branch, Dengkil Campus participated in the survey. This study has substantial implications for academia in general as well as the subject of physics education. It contributes to the existing body of knowledge by offering a comprehensive exploration of the general learning strategies that students employ in striving for success in physics subjects. The study's importance ultimately lies in its ability to narrow existing gaps in physics education, opening the door to practical solutions and enhancements that will help learners, educators, and the scientific community as a whole.
Keywords: Learning Strategies, Physics Learning, Cognitive, Metacognitive and Resource Management

Introduction

Background of Study

Learning strategies are a variety of deliberate approaches and techniques employed by learners to improve their understanding, retention, and application of new information or skills. These strategies are not passive mechanisms, but rather proactive and goal-oriented processes by which individuals actively engage with the learning material. They use a variety of cognitive, metacognitive, and behavioural strategies, such as rehearsal, elaboration, organisation, and self-regulation. Individuals can improve their learning experiences and transfer knowledge to new situations by strategically selecting and applying these strategies (Mayer, 2019; Pintrich, 2000).

Learning strategy research is critical in educational psychology and cognitive science because it has far-reaching implications for educational practices, instructional design, and academic success. Hence, understanding how learners use various strategies to process and internalise information can help educators create more effective teaching interventions and educational programmes. Furthermore, research on learning strategies reveals individual differences in learning styles and preferences, allowing educators to take a more personalised approach to instruction. By identifying the most effective strategies for diverse learners across domains, researchers help to develop evidence-based educational interventions that promote deeper learning and academic achievement (Dunlosky et al., 2013; Hattie et al., 2017).

It has come to attention that previous study shows that science and technology subjects are becoming less popular among students in schools and higher education institutions (Bernama, 2019). Interest in science and technology programmes and careers is decreasing globally, including in Malaysia (Halim et al., 2018). In physics education, it is crucial to develop students' critical thinking abilities, problem-solving skills, and understand the fundamental principles that govern the natural world. Despite the importance of physics courses, there is an urgent need to investigate and comprehend the general learning strategies used by students to strive in these courses. This paper aims to explore learners' perceptions of how they use learning strategies in science courses especially physics. This study discovered a few important insights into students' perspectives on the use of learning strategies as well as how they influence the strategies in learning physics.

Statement of Problem

Physics is an interesting subject because it covers such a broad range of topics. Physics is the study of motion, energy, gravity, fluids, and other topics such as thermodynamics and quantum physics. Physics in the real world is so complex that it is impossible to summarise every aspect of it (Loveless, 2024). On the other hand, physics seems to be one of the most prevalent and problematic subjects in the realm of science. Students perceived physics as a difficult subject during high school days and became more evasive when they reached college (Guido, 2013). The issue at hand is a lack of a comprehensive understanding of the various learning strategies students use to navigate the challenges of physics coursework. While some students excel effortlessly, others may struggle to grasp complex concepts and apply them to real-world scenarios.

In order to overcome this problem, students must first know why they learn physics and how to learn physics. Loveless (2024) suggested three important strategies; (1) active learning where students need to engage with the instructors or lectures; (2) independent study to encourage them to recall the important terms, link with appropriate concepts and practise on visualizing their reading materials and (3) additional help and resources such as an online discussion team, online videos as visual aids and e-text books are good alternatives. Mastering the problem solving skill is another alternative strategy for learning (Voskoglou, 2011). Meanwhile Frazer and Butt (1982) proposed a four-stage model for problem solving in sciences (recall, planning, implementation and evaluation). It is our strong belief that educators must identify the underlying factors of the general learning strategies that contribute to students' success in physics in order to improve the overall effectiveness of physics education. To make it precise, this study tries to apply and match with the conceptual framework by Wenden and Rubin's (1987) language learning strategies which are cognitive, metacognitive and resource management.

Objectives of The Study and Research Questions

This study is conducted to explore perception of learners on their use of learning strategies. Specifically, this study is done to answer the following questions;

- How do learners perceive the use of cognitive components in physics learning?
- How do learners perceive the use of metacognitive components in physics learning?
- How do learners perceive the use of resource management in physics learning?
- Is there a relationship between all physics learning strategies?

