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Innovative Manipulative Supplementary Materials in Improving Students' Academic Behavior and Performance

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Abstract*—The study aimed to determine the utilization of innovative manipulative supplementary materials in science and their effect on the behavior and performance of Grade Nine students. Specifically, it aimed to determine the level of the innovative manipulative supplementary materials' components, and characteristics. Also, the level of students' behavior and performance were measured. In addition, the significant relationship of the innovative manipulative supplementary materials on students' behavior and its effect on their performance were measured. The use of innovative manipulative supplementary materials was investigated using a descriptive-experimental design, which examined their relationship with students' behavior and their effect on students' performance. Purposive sampling technique was used to select the one hundred twenty (120) Grade 9 students of Linga National High School. A written test, performance tasks, and a survey questionnaire in the form of a checklist were used. The gathered data revealed that students had a very high level of perception with regard to the innovative manipulative supplementary materials components and characteristics. Furthermore, the data showed that the students' behavior was also at a very high level in utilizing the materials. Moreover, a satisfactory level on the students' performance in the written test and an outstanding performance for the practical test were noted in the study. On the other hand, it showed that there is no significant relationship between the assessment of the innovative manipulative supplementary materials and the students' behavior. Lastly, the data indicated that there is no significant effect on the assessment of the innovative manipulative supplementary materials components on students' performance. These are the conclusions drawn based on the study's various findings. The result revealed no significant relationship between the assessment of the innovative manipulative supplementary materials and students' behavior, leading to the acceptance of the null hypothesis. This shows that while the materials may be well-designed and engaging, they did not directly influence observable changes in student behavior within the context of this study. Similarly, the study found no significant effect on the innovative manipulative supplementary materials and students' academic performance, leading to the acceptance of the null hypothesis. This implies that while the materials may offer engaging and well-designed learning experiences, they alone may not directly influence academic performance. In light of the findings and conclusions, the following recommendations emerged. Based on the study's findings, it is recommended that teachers continue integrating components of the innovative supplementary materials into their instruction, as they support student learning. Gathering regular student feedback can help refine these materials to better suit learners' needs and preferences. Students are also advised to actively engage with the materials during science exploratory activities to strengthen foundational knowledge and promote positive academic behavior.*

***Keywords*—** *Innovative, manipulative, supplementary, academic behavior, performance.*

I. INTRODUCTION

With the progression of time, new teaching strategies emerge to cater and improve the learning experience of students. The Philippines stands as a prime example of this progression. The traditional teacher-centered approach, in which teachers adhere to a banking model of instruction, predominated early teaching methods. This approach involves the teacher doing most of the knowledge sharing, while students simply absorb what they are teaching. However, along with the K-12 curriculum, educators are encouraged to shift to a learner-centered approach. Following the framework of Learner Centered Psychological Principles, learners are given more opportunities to learn interactively, which stimulates their ability to think, analyze, and draw conclusions on their own.

Learning Modules are one of the instruments that can enhance students' ability to gain and use information independently. The contents of these materials include their learning objectives, assessment tools, discussions, and activities that learners will understand and accomplish. Learning modules are now utilized as a supplementary material to reinforce students' learning, as well as an alternative learning modality for struggling students or those who cannot attend school regularly.

Now that the country has shifted back to face-to-face classes, the role of learning materials is an essential part to achieve maximum output in the students' academic performance and behavior.

Academic performance in the educational system serves as a measurement of students' achievement and progress. It is usually measured quantitatively using grades, test scores, and qualitatively using performance tasks and other academic activities. According to Miremba (2024), factors that contribute to academic performance include students' characteristics (such as motivation, effort, and prior knowledge), instructional quality, learning environments, support systems, and external influences.

Learning resources or instructional materials, such as modules, play a significant role in students' behavior and performance. Miremba (2024) also stated that instructional materials impact students significantly and are multifaceted. Thus, it affects learning outcomes and achievement. High-

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quality learning materials improved academic performance and increased students' engagement.

At present, Science teachers are using the PIVOT4A materials, which highlight the Most Essential Learning Competencies. These modules are more focused on individual activities rather than diverse methods for the class, making it standardized and not suited to cater to individual needs. Moreover, teachers often find it difficult to find various references they can use in their discussions. This issue leads to challenges for learners, as well as becoming a challenge for teachers to deliver the lesson efficiently and effectively.

In response to the above-mentioned pieces of evidence, this study explores the development and use of innovative manipulative supplementary materials in improving students' academic behavior and performance.

1.1 Statement of the Problem

Problem/s which were addressed by the research

The study was used to determine the significant impact relevant to improving the grade-9 students' academic behavior and performance through the utilization of innovative manipulative supplementary materials.

Specifically, it sought to answer the following questions:

1. What is the level of assessment of the innovative manipulative supplementary materials' components in terms of:
   1. 1 Let's Gear Up (Learning Objectives);
   1. 2 Let's See What You Got (Review);
   1. 3 Let's Explore (Pre- Activity);
   1. 4 Let's Put Things Into Action (Activity);
   1. 5 Let's Fill the Gap (Content Discussion);
   1. 6 Let's Wrap Up (Generalization);
   1. 7 Let's Be Realistic (Application); and
   1. 8 Leave a Mark (Assessment)?
2. What is the level of assessment of the innovative manipulative supplementary materials' characteristics in terms of:
   2.1 Accuracy;
   2.2 Instructional Design; and
   2.3 Technical Design?
3. What is the mean level of students' behavior in connection with:
   3.1 Student's engagement;
   3.2 Self-efficacy;
   3.3 Time management;
   3.4 Task-initiation; and
   3.5 Self-reflection?
4. What is the level of students' performance in terms of:
   4.1 Written test; and
   4.2 Practical task?
5. Is there a significant relationship between the assessment of the innovative manipulative supplementary materials and students' behavior?
6. Is there a significant effect on the assessment of innovative manipulative supplementary materials and students' performance?

II. METHODOLOGY

The use of innovative manipulative supplementary materials was investigated using a descriptive-experimental design, which examined their relationship with students' behavior and their effect on students' performance. Purposive sampling technique was used to select the one hundred twenty (120) Grade 9 students of Linga National High School. A written test, performance tasks, and a survey questionnaire in the form of a checklist were used.

III. RESULTS AND DISCUSSION

This part presents the different results and discusses the results from treating the data gathered in this study. All specific questions in Chapter 1 under the statement of the problem were answered in this chapter, supported by tables. It presents the data gathered about the significant relationship between innovative manipulative supplementary materials and students' behavior.

Level of Innovative Manipulative Supplementary Materials' Components

In this study, the level of innovative manipulative supplementary materials' components refers to Let's Gear Up (Learning Objectives), Let's See What You Got (Review), Let's Explore (Pre- Activity), Let's Put Things Into Action (Activity), Let's Fill the Gap (Content Discussion), Let's Wrap Up (Generalization), Let's Be Realistic (Application), and Leave a Mark (Assessment).

The following tables show the statement, mean, and standard deviation. remarks and verbal interpretation from the perspectives of respondents.

Table 1 exhibits the level of the innovative manipulative supplementary materials' components in terms of the learning objectives. The results show a highest mean of (M= 4.68, SD= 0.57), which reflects a strong agreement on how well the objectives were delivered during the lesson. Emphasis and consistency in introducing the learning objectives may have contributed to bringing this positive result.

TABLE 1. Level of Innovative Manipulative Supplementary Materials' Components in Terms of Let's Gear Up (Learning Objectives)

Statements	Mean	SD	Remarks
I felt that the learning objectives were clearly communicated during the lesson.	4.68	0.57	Strongly Agree
I could relate the learning objectives to the activities we did in class.	4.44	0.72	Strongly Agree
I felt that the learning objectives were relevant to my learning goals.	4.57	0.72	Strongly Agree
I believed the learning objectives were well-defined and achievable.	4.67	0.57	Strongly Agree
I would say that the learning objectives helped me focus on key concepts throughout the lesson.	4.52	0.86	Strongly Agree
Weighted Mean	**4.57**		
SD	**0.70**		
Verbal Interpretation	**Very High**		

Meanwhile, although slightly lower than the previously mentioned, the mean of (M=4.44, SD=0.72) is still interpreted as strongly agree. This indicates how students connected the learning objectives to the activity they performed in class. A

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factor that may have played a role in this is the varied learning styles of the students, wherein some may easily recognize the connection while others may not.

