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The Effectiveness of Prometheia: A Technology-Based Learning Tool for Enhancing Student Performance in Science 7

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Abstract: The research aimed to determine the effectiveness of Prometheia, a technology-driven learning tool that enhances the academic performance of Grade 7 students in science as well as offering additional learning advantages beyond the usual classroom instruction. To shed light on that matter, the research explored two kinds of students' achievements: those who were taught in the traditional way and those who used Prometheia through the differences between pretests and posttests. Also, it elucidated the students' perceptions of the platform through dimensions of engagement, understanding, confidence, and overall learning experience. Forty (40) students of Grade 7 from Caalibangbangan Integrated School, Division of Cabanatuan City, during the School Year 2025–2026, served as the participants and were split into control and experimental groups. In this study, researchers used an experimental design employing pretest-posttest assessments and an Other Benefits Survey Questionnaire. The gathered data was subjected to descriptive statistics, paired sample t-test, and independent sample t-test analyses. The results indicated that the control and experimental groups' pretest scores were similar, thereby implying that the two groups had equal starting knowledge. On the other hand, there were statistically significant differences in the posttest scores of all Science 7 units. Students in the experimental group were consistently outperforming those in the control group. Besides that, the survey findings solidified that students totally agreed that Prometheia facilitated their understanding of scientific concepts, helped them to be more engaged, and elevated their confidence in learning Science. The results of the study indicate that Prometheia is a powerful educational medium offering not only a significant upgrade in students' academic results but also the provision of worthwhile learning advantages in their Science 7 lessons.
Keywords: Prometheia, academic performance, Science 7, technology-driven learning, student engagement, experimental design

I. THE PROBLEM AND REVIEW OF RELATED LITERATURE

A. Introduction

Science is an important subject in shaping students' inquisitiveness, analytical, and reasoning skills. In junior high school, it is one of the core subjects offered, as it lays the groundwork for comprehending the natural phenomena around us and equips learners for further education in multiple STEM disciplines. Despite its importance, a great number of students struggle with science because of its complicated, abstract concepts, its unique jargon, and the requirement for both a sound grasp of theory and its application in practice. This leads to a lack of motivation, poor retention and low achievement among learners.

In Grade 7 when students are introduced to more complex scientific principles, traditional methods of instruction which include lectures, note-taking, and textbook centered learning do not do enough to address the diverse learning needs of students. In addition, we see that there is little time for in-depth lessons, a set pace for all students, and very little feedback given out, which in turn restricts what it takes for true mastery. Additionally, we see that students have trouble with the material and fall behind, and those who catch on quickly are left without advanced material. In addition, there is very little parental involvement in what is going on with their academic performance which in turn creates a support gap between what is going on at home and at school.

In the integration of technology into education, we see new solutions to old problems. Digital learning platforms that present interactive content, which offer personalized pace and real time feedback, outperform traditional methods of instruction. In addition, we see that those who implement a mastery-based system of learning do so by allowing students to redo lessons and assessments till they achieve what they need to, which in turn gives them a better grasp of key concepts. In addition, we use auto communication tools which keep parents in the loop regarding student progress, which in turn brings in more outside support and accountability for the student.

In this study, the researcher introduced prometheia, a study tool based on technology designed to increase the performance of science 7 students. The platform has interactive lessons, enrichment activities and mastery-based learning system that requires students to achieve at least 60% before moving to a new lesson. In addition, prometheia includes an automated parent notification system that provides timely updates on tasks completed by students and performance, strengthening home-school collaboration.

The central focus of this research is to experimentally investigate the effects of prometheia on student performance in science 7. By comparing the control group that receives traditional teaching with an experimental group using prometheia, the study determines whether the platform improves students' educational achievements, attachment and ownership of scientific concepts significantly.

Findings of this study will provide experimental evidence regarding the effectiveness of prometheia as an educational tool. The results are expected to inform teachers, school leaders and policy makers how technology-based learning systems can be used to improve science education. In addition, this research aims to contribute to knowledge regarding the role of digital platforms to improve learning outcomes and create more inclusive, student focused approaches in 21 century classrooms.