Literature Review

This study aims to match the conceptual framework by Wenden and Rubin's (1987) language learning strategies and they are cognitive, metacognitive self-regulation and resource management. The cognitive components consist of other four sub components which are rehearsal, organization, elaboration and critical thinking. Critical thinking is the application of the cognitive skills and strategies that aim for and support evidence-based decision making. Critical thinking is recognized as a way to understand and evaluate subject matter, producing reliable knowledge, improving thinking in solving problems, formulating inferences, calculating and making decisions (Halpern, 1998; Paul and Binker, 1990). Another component in this study is the resource management that focuses on the students' effort management and help seeking. Basically these two need discipline, self-drive, motivation and attitude.

Physics Learning Strategies

Many Studies have been done to investigate the general learning strategies among students and educators to enhance the Physics teaching and learning. This study focuses on the learning strategies issues such cognitive, metacognitive self-regulation and resource management. The issues arise such as lack of cognitive, metacognitive and organization in the learning strategies leads to difficulty to excel in Physics.

There have been many past studies on general learning strategies. The study by Reddy and Panacharoensawad (2017) investigated the issues of cognitive learning strategies. This is an empirical study on the influencing factor of problem solving and implication in physics. It is carried out on 303 Bachelor of Education students of physics in Piler Mandal, Chittoor district, Andhra Pradesh, India. A 5-point scale Likert-type attitude questionnaire was constructed, a primary pilot study was conducted and tested. The results of the study indicated and revealed that poor mathematical skills and lack of understanding the problem are the major obstacles in the domain of problem solving skills in physics.

Next, a study by McCabe (2011) looked at metacognitive learning strategies. This research examined undergraduates' metacognitive awareness of six empirically-supported learning strategies. In this study, 255 participants over the age of 18 were recruited via e-mail and web postings from a variety of sources and institutions of higher education. The metacognitive self-regulation (MSR) scale Pintrich et al (1991); Duncan and McKeachie (2005) consisted of 12 Likert-type items on a 7-point scale (with "1" corresponding to "not at all true of me" and "7" corresponding to "very true of me"). As the result for all analyses, it was found that the alpha level was 0.05. One-sample *t*-tests were conducted to compare the mean rating to the neutral response of "4" (i.e., prediction of similar test scores for both situations); in addition, paired-samples *t*-tests were conducted to compare the 'students' and 'yourself' ratings. Original scale ratings were also converted to a percentage of 'correct' endorsement by re-coding responses of 5 and higher as "correct" and other responses as "incorrect." The outcome is consistent with research suggesting that students have metacognitive awareness of a memory advantage for self-generated information (Begg et al., 1991). For several other scenarios, however, participants in the current study consistently endorsed the non-empirically-supported outcome, suggesting little or no awareness of the memorial benefits of static media, low-interest extraneous details, testing, and spacing. It is entirely possible that scenarios chosen for their more obvious learning benefits would have resulted in more endorsement of empirically-supported outcomes.

Furthermore, the resource management study has been done by (Vaezi et al., 2018). This study explored the relationship between resource management learning strategies and academic achievement in college students. This cross-sectional descriptive study was conducted by having a random sampling of 300 students in western Iran and a self-reporting questionnaire was used to collect data. Data were analyzed with SPSS-21 software using t-test, Pearson correlation, ANOVA and linear regression at 95% significance level. There is found significant correlation between mean overall score for learning resource management strategies and academic achievement of the students ($r = 0.139$ and $P = 0.024$). Linear regression analysis showed that resource management strategies accounted for 3% of the variation in academic achievement. Thus it is suggested that designing and implementing educational programs to promote resource management strategies for college students could have beneficial results in increasing academic achievement.

Overall, all these three learning strategies suggested in this study will be beneficial to the students' achievement especially in Physics Learning. By using the Conceptual Framework by Rahmat (2018) and 5 Likert-scale surveys rooted from Wenden and Rubin (1987), this study reported the mean scores of each learning strategies components such as cognitive, metacognitive self-regulation and resource management and their correlation to physics learning.