Additionally, the overall results revealed a weighted mean of (M=4.57, SD=0.70), which has an interpretation of very high. This result indicates a strong agreement between the students' responses to all statements given, meaning they found the learning objectives to be clearly communicated, aligned, relevant, well-defined, achievable, and thus helped them focus on the key concepts of the lesson.

These findings emphasize the relevance of a well-created objective or goals. Leonard (2024) highlighted that to attain success, learning objectives should follow S.M.A.R.T. goals, wherein objectives are specific, measurable, attainable, relevant, and time-bound. The results show how effective learning objectives enhance student engagement, provide clear guidance, and support meaningful learning throughout the lesson.

TABLE 2. Level of Innovative Manipulative Supplementary Materials' Components in Terms of Let's See What You Got (Review)

Statements	Mean	SD	Remarks
I was able to connect the current lesson to previously learned material during the review.	4.58	0.68	Strongly Agree
I found the review activities engaging and helpful for reinforcing previous concepts.	4.44	0.66	Strongly Agree
I believed that the review allowed me to strengthen my understanding of previous material.	4.45	0.79	Strongly Agree
I felt really confident in recalling key concepts from previous lessons throughout the review.	4.44	0.68	Strongly Agree
I could see how the review connected to the new content we were learning.	4.43	0.92	Strongly Agree
Weighted Mean	**4.47**		
SD	**0.75**		
Verbal Interpretation	**Very High**		

Table 2 discusses the level of innovative manipulative supplementary materials' components in terms of the review. A highest mean score of (M=4.58, SD= 0.68) was garnered regarding the review's effectiveness in relating current lessons with previously learned material. This result shows that the review activities were successful in helping the students form meaningful connections and reinforce their overall understanding. On the other hand, the lowest mean score of (M= 4.43, SD= 0.92) was yielded with regard to the perception of how clearly the review activities aligned with the new content being introduced. Although still within the strongly agree range, this indicates a less positive perception of the students regarding the matter.

The overall weighted mean of (M=4.47, SD=0.75) indicates a very high verbal interpretation. All the statements under this component received a strongly agree verbal interpretation, which shows consistently positive responses from the learners. This means that the activities in the review part of the materials helped students to recall the concepts of the previous lesson, understand better the lesson, and enable them to connect it to the new topic being discussed.

The results imply the relevance of including a review as part of the lesson material. This is supported by the works of Stavnezer and Lom (2019), who stated that recap and retrieval practices not only uplift class participation but also give valuable insights into how this approach can improve student learning. Similarly, Chu and Nguyen (2022) found that reviewing previous lectures enhances both student and teaching experiences by promoting collaborative and inclusive classroom interactions.

Table 3 displays the level of innovative manipulative supplementary materials' components in terms of pre-activity.

TABLE 3. Level of Innovative Manipulative Supplementary Materials' Components in Terms of Let's Explore (Pre- Activity)

Statements	Mean	SD	Remarks
I was engaged in the pre- activity at the beginning of the lesson.	4.40	0.78	Strongly Agree
I could see how the pre-activity connected to the main lesson content.	4.50	0.72	Strongly Agree
I felt that the pre- activity provided a useful foundation for the rest of the lesson.	4.49	0.83	Strongly Agree
I felt the introductory activity helped me understand the purpose of the lesson.	4.50	0.79	Strongly Agree
I felt the introductory activity was an interesting way to start the lesson.	4.45	0.80	Strongly Agree
Weighted Mean	**4.47**		
SD	**0.78**		
Verbal Interpretation	**Very High**		

The table reveals that students strongly agreed on all the statements measured for the pre-activity. The highest mean score of (M=4.50, SD=0.72) indicates strong agreement on aspects of the pre-activity on how it is connected to the main lesson. On the other hand, the lowest mean score of (M= 4.40, SD= 0.78), though still within the strongly agree, reflects how the pre-activity engages students at the beginning of the lesson.

Moreover, the level of innovative supplementary materials components in terms of pre-activity garnered a weighted mean score of (M=4.47, SD=0.78), with a very high interpretation among the respondents. These strong results show that pre-activity as part of the materials provided the students with an overview of the lesson's main content, being a way to engage them in the lesson.

These findings relate to the statement from Brown (2014), saying that pre-activities provide learners the chance to have background knowledge on the new lesson, supporting their cognitive growth.

The level of innovative manipulative supplementary materials' components in terms of activity is the focus of Table 4. The highest mean score of (M=4.57, SD=0.71) reflects students' strong agreement that the activities encouraged thoughtful reflection on the lesson's topic. Meanwhile, the lowest mean score of (M=4.44, SD=0.83) pertains to the aspect of the activities that involved prompting students to come up with questions and ideas for upcoming lessons.

But overall, the strong agreement among the students resulted in a weighted mean of (M=4.50, SD=0.78), and was interpreted as very high, implying that the students view the activity as effective.

TABLE 4. Level of Innovative Manipulative Supplementary Materials' Components in Terms of Let's Put Things Into Action (Activity)

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Statements	Mean	SD	Remarks
I would say that the activities made me reflect more on the topic of the lesson.	4.57	0.71	Strongly Agree
I found the activities quite interesting; it kept my attention on what was being discussed.	4.48	0.80	Strongly Agree
I found the activities useful in setting the context for the content discussion.	4.51	0.77	Strongly Agree
I believed that the activities are inclusive experience for all participants.	4.48	0.80	Strongly Agree
The activities helped me to come up with questions and ideas for the new lesson.	4.44	0.83	Strongly Agree
Weighted Mean	**4.50**		
SD	**0.78**		
Verbal Interpretation	**Very High**		

The findings above may be related to the work of Clarindo et al. (2020), which stressed how psychological development is encouraged through structured learning activities by promoting reflective thinking, analytical skills, and mental planning among students.

The results can also be explained by Nugraha et al. (2021), which revealed that hands-on activity learning model strongly highlights student engagement through self-directed exploration, improved reasoning, model building, and real-world application.

The data in Table 5 presents the students' responses to the content discussion. The highest mean score of (M=4.58, SD=0.71) reflects strong agreement on the alignment between the content discussed and the learning objectives.

In contrast, the lowest mean score of (M=4.45, SD=0.84) pertains to the areas concerning how the content discussion clarifies difficult concepts and how it helps to deepen students' understanding of the topic.

Overall, the data shows a very high level of agreement regarding the content discussions component, with a weighted mean of 4.50. The relatively small standard deviation of 0.77 indicates that most students had similar positive perceptions of the content discussion.

TABLE 5. Level of Innovative Manipulative Supplementary Materials' Components in Terms of Let's Fill the Gap (Content Discussion)

Statements	Mean	SD	Remarks
I found that the content discussion helped clarify difficult concepts.	4.45	0.84	Strongly Agree
I was able to connect the content discussion to real-world examples.	4.48	0.71	Strongly Agree
I felt that the content discussion helped deepen my understanding of the topic.	4.45	0.84	Strongly Agree
I found the content discussions to be well-organized.	4.55	0.74	Strongly Agree
The content of the discussion relates to the learning objectives.	4.58	0.71	Strongly Agree
Weighted Mean	**4.50**		
SD	**0.77**		
Verbal Interpretation	**Very High**		

The results also show that the content discussions help participants clarify difficult concepts, connect to real-world examples, and deepen their understanding of the topic.

This highlighted the importance of content discussion as backed up by the study of Demissie (2020), who emphasized the importance of exploring the students' learning through classroom discussions, as this offers educators a fresh way to conceptualize the challenges students encounter when engaging in and participating in classroom discussions.

Considering approaches that challenge the students' knowledge and prior assumptions can be an effective method to enhance their interest in classroom discussions.