B. *Review of Related Literature and Studies*

1) *Prometheia and the MATATAG Science Curriculum:* Prometheia has been developed to align with the MATATAG K 10 Science Curriculum, which emphasizes concept based, inquiry driven and contextualized science learning. In its interactive lessons and enrichment activities are directly aligned with Grade 7 competencies in Earth and Space, Life Science, Physical Science and Chemistry. By using the Most Essential Learning Competencies (MELCs) as a framework for structuring lessons, prometheia ensures that its instructional content is developmentally appropriate while encouraging students to hypothesize, analyze, and draw evidence-based conclusions. Unlike in traditional teaching which is a linear progression, prometheia has a mastery-based system and spaced retrieval practice. Students in this platform are put through repeated assessments until they achieve a certain level of mastery. This format encourages them to reflect and reinforce basic concepts which in turn prevents moving on until the material is fully grasped. Experimental research is needed to determine whether this mastery-based design leads to significantly higher achievement in science 7 compared to conventional teaching methods.
2) *Technology-Based Learning Tools in Science Education:* Technology has transformed science instruction to be more of a hand on and student-centered. Based on Alshammari (2017), digital platforms improve conceptual understanding through dynamic visualizations and instant feedback, a finding consistent with constructivist learning principles. Similarly, Ghazali, Ashari, Hardman, and Zabit (2025) designed a project-based, technology-integrated science module for preschoolers and, through their study, evidenced that children performing science projects together with technology scored much higher on the post-test than on the pre-test, thus revealing that well-organized technology-supported learning scenarios may raise the level of interaction and understanding of science in preschool children. Based on Aksakal (2020) students that are exposed to technological-based learning systems did better on tests than those under traditional instruction, largely due to increased engagement. These results support testing whether prometheia, as a technology-based learning platform, can produce similar or greater gains in science 7 performance when compared to standard teaching strategies.
3) *Digital Platforms include student monitoring features:* Educational learning platform that includes learner analytics and task monitoring present data driven settings. Reyes and Tan (2023) emphasized that platforms support what "precision teaching" enabling educators to tailor instruction to real time student performance. Baylon and Franco (2021) further demonstrated that progress dashboards and automated parents' notification improved accountability, leading to higher task completion rates. Salazar and Mendoza (2019) an experimental study with seventh graders showed that digital monitoring enhanced both comprehension and retention in comparison to control groups. This indicates that parent notifications and progress tracking features of prometheia enhance accountability and learning outcomes to a measurable extent.
4) *Importance of Parental Engagement in Academic Performance:* Parental participation is linked to improved student outcomes and engagement. Benner, Boyle, and Sadler (2022) revealed through the meta-analysis that students whose parents frequently and consistently involve themselves in various ways are likely to have higher academic achievements. In particular, they found that academic socialization and home-based support from parents were two major factors that contributed to adolescents' high academic achievement. The meta-analytic findings of the authors suggest that among students, those whose parents actively keep track of their school progress, talk about expectations, and help with learning at home, show better academic performance than those with less parental involvement. Digital notifications to parents have been shown to enhance not only academic performance, but student discipline as well (Domingo and Agustin, 2022). The engagement actively facilitated by prometheia can be tested in an experiment that would directly measure its outcomes and compare student achievements in classrooms with such notifications to those without.