Conceptual Framework

Learners need to use a variety of strategies to make learning successful. According to Rahmat (2018), language learning strategies employed by the learners may facilitate or even hinder learning. Figure 1 shows the conceptual framework of the study. This study is rooted from Wenden and Rubin's (1987) language learning strategies and they are cognitive, metacognitive and resource management. This framework of study is adopted to ensure the reliability of how they influence physics learning in science and technology students.

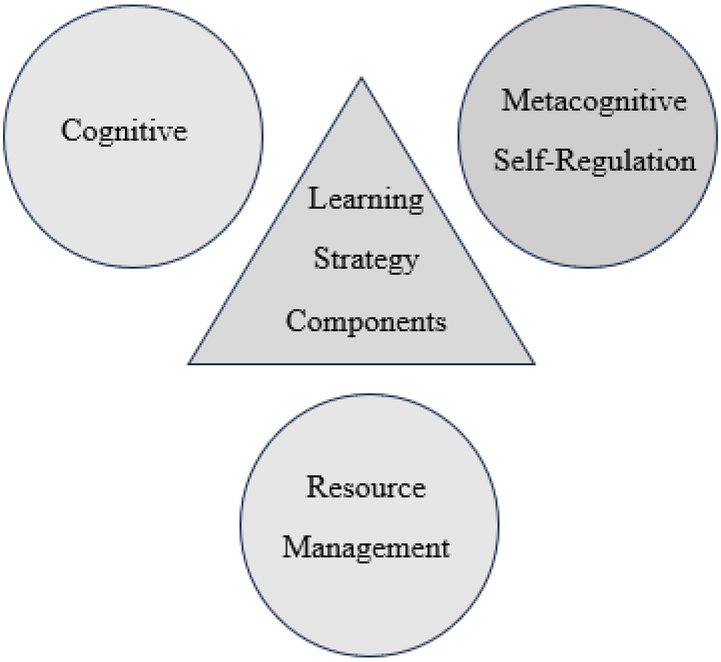

Figure 1- Conceptual Framework of the Study - Learning Strategies Components

Methodology

This quantitative study is done to explore motivation factors for learning among undergraduates. A purposive sample of 104 participants responded to the survey. The instrument used is a 5 Likert-scale survey and is rooted from Wenden and Rubin (1987) to reveal the variables in table 1 below. The survey has three sections. Section A has 19 items on cognitive components. Section B has 11 items on metacognitive self-regulation components. Section C has 11 items on resource management.

Table 1
Distribution of Items in the Survey

	STRATEGY (Wenden and Rubin (1987)		SUB-STRATEGY			Cronbach Alpha
A	COGNITIVE COMPONENTS	(a)	Rehearsal	4	19	.924
		(b)	Organization	4		
		(c)	Elaboration	6		
		(d)	Critical Thinking	5		
B	METACOGNITIVE SELF-REGULATION				11	.876
C	RESOURCE MANAGEMENT	(a)	Environment Management	5	11	.805
		(b)	Effort Management	4		
		(c)	Help-Seeking	2		
					41	.953

Table 1 also shows the reliability of the survey. The analysis shows a Cronbach alpha of cognitive components for section A, Cronbach Alpha of metacognitive self-regulation for section B and Cronbach alpha of resource management for section C. This thus reveal a good reliability of the instrument chosen/used. Further analysis using SPSS is done to present findings to answer the research questions for this study.

FINDINGS

Findings for Demographic Profile

Table 2

Percentage for Demographic Profile

Q1	Gender	Male	Female
		33.7%	66.3%
Q2	Discipline	Foundation in Science	Foundation in Engineering
		73.1%	26.9%

A total of 104 students agreed to have their responses gathered. The demographic data in Table 2 show a relatively imbalanced gender distribution among the respondents, with 33.7% identifying as male and 66.3% as female. Participants came from two different disciplines at the institution. Table 2 shows that the majority of respondents (73.1%) were Foundation in Science students, with another 26.9% being Foundation in Engineering students.

Findings for Cognitive Components

This section presents data to answer research question 1- How do learners perceive the use of cognitive components in Physics learning? The cognitive component has 19 items including 4 items for rehearsal, 4 items for organization, 6 items for elaboration and 5 items for critical thinking.