TABLE 6. Level of Innovative Manipulative Supplementary Materials' Components in Terms of Let's Wrap Up (Generalization)

Statements	Mean	SD	Remarks
I was able to transfer the concepts I learned to different contexts.	4.46	0.81	Strongly Agree
I understood the key takeaways from the lesson better after completing the generalization activity.	4.47	0.73	Strongly Agree
I felt that the generalization activity gave me a deeper understanding of the lesson's concepts.	4.54	0.78	Strongly Agree
I was able to connect the new information to what I already knew through the generalization activity.	4.63	0.55	Strongly Agree
I believed the task given in the generalization part made the lesson easier to grasp.	4.46	0.73	Strongly Agree
Weighted Mean	**4.51**		
SD	**0.73**		
Verbal Interpretation	**Very High**		

Table 6 shows the students' responses to the generalization part of the innovative manipulative supplementary materials.

The generalization activity was also seen as effective, especially in enabling learners to relate new information to previous knowledge, as evidenced by the highest mean of (M=4.63, SD=0.55). While slightly lower means of (M= 4.46, SD= 0.81) for concept transfer indicates that although the activity facilitated learning, some learners might require more guidance or examples to transfer concepts in other contexts and fully understand the lesson. The weighted mean of (M=4.51, SD= 0.73) indicates that the students, overall, had a highly positive experience with the generalization activity. The reliability of responses, as indicated by the relatively low standard deviation, demonstrates that the majority of students concurred on the effectiveness of the activity in aiding them to comprehend and apply the concepts of the lesson.

This aligns with the ideas presented in the paper written by De Ley (2016), wherein it emphasizes the importance of promoting materials that facilitate generalization. To support students in making meaningful connections, teachers can encourage cross-disciplinary thinking, similar to the positive effects observed in this activity.

Table 7 focuses on the Level of innovative manipulative supplementary materials' components in terms of the application.

The highest mean score of (M=4.53, SD=0.80) was garnered on the statement, which emphasized the capacity of students to apply the learned knowledge in different situations set during the lesson. This suggests that the lesson effectively facilitated the ability of students to apply knowledge in real-world, practical situations. In addition, a slightly lower mean score of (M=4.38, SD=0.82) was obtained for the statement about the efficacy of application activities in building problem-solving skills. Although the score still indicated strong agreement, it indicates that the activities, although

helpful, were perhaps less effective in building these particular skills than other areas of the lesson.

TABLE 7. Level of Innovative Manipulative Supplementary Materials' Components in Terms of Let's Be Realistic (Application)

Statements	Mean	SD	Remarks
I was able to apply the lesson content creatively to new situations.	4.51	0.79	Strongly Agree
I was able to connect the lesson content to my personal experiences during the application activities.	4.52	0.63	Strongly Agree
I felt confident in applying the knowledge I gained during the lesson.	4.45	0.82	Strongly Agree
I felt that the application activities allowed me to practice and improve my problem-solving skills.	4.38	0.82	Strongly Agree
I was able to use what I learned to answer the given scenarios during the lesson.	4.53	0.80	Strongly Agree
Weighted Mean	**4.48**		
SD	**0.77**		
Verbal Interpretation	**Very High**		

Overall, the weighted mean of (M=4.48, SD=0.77) suggests that students generally felt confident and successful in applying the knowledge they gained during the lesson.

The results show that the application activities were generally effective in allowing students to apply knowledge in new situations, connect the content to everyday life, and have faith in their problem-solving abilities. However, the lower mean for problem-solving development implies that there may be potential to enhance activities designed to develop these specific skills even further.

This relates to the findings of Goethe (2019), who emphasizes the importance of key factors such as experiential learning, technology integration, and the relevance of the subject matter to real-life situations in enhancing students' ability to apply their learning in real-world contexts.

Table 8 presents data on the level of the innovative supplementary materials components in terms of assessment.

TABLE 8. Level of Innovative Manipulative Supplementary Materials' Components in Terms of Leave a Mark (Assessment)

Statements	Mean	SD	Remarks
I felt prepared for the assessment after completing the activities in the lesson.	4.57	0.69	Strongly Agree
I was able to perform well on the assessment based on the lesson activities.	4.39	0.80	Strongly Agree
I believed the assessment accurately measured my understanding of the lesson content.	4.52	0.77	Strongly Agree
I felt that the assessment was fair and based on the lesson content.	4.58	0.74	Strongly Agree
I believed the assessment helped me demonstrate what I learned during the lesson.	4.54	0.84	Strongly Agree
Weighted Mean	**4.52**		
SD	**0.77**		
Verbal Interpretation	**Very High**		

The results show the highest mean rating of (M=4.58, SD= 0.74) was provided to the statement about fairness and content alignment of the assessment, indicating that students believe the evaluation was appropriate and related to what was taught. However, the lowest mean score of the group (M=4.39, SD=0.80) was recorded for the statement indicating successful performance on the assessment based on lesson activities. This suggests that some students struggled to apply their learning from the activities to the assessment.

In general, the overall mean results of (M=4.52, SD=0.77) indicate that students felt well-prepared for the assessment and found it fair, with a strong connection between the activities and the content being assessed.

This aligns with Chebaiki and Addou (2024), who emphasized that assessing student learning is a continuous and crucial step in the teaching/learning process.

The results of this assessment reflect the effectiveness of such evaluation methods, as they not only allow educators to gauge student preparedness and perception of fairness but also offer insights into potential areas for improvement in teaching strategies. Furthermore, these results can help in aligning curriculum objectives with student needs, ultimately enhancing overall educational outcomes.

Composite Table on the Level of Innovative Manipulative Supplementary Materials' Components

The data presented in Table 9 shows the components of the innovative manipulative supplementary materials, with all indicators receiving very high verbal interpretations based on their weighted mean scores.

TABLE 9. Composite Table on the Level of Innovative Manipulative Supplementary Materials' Components

Indicators	Weighted Mean	SD	Verbal Interpretation
Let's Gear Up (Learning Objectives)	4.57	0.70	Very High
Let's See What You Got (Review)	4.47	0.75	Very High
Let's Explore (Pre- Activity)	4.47	0.78	Very High
Let's Put Things Into Action (Activity)	4.50	0.78	Very High
Let's Fill the Gap (Content Discussion)	4.50	0.77	Very High
Let's Wrap Up (Generalization)	4.51	0.73	Very High
Let's Be Realistic (Application)	4.48	0.77	Very High
Leave a Mark (Assessment)	4.52	0.77	Very High
Grand Mean	**4.50**		
SD	**0.76**		
Verbal Interpretation	**Very High**		

The Learning Objectives component received the highest mean score of (M=4.57, SD=0.70), indicating that students found the clarity and relevance of the learning objectives to be particularly effective. A high score in this category shows that students felt well-prepared and oriented at the start of the lesson. The relatively low standard deviation of 0.70 indicates that students' opinions were consistent across the board, showing agreement on the importance of clear and specific learning goals in setting the stage for effective learning.

On the contrary, both Review and Pre-Activity components had the lowest mean of 4.47, although still categorized as very high. The difference in these components' mean scores is minor, but these scores represent the lowest values in the dataset. Despite their slightly lower scores, these components were still rated positively, indicating that students generally found value in the review and pre-activity stages, but perhaps felt they were slightly less impactful compared to other components like the learning objectives or assessments.

Overall, the level of innovative manipulative supplementary materials' components arrived at a grand mean score of (M= 4.50, SD=0.76) was verbally interpreted as very high among the respondents.

The results mean that the innovative manipulative supplementary materials' components make students see and realize that these components create an engaging and structured approach to learning, making students synthesize and connect the new knowledge with what they already know, reinforcing their understanding in meaningful way. The high score concludes that students felt these activities helped them learn and make connections more effectively.

This is consistent with the definition of manipulatives given by SchoolMart (2017), who recognize manipulatives as objects that are utilized as instructional materials to assist students in understanding mathematical and scientific principles. Moreover, it is crucial that the lesson be planned in a manner that directs students to use the manipulatives to gain maximum learning.

Level of Innovative Manipulative Supplementary Materials' Characteristics

In this study, the level of innovative manipulative supplementary materials' characteristics refers to accuracy, instructional design**,** and technical design.

The following tables show the statement, mean, and standard deviation. remarks and verbal interpretation from the perspectives of respondents.