5) *Student Performance and Task Completion Tracking:* Research studies continue to back up the fact that structured monitoring aids in the enhancement of performance. Villanueva (2018) highlighted that the use of platforms with prompts and feedback helped in the organization and time management, which are necessary for academic success. Bautista and Carreon (2021) confirmed through experiment that students with tracking features on their platforms performed at a higher mastery level and retained scientific concepts better than their peers in the control groups. In addition, Salazar and Mendoza (2019) the groups with real-time monitoring performed better than control groups in post-test assessments.
6) *Digital Assessments, Student Perceptions, Experiences, and Other Benefits in Science:* Recent studies show that the use of digital assessment tools has a significant impact on students' positive perceptions, experience and other benefits towards science and consequently their performance and motivation. Roschelle, Feng, Murphy, & Mason (2020). A technology-enabled assessment package offers such features as interactive tasks, real-time feedback, and remediation activities, which help learners to access science easily. Roschelle et al., (2020) Digital assessments serve formative and self-assessment purposes as they allow learners to track their progress and become familiar with the standards of quality understanding. In fact, the feedback provided in the moment and that can be easily acted upon gives students the opportunity to dislodge misconceptions that have only just taken root thus promoting not only scientific accuracy but also confidence in the scientific process. In addition to that, Roschelle et al., (2020) Digital assessments were found to be effective in helping learners from various socioeconomic backgrounds and, therefore, they contribute to the elimination of gaps in access to quality feedback mechanisms. Through the support of reflective learning and deeper engagement with the content, digital assessments are no longer merely testing instruments but learning enhancers. Platforms such as prometheia, which integrates digital assessment features, may be instrumental in increasing students' endurance and mastery performance through the repeated learning cycles. Roschelle et al., (2020) Feedback-intensive digital environments have the potential to close the chasms that lie between comprehension and application thus making science teaching more tailored, open to all, and efficient.
7) *Intelligent Educational Technologies and Personalized Learning:* Chen, Xie, & Hwang, (2021) Intelligent educational technologies significantly change individual learning experiences by modifying the content based on the student's achievement level. These adaptive systems empower learners as they can choose the content with which they want to interact at the appropriate level of mastery, thus, they facilitate differentiated learning. Chen et al., (2021) Technology employs analytics to figure out misconceptions and to give prompt support thus, cognitive engagement and self-regulated learning are enhanced. Chen et al., (2021) Multimodal representations of abstract science concepts greatly elevate conceptual understanding, especially in areas of chemistry and physics. Intelligent systems provide information to teachers about their practices by pointing out the trends that are present not only in the class but also on a wide scale which allows targeted interventions. Chen et al., (2021) The use of intelligent devices in science classes is in line with the pedagogical demands of today for personalized and equity-oriented instruction.
8) *Digital Literacy, Self-Efficacy, and Engagement:* According to research of Lee, Anderson, & Park (2021), self-efficacy and digital literacy are the two main factors that determine the level of student engagement in online science activities. The combination of students' favorable perceptions, experiences toward digital technology and their digital literacy skills significantly contributes to the development of self-efficacy, which in turn, predicts the engagement of the students across cognitive, behavioral, and emotional domains. Lee et al., (2021) A greater level of digital self-efficacy enables students to participate more effectively in collaborative learning, thus, they can better interact with their peers and carry out the collective inquiry processes. An individual who has a positive perception and experience towards the use of technology in the learning process will experience fewer feelings of isolation in a virtual environment, which eventually leads to the enhancement of social presence and the feeling of being connected. By the time students are digital literate, the interventions that led to it no longer constitute problems in their tasks. Lee et al., (2021). Their competence and confidence are then at a level whereby they can engage in mastery learning and be involved in science tasks. Lee et al., (2021). The fusion of digital literacy enhancement with the use of such platforms as prometheia not only leads to a better conceptual understanding but also helps learners to be more self-regulated in their learning.
9) *Mechanisms of Digital Literacy and Learning*: According to Zhang & Liu (2025), the digital atmosphere, self-efficacy, and engagement are mediating mechanisms through which digital literacy influences learning outcomes. When digital literacy is high, learners become more confident, which allows them to use technology tools effectively and carry out self-regulated learning. On one hand, the effect of a positive digital environment is to broaden self-efficacy that, in turn, shows the role not only of personal skills but also of the learning context. Mechanistic breakthroughs reveal the role of digital literacy in capturing learners' interest thus, digital literacy becomes a tool to facilitate learners' mastery of the subject and their conceptual

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understanding. One can hypothesize that embedding features that not only increase but also sustain students' digital competence and confidence in a platform such as prometheia will be a great strategy for boosting student performance. Zhang & Liu, (2025). The role of digital literacy cannot be underestimated in the realization of the full potential of technology-enhanced science education.

10) *Adaptive Learning Technologies and Engagement:* Khan et al., (2025) One potential explanation for the success of adaptive learning technologies in raising learning outcomes and engagement is an account adjustment in real-time based on student performance by such technologies. In adaptive environments, the technology self-efficacy level is continuously increasing, thus progressive learners become not only more confident but also more competent. The motivation to persist comes from the mastery-oriented structure that, thus, guarantees success at every stage. Moreover, such systems support retention and long-term learning through the process of individualizing the learning content and tackling each learner's misconceptions. Moreover, they do so by drastically lowering the same achievement gaps when these are brought about by differences in the diverse learners' strengths or challenges, making use of customized support that is adaptive in nature. Khan et al., (2025). Adaptive feature inclusion in prometheia is in line with the evidence of personalized learning as a stimulator of both cognitive and affective gains.
11) *Teacher Digital Competence and Implementation Quality:* Araújo & Esteves, (2025) Teacher readiness and digital competence are the major factors that determine the level of success of digital tools in classrooms. While most of the teachers accept the use of technology as beneficial, there are still some areas where the teachers lack such as in the creation of digital content, pedagogical application, and confidence. Just to name one, the effective utilization of prometheia type of platform calls for professionals who are well-equipped through professional development activities in their technical and pedagogical skills. Araújo & Esteves, (2025) Differences in the use of digital tools by teachers have a strong impact on student outcomes and engagement, which in turn leads to a question of whether the adoption has been evenly distributed or not. Continued education for teachers should be an important component of the education system whereby the focus should be on the wise use of adaptive and mastery-oriented features so that the learning benefits can be maximized. Araújo & Esteves, (2025) Proper use of digital platforms in science education depends on not only on institutional support but also well-organized training.