Cognitive Components (19 items)

Table 3

Mean for Rehearsal (4 items)

ITEM	MEAN
LSCCRQ1 When I study for the classes, I practice saying the material to myself over and over.	3.9
LSCCRQ2 When studying for the courses, I read my class notes and the course readings over and over again.	4.2
LSCCRQ3 I memorize keywords to remind me of important concepts in this class.	4.4
LSCCRQ4I make lists of important items for the courses and memorize the lists.	4.3

Table 3 shows the mean for rehearsal of the cognitive components. From the table, it is observed that the lowest mean score is 3.9 indicates the students practice saying the material to themselves while the highest mean score is 4.4 of the mean shows they memorize the key words to remind themselves of the important concepts in their classes. The students who make a list of the important items for courses and then memorize the list fall in 4.3 of the mean score. However, 4.2 of the mean score shows they read the notes and course reading over and over again as a method to study for the classes and the courses. Overall, these four items are very important in helping the students to study for Physics classes and courses.

Table 4
Mean for Organization (4 items)

ITEM	MEAN
LSCCOQ1 When I study the readings for the courses in the program, I outline the material to help me organize my thoughts.	4.2
LSCCOQ2 When I study for the courses, I go through the readings and my class notes and try to find the most important ideas.	4.4
LSCCOQ3 I make simple charts, diagrams, or tables to help me organize course materials in this program.	3.6
LSCCOQ4 When I study for the courses, I go over my class notes and make an outline of important concepts.	4.3

Table 4 shows the mean for organization of the cognitive components. From the table, it is observed that the highest mean score is 4.4 indicates the students went through the readings and the class notes to find the most important ideas while the lowest mean score is 3.6 indicates the students made simple charts, diagrams, or tables in order to help them organize their course materials in learning Physics. Besides, 4.2 of the mean score shows the students used to outline the material to organize their thoughts. The students who went over the class notes and made outlines of the important concepts of Physics fall in 4.3 of the mean score. Overall, there are three impactful ways that have been done by the students to organize their studies, material and thoughts which are going through the readings of the course materials and notes, outlining the important concepts and coming out with the most important ideas. However, few of the students are visualizing the course materials by translating them into charts, diagrams or tables.

Table 5
Mean for Elaboration (6 items)

ITEM	MEAN
LSCCEQ1 When I study for the courses in this program, I pull together information from different sources, such as lectures, readings, and discussions.	4.0
LSCCEQ2 I try to relate ideas in one subject to those in other courses whenever possible	3.9
LSCCEQ3When reading for the courses, I try to relate the material to what I already know.	4.3
LSCCEQ4 When I study for the courses in this program, I write brief summaries of the main ideas from the readings and my class notes.	3.9
LSCCEQ5 I try to understand the material in the classes by making connections between the readings and the concepts from the lectures.	4.3
LSCCEQ6 I try to apply ideas from course readings in other class activities such as lecture and discussion.	4.2

Table 5 shows the mean score for elaboration within the cognitive component. Based on the table, it is observed that item 3 and item 5 have the highest mean at 4.3 which indicates that most students made efforts in trying to relate and make connections between the material and readings with the concepts taught by their lecturers. This is followed by items 6 and 1 with the mean score of 4.2 and 4.0 respectively. This suggests that students are proactive in gathering information from different sources and can apply the ideas in the class activities. Item 2 shows a mean score of 3.9 where students generally try to relate ideas obtained during physics class with other courses whenever possible. Meanwhile, item 6 also recorded a mean score of 3.9 which shows that when studying for this course, students mainly write a summary from their readings and concepts obtained from class. On average, the mean score for the elaboration cognitive component is around 4.1.