TABLE 10. Level of Innovative Manipulative Supplementary Materials' Characteristics in Terms of Accuracy

Statements	Mean	SD	Remarks
I felt that the course material is based on reliable sources.	4.59	0.59	Strongly Agree
I believed the facts presented in this course are up-to-date.	4.53	0.69	Strongly Agree
I am satisfied with the factual accuracy of the resources provided in this course.	4.63	0.61	Strongly Agree
I believed that the content in this course is accurate for my learning.	4.56	0.73	Strongly Agree
I am confident that the content in this course supports my learning.	4.58	0.73	Strongly Agree
Weighted Mean	**4.58**		
SD	**0.67**		
Verbal Interpretation	**Very High**		

Table 10 presents the level of innovative manipulative supplementary materials' characteristics in terms of Accuracy. The factual accuracy of the resources provided in the course received the highest mean score of (M=4.63, SD=0.61). This indicates that students had a high level of confidence in the credibility of the sources from which the material was derived.

On the other hand, the aspects of the materials being up to date received the lowest mean of (M=4.53, SD= 0.69), though it is still in the strongly agree category. While this score is slightly lower than the others, it still reflects a strong positive sentiment from students. Some students may have felt that certain aspects of the course content were not as current as they would have liked, but overall, the course was still perceived as accurate and relevant.

The overall weighted mean of (M=4.58, SD=0.67) is a strong positive indicator of how students viewed the accuracy of the course content. The "Very High" verbal interpretation reflects that students felt the course materials were both factually accurate and reliable, which is crucial for effective learning.

The above findings mirror the statement of Strutynskyi and Semenchuk (2021), where they revealed that the accuracy of manipulative materials directly influences their ability to perform tasks effectively. They emphasized that high accuracy ensures reliable functionality, which is essential for successful manipulation in learning environments.

Table 11 shows the results of the level of innovative manipulative supplementary materials' characteristics in terms of instructional design. Here, the highest mean score of (M=4.63, SD=0.65) was given to the statement indicating that the materials' instructions were well-organized and easy to follow.

TABLE 11. Level of Innovative Manipulative Supplementary Materials' Characteristics in Terms of Instructional Design

Statements	Mean	SD	Remarks
I found the materials' instructions well-organized and easy to follow.	4.63	0.65	Strongly Agree
I found the materials appropriately aligned with the learning objectives.	4.51	0.51	Strongly Agree
I felt the pacing of the activities in the material was appropriate, neither too fast nor too slow.	4.50	0.50	Strongly Agree
I felt that the assessments were designed to fairly measure my understanding of the material.	4.49	0.49	Strongly Agree
I am satisfied with the overall design of the course and how it supports my learning.	4.47	0.47	Strongly Agree
Weighted Mean	**4.52**		
SD	**0.75**		
Verbal Interpretation	**Very High**		

This could indicate that the materials likely had clear instructions, a logical flow, and well-defined sections, which made them easy to navigate and understand. The lowest mean score (M = 4.47, SD = 0.47) pertained to the design of the course and how it supports students' learning. Though still rated very highly, this suggests that while most participants were satisfied with the overall instructional design, this characteristic received slightly less enthusiastic agreement compared to the other factors. It indicates that there may have been minor concerns or areas for improvement in the overall design and its effectiveness in supporting learning.

Overall, the data reflect a very high level of satisfaction with the instructional design of the materials, reflected by the overall weighted mean of (M= 4.52, SD= 0.75). There is slight variability in responses, but still, the materials effectively support student learning and align with key instructional design principles.

Zakkiyah et al. (2024) emphasize several crucial aspects of instructional design, including goal setting, material selection, question development, difficulty level adjustment, testing, evaluation, and result utilization. These principles are reflected in the positive feedback from the data gathered for this part.

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Table 12 is about the level of innovative manipulative supplementary materials' characteristics in terms of Technical Design.

The highest mean score of (M=4.62, SD=0.78) was attributed to the statement highlighting the clear and well-organized formatting of the materials. This is a strong indicator of effective formatting, where readability and clarity were prioritized in the design of the worksheets. On the other hand, the lowest mean of (M=4.55, SD= 0.72) pertains to the technical design of the worksheets and their ease of navigation and task completion, which might be caused by the diverse learners. Some students might have preferred a more streamlined, simplified design, while others may have enjoyed the complexity or multi-step nature of the tasks.

TABLE 12. Level of Innovative Manipulative Supplementary Materials' Characteristics in Terms of Technical Design

Statements	Mean	SD	Remarks
I found the worksheets are formatted in a way that makes them easy to read.	4.62	0.78	Strongly Agree
I believed the technical design of the worksheets makes it easy to navigate and complete tasks.	4.55	0.72	Strongly Agree
I felt that the manipulatives were well integrated into the learning objectives and learning activities.	4.57	0.68	Strongly Agree
I found the worksheets are formatted in a way that makes them easy to understand.	4.57	0.74	Strongly Agree
I found the designs of both the worksheet and the manipulatives engaging.	4.57	0.80	Strongly Agree
Weighted Mean	**4.57**		
SD	**0.75**		
Verbal Interpretation	**Very High**		

But the overall results still show a very high mean of (M=4.57, SD=0.75), which indicates that the technical design of the materials helped the learners in navigating, finishing, and learning the materials.

These results align with the ideas presented by Yeo et al. (2018) and Chen et al. (2015), who stress the importance of designing materials with specific, desired properties and ensuring that these materials undergo validation and optimization to meet their intended outcomes. The study's findings suggest that the technical design of the instructional materials helped achieve these objectives effectively, benefiting the learners' experience.

Composite Table on the Level of Innovative Manipulative Supplementary Materials' Characteristics

Table 13 on the level of innovative manipulative supplementary materials' characteristics in terms of Accuracy, Instructional Design**,** and Technical Design arrived at a grand mean score of (M= 4.56, SD= 0.72), and was verbally interpreted as very high among the respondents. The result means that the innovative manipulative supplementary materials' characteristics, based on factors like accuracy, instructional design, and technical design, were evaluated positively by the respondents.

The consistency of responses, as indicated by the relatively low standard deviations, implies that the respondents were in strong agreement about the quality of these characteristics. Overall, the innovative manipulative supplementary materials are perceived to excel in all evaluated areas, highlighting their strong potential for educational and instructional use.

TABLE 13. Composite Table on the Level of Innovative Manipulative Supplementary Materials' Characteristics

Indicators	Weighted Mean	SD	Verbal Interpretation
Accuracy	4.58	0.67	Very High
Instructional Design	4.52	0.75	Very High
Technical Design	4.57	0.75	Very High
Grand Mean	**4.56**		
SD	**0.72**		
Verbal Interpretation	**Very High**		

This underscores the importance that Twizeyimana (2023) noted in their study that effective scientific education relies on well-designed teaching resources. This is because instructional materials allow educators to improve and innovate their teaching techniques.

Level of Students' Behavior

In this study, the level of students' behavior refers to students' engagement, self-efficacy, time management, task initiation**,** and self-reflection.

The following tables show the statement, mean, and standard deviation. remarks and verbal interpretation from the perspectives of respondents.

The data in Table 14 provides valuable insights into the level of students' behavior in terms of engagement. The material's aspect of engaging students to collaborate with their classmates received the highest mean of (M=4.73, SD=0.62). The high mean suggests that the materials were successful in fostering group interaction, participation, and active involvement in the learning process.

TABLE 14. Level of Students' Behavior in Terms of Students' Engagement

Statements	Mean	SD	Remarks
I felt more engaged in the lesson while using the manipulative materials with my classmates.	4.73	0.62	Strongly Agree
I was able to communicate my thoughts clearly while working with the manipulative materials.	4.56	0.62	Strongly Agree
I enjoyed working with my classmates using the manipulative materials.	4.53	0.77	Strongly Agree
I felt more confident in my answers while using the manipulative materials.	4.56	0.61	Strongly Agree
The materials encouraged effective communication among our groupmates.	4.51	0.72	Strongly Agree
Weighted Mean	**4.58**		
SD	**0.67**		
Verbal Interpretation	**Very High**		

The lowest mean in this table is (M=4.51, SD= 0.72), which is associated with how effectively the materials promoted communication within the group. This shows that while the materials generally encouraged communication among students, there might have been minor barriers or room for improvement in terms of facilitating more effective communication. The reason for this may lie in the group dynamics. Maybe in some groups, certain students may have dominated the discussion, or some may have been less inclined to communicate.