Table 6
Mean for Critical Thinking (5 items)

ITEM	MEAN
LSCCCTQ1 I often find myself questioning things I hear or read in the courses to decide if I find them convincing.	3.9
LSCCCTQ2 When a theory, interpretation, or conclusion is presented in classes or in the readings, I try to decide if there is good supporting evidence.	3.8
LSCCCTQ3 I treat the course materials as a starting point and try to develop my own ideas about it.	3.9
LSCCCTQ4 I try to play around with ideas of my own related to what I am learning in the courses.	3.9
LSCCCTQ5 Whenever I read or hear an assertion or conclusion in the classes, I think about possible alternatives.	3.9

Table 6 shows the mean score for the critical thinking element within the cognitive component. The average score for all questions within this element is around 3.9. This indicates that students generally apply critical thinking during and after their class sessions with their lecturers. They would question, find evidence, build, and apply ideas as well as come out with possible alternatives for related topics based on the input they gained in class.

Findings for Metacognitive Components

This section presents data to answer research question 2- How do learners perceive the use of metacognitive components in language learning?

Table 7
Mean for Metacognitive Self-Regulation (11 items)

ITEM	MEAN
MSSRQ1 During class time, I often miss important points because I am thinking of other things.	2.9
MSSRQ2When reading for the courses, I make up questions to help focus my reading.	3.7
MSSRQ3 When I become confused about something I am reading for the classes, I go back and try to figure it out.	4.2
MSSRQ4 If course readings are difficult to understand, I change the way I read the material.	4.1
MSSRQ5 Before I study new course material thoroughly, I often skim it to see how it is organized	3.9
MSSRQ6 I ask myself questions to make sure I understand the material I have been studying in this program.	3.9

MSSRQ7 I try to change the way I study in order to fit any course requirements and the instructors' teaching style.	4.0
MSSRQ8 I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for the courses in this program.	4.0
MSSRQ9 When studying for the courses in this program I try to determine which concepts I do not understand well.	4.3
MSSRQ10 When I study for the courses, I set goals for myself in order to direct my activities in each study period.	4.1
MSSRQ11 If I get confused taking notes in classes, I make sure I sort it out afterwards.	4.1

According to Dale (2008), both metacognition and self-regulation are recognized as types of cognitive control. Prather et al (2020) mentioned that understanding metacognitive knowledge is crucial to nurturing self-regulated learning, and engaging self-regulation tasks is essential for development of metacognition. Table 7 shows the mean scores of metacognitive self-regulation among students for its components. From the table, item 9 has the highest mean score for metacognitive self-regulation, which is at 4.3, followed by item 3 with the second-highest mean score at 4.2 and items 4, 10, 11 with the third-highest mean score at 4.1. Following that, the mean score of 4.0 is observed for items 7 and 8. These mean scores show that the students are proactive, adaptable, and focused on understanding the course materials, which is likely to positively contribute to their success in the course. The remaining items are observed to have a mean score lower than 4.0, with item 1 having the lowest mean score for metacognitive self-regulation, which is at 2.9. This reveals a positive aspect of their attention and focus during Physics classes, implying that most of the students are fully engaged and able to maintain concentration throughout the class sessions. Overall, the average mean score for metacognitive self-regulation in learning physics is 3.9.

Findings for Resource Management

This section presents data to answer research question 3- How do learners perceive the use of resource management in language learning?

Resource Management Component (11 items)

Table 8

Mean for Environment Management (5 items)

ITEM	MEAN
RMCEMQ1 I usually study in a place where I can concentrate on my course work.	4.6
RMCEMQ2 I make good use of my study time for the courses in this program.	4.2
RMCEMQ3 I have a regular place set aside for studying	4.1
RMCEMQ4 I make sure that I keep up with the weekly readings and assignments for the courses.	4.2
RMCEMQ5 I attend the classes regularly in this program.	4.8

According to Kassim et al (2023) in Section D: Resource Management Component (Environment Management), the studies also discussed the environment management with 5 items being highlighted. Table 8 shows the environment management mean. From the table, item 5 has the highest mean score for environment management, which is at 4.8, followed by item 1 with the second-highest mean score at 4.6 and items 2 and 4 has equal mean scores that are 4.2 and the lowest is item 3 that is at only 4.1. These mean scores show that the students always attend classes and usually study in a place where they can concentrate on their course work. The lowest item that is almost to 4.0 which is item 3 reveals the students have a regular place set aside for studying implying that most of the students are fully engaged and able to maintain concentration throughout the class sessions. This reveals that a good and convenient environment does affect the students' concentration. Overall, the average mean score for environment management in learning Physics is 4.4.