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Overall weighted mean of (M=4.58, SD= 0.67) falls in the "Very High" category, indicating that, overall, the manipulative materials were highly effective in engaging students.

This implies that students were actively involved, enjoyed working with their peers, felt confident in their answers, and communicated effectively. The relatively low standard deviation of 0.67, indicates that there is little variation in responses, suggesting a consistent level of engagement across the group of respondents.

The results align well with Sahlberg's (2016) conceptualization of engagement. The focus, curiosity, enthusiasm, and motivation demonstrated by the students through their interactions with the manipulative materials suggest that the materials effectively fostered an environment where students felt confident, actively participated, and were motivated to learn.

The data presented in Table 15 reflect students' self-efficacy when using manipulative materials during lessons**.**

The statement expressing confidence in the ability to improve performance through practice with manipulative materials received the highest mean score of (M=4.63, SD=0.62). This indicates that the students recognized the value of hands-on practice

On the side note, the statement referring to the use of manipulative materials as a means to express ideas more clearly received the lowest mean score of (M=4.48, SD=0.88). This shows that while students generally felt that the materials helped them express their ideas, there might have been some slight reservations or limitations in how effectively the materials facilitated clearer expression. Students might feel that while the materials helped them grasp concepts, they still struggled to communicate their ideas as clearly as they would like.

TABLE 15. Level of Students' Behavior in Terms of Self-Efficacy

Statements	**Mean**	**SD**	**Remarks**
I felt confident in my ability to use manipulative materials effectively during lessons.	4.58	0.69	Strongly Agree
I believed that using manipulative materials enhances my understanding of the subject.	4.58	0.68	Strongly Agree
I can successfully complete tasks using manipulative materials with little to no assistance.	4.56	0.71	Strongly Agree
I believed that I could improve my performance by practicing with manipulative materials.	4.63	0.62	Strongly Agree
I felt that using manipulative materials allowed me to express my ideas more clearly.	4.48	0.88	Strongly Agree
Weighted Mean	**4.57**		
SD	**0.72**		
Verbal Interpretation	**Very High**		

The weighted mean of (M=4.57, SD=0.72) reflects a "Very High" level of self-efficacy among the students when using manipulative materials. This means that, overall, the students felt very confident in their ability to use the materials effectively, believed that the materials helped enhance their understanding, and were optimistic about improving their performance through practice.

The results closely align with the findings shared by Munajjah et al. (2024), who emphasized the critical role of self-efficacy in influencing student engagement and motivation. According to Munajjah et al., students who possess a higher level of self-efficacy tend to put in more effort, demonstrate greater resilience and persistence through challenges, which ultimately leads to increased engagement in their academic tasks.

Table 16 presents the level of students' behavior in terms of time management. The highest mean score of (M=4.60, SD=0.67) was given to the statement highlighting students' ability to complete tasks using manipulative materials. This indicates that the use of these materials helped students stay on track with their work and manage their time effectively.

Table 16. Level of Students' Behavior in Terms of Time Management

Statements	**Mean**	**SD**	**Remarks**
I completed tasks with manipulative materials within the given time limits.	4.60	0.67	Strongly Agree
I used time efficiently when working with manipulative materials during lessons.	4.43	0.68	Strongly Agree
I learned the lessons in a shorter time when using manipulative materials.	4.53	0.86	Strongly Agree
I remain focused and minimize distractions when working with manipulative materials.	4.54	0.72	Strongly Agree
Using manipulative materials helped me work through lessons more efficiently.	4.53	0.87	Strongly Agree
Weighted Mean	**4.53**		
SD	**0.76**		
Verbal Interpretation	**Very High**		

In contrast, the statement related to efficient use of time when working with manipulative materials during lessons received the lowest mean score of (M=4.43, SD=0.68), though it still falls under the "Strongly Agree" category. While students felt confident in completing tasks on time, there seems to be a slight dip in their perceived efficiency in utilizing time effectively. Some students may have found certain tasks more complex or time-consuming, which could have made it harder to use time as efficiently as they would have liked. The nature of the manipulative materials may sometimes require more time to explore or understand, which might have affected their perceived efficiency.

Nevertheless, the weighted mean of (M=4.53, SD=0.76) reflects a "Very High" interpretation in terms of time management when using manipulative materials. This suggests that, overall, students were able to manage their time effectively, complete tasks within the given time limits, and maintain focus. The relatively high level of agreement across the statements indicates that students found the manipulative materials to be supportive in helping them work through lessons efficiently.

The results align with the study by Valente et al. (2024), which highlights that better time management planning is positively correlated with self-regulated learning. In contrast, procrastination negatively impacts self-regulation. The results emphasize the importance of effective time management in fostering positive student behavior and improving academic performance, reinforcing the value of manipulative materials in helping students work through lessons efficiently.

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Table 17 focuses on the level of students' behavior related to task initiation when using manipulative materials.

The highest mean score of (M=4.60, SD=0.70) was recorded for the statement reflecting students' motivation to independently explore new ideas using manipulative materials. It indicates that these materials effectively encouraged students to engage actively and explore concepts in a self-directed manner. On the other hand, the statement concerning the role of manipulative materials in helping students take ownership of their learning process received the lowest mean score of (M=4.48, SD=0.80).

While students may have felt motivated and engaged, some might have still relied on teacher guidance and support, limiting their perceived ownership of the learning process.

TABLE 17. Level of Students' Behavior in Terms of Task-Initiation

Statements	Mean	SD	Remarks
I am motivated to explore new ideas with manipulative materials on my own.	4.60	0.70	Strongly Agree
I felt that using manipulative materials helps me take ownership of my learning process.	4.48	0.80	Strongly Agree
I felt confident when working with manipulative materials in group activities.	4.53	0.80	Strongly Agree
I enjoyed discovering new methods to use manipulative materials independently.	4.52	0.81	Strongly Agree
I am eager to begin activities that use manipulative materials without waiting for prompts.	4.58	0.72	Strongly Agree
Weighted Mean	**4.54**		
SD	**0.77**		
Verbal Interpretation	**Very High**		

Overall, the weighted mean of (M=4.54, SD=0.77) reflects a very high level of task initiation among students when using manipulative materials. This concludes that, overall, manipulative materials significantly contribute to encouraging students to engage actively and initiate tasks, though there may be some room for increasing their sense of autonomy.

The findings of the current study, showing high task initiation but with some variability, reinforce Aberg's (2017) suggestion that guidance and feedback play an important role in helping students fully take ownership of their learning. While manipulative materials encourage independent exploration, the need for teacher support remains crucial for guiding students through tasks, ensuring they can confidently engage with the materials and take full responsibility for their learning.

TABLE 18. Level of Students' Behavior in Terms of Self-Reflection

Statements	Mean	SD	Remarks
I reflected on what I learned after working with manipulative materials.	4.58	0.75	Strongly Agree
I think about how manipulative materials helped me understand the lesson.	4.58	0.78	Strongly Agree
I reflected on whether manipulative materials made learning more engaging for me.	4.56	0.71	Strongly Agree
I considered if manipulative materials helped me retain information better.	4.50	0.74	Strongly Agree
I am aware of my learning progress after using manipulative materials.	4.55	0.70	Strongly Agree
Weighted Mean	**4.56**		
SD	**0.74**		
Verbal Interpretation	**Very High**		

Table 18 focuses on the Level of students' behavior in terms of self-reflection and reveals that the highest-rated statements were those related to reflecting on learning after working with manipulative materials, as well as considering how these materials contributed to understanding the lesson, where both got the mean of (M=4.58).

On the contrary, the statement related to evaluating whether manipulative materials aided in better information retention received the lowest mean score of (M=4.50, SD=0.74), showing that while students strongly agreed with reflecting on the benefits of manipulative materials, they may not have directly connected them to improved information retention. The immediate effects of using manipulative materials might be clear in terms of understanding the lesson or completing tasks. However, students may not immediately notice a long-term improvement in memory retention, which could lead to a lower perceived connection between materials and information retention.

Overall, the weighted mean of (M=4.56, SD=0.74), reflects that, on the whole, students engage in a high level of self-reflection after using manipulative materials, considering how these materials impact their learning, understanding, and engagement. However, there is slight variability in the strength of their reflections, especially concerning retention. This concludes that while the materials foster a reflective learning process, further emphasis could be placed on explicitly linking them to retention and long-term learning outcomes.

The study by Darmiany et al. (2024) highlights the importance of self-reflection in learning, noting that it enables students to evaluate their learning experiences, identify challenges, and set goals. This process, according to their findings, enhances self-efficacy, motivation, and the ability to apply learned concepts to real-life situations, ultimately leading to meaningful learning. The results from the current data align well with this, showing that students exhibit a high level of self-reflection after using manipulative materials.

Composite Table on the Level of Students' Behavior

Table 19. Composite Table on the Level of Students' Behavior

Indicators	Weighted Mean	SD	Verbal Interpretation
Student's engagement	4.58	0.67	Very High
Self-efficacy	4.57	0.72	Very High
Time management	4.53	0.76	Very High
Task initiation	4.54	0.77	Very High
Self-reflection	4.35	0.74	Very High
Grand Mean	**4.51**		
SD	**0.73**		
Verbal Interpretation	**Very High**		

Table 19 shows the level of students' behavior in terms of students' engagement, self-efficacy, Time management, task initiation**,** and Self-reflection.

The results revealed a grand mean score of (M=4.51, SD= 0.73), and was verbally interpreted as very high among the respondents. This means that the students' behavior, as measured through these important areas, is positively strong, signifying that the students are greatly engaged, positive about their capacities, efficient in time management, active in starting tasks, and reflective in their learning. The findings

indicate that the innovative manipulative supplementary materials could have helped to create a more motivated and self-regulated learning environment and hence improved the overall students' behavior and learning achievements.

Level of Students' Performance in Terms of Written Test

Table 20 presents the students' performance in terms of a written test, categorized by score ranges and descriptive equivalents.

TABLE 20. Level of Students' Performance in Terms of Written Test

Score	Written Test		Descriptive Equivalent
	F	%	
25 - 30	13	10.83	Outstanding
19 - 24	43	35.83	Very Satisfactory
13 - 18	48	40.00	Satisfactory
7 - 12	16	13.33	Fairly Satisfactory
0 - 6	0	0.00	Did not meet Expectation
Total	**120**	**100**	
Weighted Mean	18.20		
SD	4.961		
Verbal Interpretation	Satisfactory		

Outstanding (25 - 30): 13 students (10.83% of the total) scored within this range, which indicates that a small proportion of students performed exceptionally well on the test.

Very Satisfactory (19 - 24): 43 students (35.83%) fell into this range, representing a large group. This suggests that students performed at a very satisfactory level.

Satisfactory (13 - 18): 48 students (40%) scored in this range. This indicates that the majority of students performed at a satisfactory level, meeting the expected standards but not exceeding them.

Fairly Satisfactory (7 - 12): 16 students (13.33%) were in this range, suggesting a smaller portion of students performed below average but still somewhat met expectations.

Did Not Meet Expectation (0 - 6): No students (0%) scored in this range, indicating that every student at least met the minimum expected level for the written test

The overall performance is Satisfactory (with a weighted mean of 18.20), meaning that most students met the expected learning outcomes, but there is room for improvement in terms of achieving higher performance levels. The absence of students who scored Did Not Meet Expectation is a positive indicator of overall student preparedness, suggesting that the materials or teaching strategies may have been effective in preparing the students to meet at least the minimum required standard.

In the context of the result of the study, the written test results are example of indirect evidence of learning, as they provide insights into students' knowledge and abilities, but may not fully capture the depth of understanding or competencies demonstrated by students through practical application. This reflects the study of Ortega (2016), where he emphasized that a holistic assessment should combine written exams with other assessment activities that explicitly address high levels of thinking. Furthermore, he also states that in designing written exams, creativity is necessary to identify students who are strong and weak and align the exams for them.

Level of Students' Performance in Terms of Practical Test

TABLE 21. Level of Students' Performance in Terms of Practical Test

Score	Practical Test		Descriptive Equivalent
	F	%	
36 - 44	120	100.00	Outstanding
27 – 35	0	0.00	Very Satisfactory
18 – 26	0	0.00	Satisfactory
9 – 17	0	0.00	Fairly Satisfactory
0 – 8	0	0.00	Did not meet Expectation
Total	**120**	**100**	
Weighted Mean	42.80		
SD	1.230		
Verbal Interpretation	Outstanding		

The results of Table 21 reflect an outstanding performance in the practical test, with a weighted mean of (M= 42.80, SD=1.230). The table also shows that all students (120 out of 120) achieved scores within the range of (36-44), which is categorized as Outstanding.

The results align with Abidoye and Abidoye (2023), highlighting that students taught with instructional materials performed significantly better in practical tests than those who did not use such materials. The fact that all students in this study performed at an outstanding level show that the use of manipulative materials played a key role in helping students grasp the concepts and apply them effectively in a practical setting.

Moreover, it can also be supported with Oliveira and Bonito (2023), who emphasized that practical tests in science education, when conducted with a hands-on approach, significantly enhance both practical skills and conceptual understanding. The outstanding performance across the board in this study reflects this notion, as the hands-on nature of manipulative materials likely facilitated deeper engagement with the material, allowing students to apply theoretical knowledge in a real-world context.

Test of Relationship Between the Innovative Manipulative Supplementary Materials and the Students' Behavior

To test the significant relationship between the innovative manipulative supplementary materials and the students' behavior in terms of students' engagement, self-efficacy, time management, task initiation, and self-reflection, they were treated statistically using Real Statistics Data Analysis Tools using the Pearson product-moment correlation coefficient.

Table 22 shows the significant relationship between the innovative manipulative supplementary materials and the students' behavior. Across all combinations, a total of 60 correlations were tested. Among them, 13 relationships were statistically significant ($p < 0.05$) and 47 relationships were not statistically significant ($p \geq 0.05$).

The Learning Objectives component showed no significant correlation with any of the behavioral dimensions, showing that while this component may provide foundational direction, it does not appear to directly influence students' behavioral engagement or learning strategies in a statistically measurable way. The Activity and Content Discussion components were

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only significantly correlated with student engagement, revealing that t interactive and discussion-based phases of the lesson are particularly effective in sustaining interest and participation, though they may have less impact on students' self-efficacy.

TABLE 22. Significant Relationship between the innovative manipulative supplementary materials and the students' behavior