Table 9
Mean for Effort Management (4 items)

ITEM	MEAN
RMCEMQ1I have a regular place set aside for studying	4.2
RMCEMQ2 I work hard to do well in the classes in this program even if I do not like what we are doing.	4.3
RMCEMQ3 When course work is difficult, I either give up or only study the easy parts.	2.7
RMCEMQ4 Even when course materials are dull and uninteresting, I manage to keep working until I finish.	4.2

Table 9 shows the effort management means. From the table, there are 4 items being evaluated. Item 2 has the highest mean score which is at 4.3, followed by item 1 and 4 with the second-highest mean score at 4.2 and last item is the lowest that is at only 2.7. The highest mean scores show that the students work hard to do well in the classes even though they do not prefer what they are doing. This shows most of the students can adapt well and strive to be excellent students by pushing themselves at full throttle. The medium mean shows that the students have a regular study place. Besides that, even though the course materials are dull and uninteresting, they managed to keep working until they finished. This shows they are keen and preserver in doing their work. The lowest item that is below 4.0 which is item 3 shows some students are either giving up or only study the easy parts when coursework is difficult. This reveals that most of the students work so hard to excel in their studies although some parts are difficult. Overall, the average mean score for effort management in learning Physics is 3.9. This study on effort management is also similar with studies by Kassim et al. (2023) under items for resource management components. In the studies, he mentioned that the plausible explanation of this component suggests that students highly value effort management and would strive within their means to study and accomplish their studies even under various constraints.

Table 10
Mean for Help-Seeking (2 items)

ITEM	MEAN
RMCHSQ1 When I cannot understand the material in a course, I ask another student in the class for help.	4.4
RMCHSQ2 I try to identify students in the classes whom I can ask for help if necessary.	4.3

According to Kassim et al (2023); Puteh et al (2022), both studies showed the discussion on help seeking components. Overall mean values of Kassim et. al., is 4.1 and for Puteh et. al., is 4.4 indicating the respondents seek help from other students or the peers in the class as their learning strategy. This shows a similar finding within this paper. Table 10 shows the mean for help-seeking with only 2 items being assessed. Item 1 and 2 show almost similar mean values which are 4.4 and 4.3, respectively. For item 1, it shows that most of the students will ask other students in the class for help whereas for item 2, the students will try to identify their classmates in the class whom they can ask for help if necessary. With a high average mean score of 4.35 for help-seeking, it shows the students' positive attitude in finding ways to elevate their understanding in learning Physics.

Findings for Relationship Between All Learning Strategies

This section presents data to answer research question 4- Is there a relationship between all learning strategies? To determine if there is a significant association in the mean scores between all learning strategies, data is analysed using SPSS for correlations. Results are presented separately in table 11, 12 and 13 below.

Table 11
Correlation between Cognitive and Metacognitive Strategies

Correlations

		COGNITIVE	METACOGNITIVE
COGNITIVE	Pearson Correlation	1	.889**
	Sig. (2-tailed)		<.001
	N	104	104
METACOGNITIVE	Pearson Correlation	.889**	1
	Sig. (2-tailed)	<.001	
	N	104	104

**. Correlation is significant at the 0.01 level (2-tailed).

Table 11 shows there is an association between cognitive and metacognitive strategies. Correlation analysis shows that there is a high significant association between cognitive and metacognitive strategies (r=.889**) and (p=.000). According to Jackson (2015), coefficient is significant at the .05 level and positive correlation is measured on a 0.1 to 1.0 scale. Weak positive correlation would be in the range of 0.1 to 0.3, moderate positive correlation from 0.3 to 0.5, and strong positive correlation from 0.5 to 1.0. This means that there is also a strong positive relationship between cognitive and metacognitive strategies.

Table 12
Correlation between Resource Management and Metacognitive

Correlations

		REAOURCE_MANAGEMENT	METACOGNITIVE
REAOURCE_MANAGEMENT	Pearson Correlation	1	.699**
	Sig. (2-tailed)		<.001
	N	104	104
METACOGNITIVE	Pearson Correlation	.699**	1
	Sig. (2-tailed)	<.001	
	N	104	104

**. Correlation is significant at the 0.01 level (2-tailed).

Table 12 shows there is an association between metacognitive and resource management strategies. Correlation analysis shows that there is a high significant association between metacognitive and resource management strategies (r=.699**) and (p=.000). According to Jackson (2015), coefficient is significant at the .05 level and positive correlation is measured on a 0.1 to 1.0 scale. Weak positive correlation would be in the range of 0.1 to 0.3, moderate positive correlation from 0.3 to 0.5, and strong positive correlation from 0.5 to 1.0. This means that there is also a strong positive relationship between metacognitive and resource management strategies.

Table 13
Correlation between Cognitive and Resource Management

Correlations

		COGNITIVE	REAOURCE_MANAGEMENT
COGNITIVE	Pearson Correlation	1	.680**
	Sig. (2-tailed)		<.001
	N	104	104
REAOURCE_MANAGEMENT	Pearson Correlation	.680**	1
	Sig. (2-tailed)	<.001	
	N	104	104

**. Correlation is significant at the 0.01 level (2-tailed).

Table 13 shows there is an association between cognitive and resource management strategies. Correlation analysis shows that there is a high significant association between cognitive and resource management strategies. (r=.680**) and (p=.000). According to Jackson (2015), coefficient is significant at the .05 level and positive correlation is measured on a 0.1 to 1.0 scale. Weak positive correlation would be in the range of 0.1 to 0.3, moderate positive correlation from 0.3 to 0.5, and strong positive correlation from 0.5 to 1.0. This means that there is also a strong positive relationship between cognitive and resource management strategies.

Conclusion

In conclusion, the study comprehensively examines the cognitive, metacognitive, and resource management strategies employed by students in learning physics, revealing several important findings.

The analysis of cognitive components highlights various strategies students use to enhance their learning. The rehearsal strategies, such as practicing material and memorizing key concepts indicating a strong reliance on repetitive review to grasp course content. Organizational strategies, like going through readings and making outlines underscoring the importance of structuring information for better understanding. Elaboration techniques, such as relating new information to prior knowledge, also demonstrate significant. Critical thinking, though slightly lower still plays a vital role in how students engage with the material.

The findings on metacognitive self-regulation reveal that students actively manage their learning processes proactively and adaptively. These learning behaviours suggest that students are generally focused and diligent in their approach to mastering physics concepts.

Resource management strategies are crucial for effective learning environments. Environment management demonstrate that students prioritize attending classes and studying in conducive settings. Effort management shows that while most students are persistent and hardworking, some struggle with more challenging tasks. Help-seeking actions demonstrating a significant tendency among students to seek peer assistance to improve their comprehensive of the subject matter.

The correlation analysis reveals significant associations between the different strategies. Cognitive and metacognitive strategies show a strong positive relationship (r =.889*), highlighting the interdependence of these approaches in effective learning. Similarly, there are strong positive correlations between metacognitive and resource management strategies (r =.699) and between cognitive and resource management strategies (r =.680*), suggesting that a holistic approach incorporating all these strategies enhances overall academic performance.

Investigating how individual differences such as prior knowledge, motivation, and cognitive abilities interact with learning strategies in physics education will leads to improvements in tackling issues on students' achievements in the future. Meanwhile, understanding these interactions can help educators tailor instruction to meet diverse learning needs by the students to achieve their success in physics. Moreover, exploring unique assessment methods and feedback mechanisms encouraging the development and refinement of learning strategies in physics education by providing the students with timely and constructively understand the efficacy of their strategies and make necessary adjustments to improve their learning outcomes.

Overall, the study underscores the importance of diverse and integrated learning strategies in physics education. By leveraging cognitive, metacognitive, and resource management techniques, students can significantly improve their comprehension and retention of complex scientific concepts. The findings point to the need for educational interventions that support and develop these strategies to foster more effective and self-regulated learners.

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