Innovative manipulative supplementary materials	Students' behavior					
	Student's engagement		Self-efficacy	Time management	Task initiation	Self-reflection
Components						
Learning Objectives	Pearson Correlation	0.4614	0.5175	0.6325	0.5085	0.4713
	Significance (2-Tailed)	0.9180	0.8655	0.2668	0.4898	0.7221
	N	119	119	119	119	119
	Analysis	Not Sig	Not Sig	Not Sig	Not Sig	Not Sig
Review	Pearson Correlation	0.7371	0.7159	0.7115	0.7511	0.7588
	Significance (2-Tailed)	0.0024	0.0145	0.1545	0.0621	0.0175
	N	119	119	119	119	119
	Analysis	Sig	Sig	Not Sig	Not Sig	Sig
Pre- Activity	Pearson Correlation	0.7508	0.7646	0.7052	0.7421	0.7355
	Significance (2-Tailed)	0.0035	0.0105	0.1780	0.0785	0.0299
	N	119	119	119	119	119
	Analysis	Sig	Sig	Not Sig	Not Sig	Sig
Activity	Pearson Correlation	0.7422	0.7317	0.7623	0.7460	0.7095
	Significance (2-Tailed)	0.0244	0.0748	0.4175	0.2623	0.1417
	N	119	119	119	119	119
	Analysis	Sig	Not Sig	Not Sig	Not Sig	Not Sig
Content Discussion	Pearson Correlation	0.7621	0.8048	0.7538	0.7518	0.7656
	Significance (2-Tailed)	0.0306	0.0584	0.5343	0.3358	0.1449
	N	119	119	119	119	119
	Analysis	Sig	Not Sig	Not Sig	Not Sig	Not Sig
Generalization	Pearson Correlation	0.6134	0.6431	0.6832	0.6134	0.6156
	Significance (2-Tailed)	0.1193	0.2212	0.7467	0.5628	0.3380
	N	119	119	119	119	119
	Analysis	Not Sig	Not Sig	Not Sig	Not Sig	Not Sig
Application	Pearson Correlation	0.7142	0.7369	0.7781	0.7226	0.7291
	Significance (2-Tailed)	0.0102	0.0251	0.1816	0.1312	0.0500
	N	119	119	119	119	119
	Analysis	Sig	Sig	Not Sig	Not Sig	Sig
Assessment	Pearson Correlation	0.7461	0.7662	0.7493	0.7144	0.6981
	Significance (2-Tailed)	0.1048	0.2054	0.8616	0.6274	0.3807
	N	119	119	119	119	119
	Analysis	Not Sig	Not Sig	Not Sig	Not Sig	Not Sig
Characteristics						
Content	Pearson Correlation	0.6451	0.6879	0.6701	0.5933	0.5514
	Significance (2-Tailed)	0.1167	0.0598	0.0058	0.0284	0.0739
	N	119	119	119	119	119
	Analysis	Not Sig	Not Sig	Sig	Sig	Not Sig
Accuracy	Pearson Correlation	0.7915	0.7935	0.7851	0.7808	0.6925
	Significance (2-Tailed)	0.9566	0.7215	0.1268	0.2675	0.5866
	N	119	119	119	119	119
	Analysis	Not Sig	Not Sig	Not Sig	Not Sig	Not Sig
Instructional Design	Pearson Correlation	0.6599	0.7540	0.7449	0.6632	0.6617
	Significance (2-Tailed)	0.1633	0.2261	0.8876	0.6732	0.4205
	N	119	119	119	119	119
	Analysis	Not Sig	Not Sig	Not Sig	Not Sig	Not Sig
Technical Design	Pearson Correlation	0.7089	0.7666	0.7785	0.7188	0.7517
	Significance (2-Tailed)	0.8982	0.8196	0.1788	0.3907	0.6272
	N	119	119	119	119	119
	Analysis	Not Sig	Not Sig	Not Sig	Not Sig	Not Sig

On the other hand, the Generalization and Assessment components showed no significant correlation with student behavior, suggesting that although they support cognitive consolidation and performance evaluation, they may not directly affect students' behavioral aspects of learning.

The Application component showed significance in three dimensions: engagement, self-efficacy, and self-reflection, reinforcing its value as a practical bridge between theory and behavior. This suggests that giving students opportunities to apply their learning in meaningful ways helps solidify their confidence and reflective habits.

The analysis found generally low statistical significance between the characteristics of innovative manipulative supplementary materials and student behavior. However, the Content component showed significant positive correlations with two behaviors: time management ($p = 0.0058$) and task initiation ($p = 0.0284$). This implies that well-structured content can enhance students' ability to manage their time and

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start tasks independently. Clear, relevant, and engaging content may help students feel more confident and motivated to take initiative in their learning. As a result, educators should prioritize content quality when designing or selecting manipulative materials to support positive behavioral outcomes.

Overall, the absence of a significant correlation between the innovative manipulative supplementary materials and students' behavior could be because of individual preference, learning style, or previous experience. Some students might be interested in the materials, while others are not, and this influences their behavior. The materials can improve academic performance, but might not necessarily result in changes in behavior.

Just like in the study of Thomas et al. (2024), where they argued that an awareness of such emotional and behavioral considerations is essential in creating an effective learning environment. It postulates that although study aids such as manipulative materials can facilitate performance, they might not be sufficient to deal with underlying behavioral problems or emotional demands, pointing to the requirement of focused intervention to assist students in overcoming disengagement and learning-related behavioral hurdles.

Test of Effect Between the Innovative Manipulative Supplementary Materials and the Students' Performance

To test the significant effect between the innovative manipulative supplementary materials and the students' performance in terms of the Written Test and the Practical Test, they were treated statistically using Real Statistics Data Analysis Tools using the Regression Analysis.

The analysis of the components of innovative manipulative supplementary materials reveals varying levels of influence on written and practical performance, as reflected in the beta coefficients, t-values, and p-values.

For written performance, the strongest positive beta was observed in the Pre-Activity component (β = 1.8664, t = 1.0026, p = 0.3182), suggesting a potentially meaningful impact, although not statistically significant. Similarly, Activity (β = 1.3098, t = 0.7746, p = 0.4402), Application (β = 0.7100, t = 0.3768, p = 0.6786), and Generalization (β = 0.7110, t = 0.3868, p = 0.6996) all showed positive associations, indicating these stages might contribute to improved written outcomes. However, their high p-values confirm that these results are not statistically significant. Conversely, Assessment had the strongest negative beta (β = -2.1248, t = -1.0193, p = 0.3102), implying that it may have hindered written performance, followed by Review (β = -1.5118, t = -0.8578, p = 0.3928), and Learning Objectives (β = -0.4292, t = -0.3334, p = 0.7394), which also showed negative but non-significant effects.

For practical performance, all components had small beta coefficients and non-significant p-values, indicating minimal impact.

The highest positive effect was seen in Pre-Activity (β = 0.3269, t = 0.6893, p = 0.4920), followed by Review (β = 0.1922, t = 0.4280, p = 0.6694), while Application (β = 0.0810), Generalization (β = 0.0813), and Activity (β = 0.0801) showed negligible influence, with t-values close to zero and p-values well above 0.05. Notably, Learning Objectives (β = -0.4717, t = -1.4379, p = 0.153) showed the most negative effect, though still not statistically significant. Content Discussion (β = -0.2031) and Assessment (β = -0.2087) also exhibited slight negative trends.

TABLE 23. Test of Effect on the Use of Innovative Manipulative Supplementary Materials on Students' Performance

Components of Innovative Manipulative Supplementary Materials	**Performance**	**Beta coefficient**	**t-value**	**p-value**
Learning Objectives	Written	-0.4292	-0.3334	0.7394
	Practical	-0.4717	-1.4379	0.153
Review	Written	-1.5118	-0.8578	0.3928
	Practical	0.1922	0.4280	0.66942
Pre-Activity	Written	1.8664	1.0026	0.3182
	Practical	0.3269	0.6893	0.4920
Activity	Written	1.3098	0.7746	0.4402
	Practical	0.0801	0.1859	0.85228
Content Discussion	Written	0.5375	0.2982	0.7660
	Practical	-0.2031	-0.4423	0.6591
Generalization	Written	0.7110	0.3868	0.6996
	Practical	0.0813	0.1736	0.8624
Application	Written	0.7100	0.3768	0.6786
	Practical	0.0810	0.1746	0.8520
Assessment	Written	-2.1248	-1.0193	0.3102
	Practical	-0.2087	-0.3929	0.6951
Characteristics				
Accuracy	Written	-1.8944	-1.3438	0,1816
	Practical	0.5337	1.4814	0.1412
Instructional Design	Written	0.2458	0.2002	0.8416
	Practical	-0.0319	-0.1018	0.9191
Technical Design	Written	4.0155	2.8724	0.0048
	Practical	-0.5975	-1.6722	0.0972

Additional analysis of the characteristics of the materials, namely, Accuracy, Instructional Design, and Technical Design, provides further insights. For written performance, Technical Design stands out with a highly significant and strong positive impact (β = 4.0155, t = 2.8724, p = 0.0048), indicating that well-constructed technical features of the materials (e.g., layout, visuals, usability) substantially enhance written outcomes. This is the only component across all dimensions to reach statistical significance, emphasizing the importance of effective visual and structural design in supporting written learning. In contrast, Accuracy showed a negative relationship (β = -1.8944, t = -1.3438, p = 0.1816), suggesting that inaccuracies may detract from written performance, although the result is not significant. Instructional Design (β = 0.2458, t = 0.2002, p = 0.8416) had a very weak and non-significant positive effect.

For practical performance, Accuracy (β = 0.5337, t = 1.4814, p = 0.1412) emerged as the strongest positive contributor, though not statistically significant, suggesting that precise and correct content might aid hands-on activities. Interestingly, Technical Design showed a negative relationship with practical performance (β = -0.5975, t = -1.6722, p = 0.0972), which, while nearing significance, could indicate that

overly technical designs may complicate rather than aid practical execution. Instructional Design again had minimal impact (β = -0.0319, t = -0.1018, p = 0.9191), revealing little influence on practical tasks.

While many components showed promising trends for written performance, especially Pre-Activity, Activity, and Application, none achieved statistical significance, highlighting the need for refinement. For practical performance, the effects were mostly negligible. Notably, Technical Design was the most influential factor for written performance, showing a statistically significant positive effect, suggesting that the usability and layout of materials play a critical role in enhancing learning outcomes. These findings underscore the necessity to prioritize both content clarity and design quality to improve the overall effectiveness of learning materials in both written and practical contexts.

The results are connected to what Maisari et al. (2023) stated, that learning becomes successful when students are involved not just intellectually, but also emotionally and physically. Additionally, it is also important to consider the learners when searching and designing science learning materials, using a Hands-on Instructional Model. Kibga et al. (2022) in their paper explained this by stating that by involving students in instructional design, it improves their understanding of concepts, particularly in chemistry.

IV. Conclusion and Recommendations

The following conclusions are drawn based on the study's various findings in order to address the problem's stated requirements;

There is no significant relationship between the assessment of the innovative manipulative supplementary materials and the students' behavior; thus, the null hypothesis was accepted. This shows that while the materials may be well-designed and engaging, they did not directly influence observable changes in student behavior within the context of this study. It implies that other factors beyond instructional materials may play a more critical role in shaping student behavior.

There is no significant effect on the assessment of the innovative manipulative supplementary materials components on students' performance, thus, the null hypothesis was also accepted. This implies that while the materials may offer engaging and well-designed learning experiences, they alone may not directly influence academic performance.

Given the findings and conclusions drawn, the following were recommended:

Teachers are encouraged to continue integrating the components of the innovative supplementary materials into their instruction as they are effective in supporting student learning.

Teachers may gather regular feedback from students to refine and adapt the materials to better meet their learning needs and preference.

Students are encouraged to actively use manipulative supplementary materials during science exploratory activities, as doing so can help strengthen their foundational knowledge and promote positive academic behavior.

Teachers should consider incorporating more structured written practice exercises, and formative assessments to strengthen students' test-taking skills and ensure balanced academic development across both practical and written tasks.

Curriculum planners and teachers should consider supplementing the materials with differentiated instruction and varied teaching strategies that address diverse learning styles.

Reference

[1]. Åberg, M. (2017). Talk, Text, and Tasks in Student-Initiated Instructional Interaction. Discourse Processes, 54(8), 1–20. https://doi.org/10.1080/0163853X.2016.1139966

[2]. Brown, D. (2014). Effects of cooperative pre-activities on student understanding of high school biology. 1–85. https://scholarworks.montana.edu/xmlui/handle/1/3535

[3]. Chebaiki, N., & Addou, M. (2024). La valutazione dell'espressione orale nell'insegnamento dell'italiano come LS al liceo in Algeria. Altralang Journal, 6(1), 502–516. https://doi.org/10.52919/altralang.v6i1.447

[4]. Chu, D., & Nguyen, H. (2022). Recapping: effective pedagogy to ensure inclusivity and optimise learning and teaching experiences. Compass: Journal of Learning and Teaching, 15(2). https://doi.org/10.21100/compass.v15i2.1261

[5]. Clarindo, C. B. da S., Miller, S., & Kohle, É. C. (2020). Learning Activity as a Means of Developing Theoretical Thinking Capacities. Frontiers in Psychology, 11, 603753. https://doi.org/10.3389/FPSYG.2020.603753

[6]. Darmiany, D., Istiningsih, S., Nurmawanti, I., Nurwahidah, N., & Mauldya, M. A. (2024). Student's Self-Regulated Learning in Online Class Design Based on Reflective Learning. Al-Ishlah, 16(1), 440–449. https://doi.org/10.35445/alishlah.v16i1.3947

[7]. De Ley, L. (2016). Generalization: Making Learning More than a "Classroom Exercise." In Scientific Learning Whitepaper. Scientific Learning Corp. https://www.scilearn.com/wpcontent/uploads/generalizationwhitepaper_2016-10-12.pdf

[8]. Demissie, F. (2020). Understanding barriers to discussion-based learning: using an epistemological perspective to theorise student teachers' perceptions. Teacher Education Advancement Network Journal, 12(1), 97–108. https://files.eric.ed.gov/fulltext/EJ1276068.pdf

[9]. Goethe, O. (2019). Learning Experiences in Real Life (pp. 49–58). Springer, Cham. https://doi.org/10.1007/978-3-030-11078-9_5

[10]. Kibga, E. S., Gakuba, E., & Sentongo, J. (2022). Learners' Active Engagement in Searching and Designing Learning Materials through a Hands-on Instructional Model. International Journal of Learning, Teaching and Educational Research, 21(8), 75–91. https://doi.org/10.26803/ijlter.21.8.6

[11]. Leonard, K., & Watts, R. (2024). The ultimate guide to S.M.A.R.T. goals. Forbes Advisor; Forbes. https://www.forbes.com/advisor/business/smart-goals/

[12]. Maisari, D., Junaidi, J., Fauzan, F., & Nurhasnah, N. (2023). Studi Tentang Keaktifan Siswa Dalam Pembelajaran Pendidikan Agama Islam. Ta'rim, 4(4), 139–153. https://doi.org/10.59059/tarim.v4i4.527

[13]. Miremba Bacia, & Kiu Publication Extension. (2024, July 5). Role of Instructional Materials in Students' Academic Performance. ResearchGate; unknown. https://www.researchgate.net/publication/382004589_Role_of_Instructional_Materials_in_Students

[14]. Munajjah, S. N. H., Supriatna, M., & Suryana, D. (2024). Analisis Validitas Instrument Self-Efficacy Belajar Siswa Pada Sekolah Terbuka Atlet Dengan Menggunakan Model Rasch. JKI (Jurnal Konseling Indonesia), 9(1), 1–13. https://doi.org/10.21067/jki.v1i9.9411

[15]. Nugraha, F. F., Rahayu, G. D. S., & Purnomo, H. (2021). The effect of the hands on activity learning model on science process skills in elementary school students. 5(2), 222. https://doi.org/10.22460/PEJ.V5I2.2719

[16]. Oliveira, H. M. de, & Bonito, J. (2023). Practical work in science education: a systematic literature review. Frontiers in Education, 8. https://doi.org/10.3389/feduc.2023.1151641

[17]. Ortega-Sanchez, C. (2016). Written Exams: How Effectively are We Using Them? Procedia - Social and Behavioral Sciences, 228, 144–148. https://doi.org/10.1016/j.sbspro.2016.07.021
[18]. Sahlberg, P. (2016). The Global Educational Reform Movement and Its Impact on Schooling. The Handbook of Global Education Policy, 128–144. https://doi.org/10.1002/9781118468005.ch7
[19]. Stavnezer, A. J., & Lom, B. (2019). Student-led Recaps and Retrieval Practice: A Simple Classroom Activity Emphasizing Effective Learning Strategies. Journal of Undergraduate Neuroscience Education, 18(1), A1. https://pmc.ncbi.nlm.nih.gov/articles/PMC6973304/
[20]. Strutynskyi, S., & Semenchuk, R. (2021). Investigation of the accuracy of the manipulator of the robotic complex constructed on the basis of cycloidal transmission. Technology Audit and Production Reserves, 4, 6–14. https://doi.org/10.15587/2706-5448.2021.237326
[21]. Thomas, J., Egeberg, H., Parada, R. H., Tracey, D., & Martin, K. (2024).Student Engagement. https://doi.org/10.1017/9781009289771
[22]. Twizeyimana, E. (2023). Instructional Materials in Science Education: Secondary School Teachers' Perceptions. Journal of Global Research in Education and Social Science, 28–34. https://doi.org/10.56557/jogress/2023/v17i38235