C. Synthesis of Related Literature and Studies

The reviewed literature pieces together a firm basis for the experimental use of prometheia as a digital, mastery-based learning platform. A consistent message can be drawn from the sources of research that the use of technology in instruction leads to the improvement of students' cognitive and affective aspects of learning science. Alshammari (2017), and Aksakal (2020), found that interactive and self-paced digital learning environments significantly improve students' conceptual understanding, inquiry skills, and problem-solving abilities. These results are in line with the primary functions of prometheia, which is an online resource with interactive lessons, enrichment activities, and mastery-based learning cycles, the platform may have the same effect on enhancing science 7 performance as suggested by these studies. With respect to digital learning, a series of investigations have drawn attention to the significance of key monitoring and analytics functions. Reyes and Tan (2023), Baylon and Franco (2021), and Salazar and Mendoza (2019), all strongly argued that platforms featuring learner analytics, progress dashboards, and automated notifications bring about precision teaching, contribute to accountability, and affect positively the rates at which tasks get completed. prometheia is a platform that encourages frequent assessments and parent notifications and thus, is equipped with such features. Apart from facilitating improved academic performance, these methods also motivate students to become reflective learners, hence mastering the core concepts further. In addition, the reviewed pieces of literature consistently draw the researchers' attention towards the significant contribution of parental engagement in enhancing student outcomes. Domingo and Agustin (2022), and Lee and Gomez (2020) discovered that active parental participation has a positive impact on children's motivation, discipline, and achievement. The automated parent notification system in prometheia is in line with these findings, thus transforming home-school collaboration into a means for closing support gaps and increasing accountability. Such a feature is of utmost importance in junior high school, where students might need extra guidance in managing their learning responsibilities efficiently. Moreover, the current research opens more possibilities for understanding technology-mediated learning through digital assessments, intelligent educational technologies, and adaptive learning systems. Roschelle et al. (2020) provided evidence that now when students were assessed interactively and digitally, their perceptions and experience towards science became positive, they felt more confident, and their misconceptions decreased. Chen, Xie, and Hwang (2021) pointed out that intelligent adaptive platforms accommodate personalized learning as they change the material according to user mastery, give support, and provide various ways of representing a complex scientific concept. Khan et al. (2025) argued that learning technologies that are adaptive facilitate learning, motivate, and facilitate long-term engagement because they give tailored support and reduce the gap between high and low achievers. Besides that, digital literacy and self-efficacy have also been considered as very important, and they are the main factors that determine the success of technology-based learning. Lee, Anderson, and Park (2021) and Zhang and Liu (2025) agreed that a high level of digital literacy leads to self-efficacy, engagement, and mastery learning, especially if there is a positive digital learning environment to support. These factors highlight the necessity not only to provide the technology but also the skills and confidence needed for the students to be fully engaged with digital platforms such as prometheia. The combination of self-regulated learning, personalized feedback, and adaptive instruction in one system satisfies both the cognitive and affective requirements, thus leading to authentic learning experiences. The success of technology-enhanced learning largely depends on teacher readiness and their digital competence. In their study, Araújo and Esteves (2025) pointed out that no matter how advanced a platform is, it still requires educators to be pedagogically and technically proficient in the digital instruction. The successful use of prometheia is therefore contingent upon the teachers' capacity to employ its adaptive and mastery-oriented features, keep track of student progress, and offer the targeted support. Consequently, institutional support, professional development, and well-organized teacher training are indispensable in unlocking the full potential of digital platforms as a means of enhancing science education outcomes. First, the integrated review of research works reveals that prometheia can be a powerful tool to elevate the performance, engagement, and mastery of the scientific concepts of grade 7 students. By leveraging interactive content, adaptive and mastery-based instruction, real-time assessment, digital literacy support, and parental engagement, prometheia is in line with the technology-enhanced science education best practices derived from the literature. Hence, an experimental study is needed for a scientific and objective comparison of its effectiveness with that of the traditional teaching methods.

D. Conceptual Framework

In Science, knowledge acquisition, application in problem-solving, active participation, and deep understanding are pivotal. Motivational and performance issues are often a result of traditional teaching methods. While technology in teaching can enhance the comprehension and communicative skills of the student, particularly when it involves interactive and curriculum-aligned platforms. This study is grounded on the premise that learning is enhanced with the use of technology equipped with organized lessons, instant evaluation, and peer academic assistance. Specifically, prometheia, a learning technology tool, was created to fit the MATATAG K–10 Science Curriculum to improve students' performance in science 7. In addition to classroom learning, prometheia ensures learning extends to the home environment through its interactive lessons, automated assessments, and parental notifications. Study adopts constructivism (Bruner, Piaget) and connectivism (Siemens) which note that students learn effectively when they are fully engaged in the construction of knowledge and when meaningful connections with the teachers, peers, and family are present. With interactive activities, real-time assessment, and parental participation, prometheia is anticipated to promote cognitive and affective development in the learners. In this study, the control group will continue with traditional teaching methods, whereas the experimental group will utilize prometheia as an adjunct learning tool for some lessons. All groups will be evaluated in science 7 with pre-tests and post-tests for measuring performance differences. In addition, feedback from students in the experimental group will be collected to evaluate other benefits toward prometheia as an innovative educational tool.

E. Paradigm of the Study

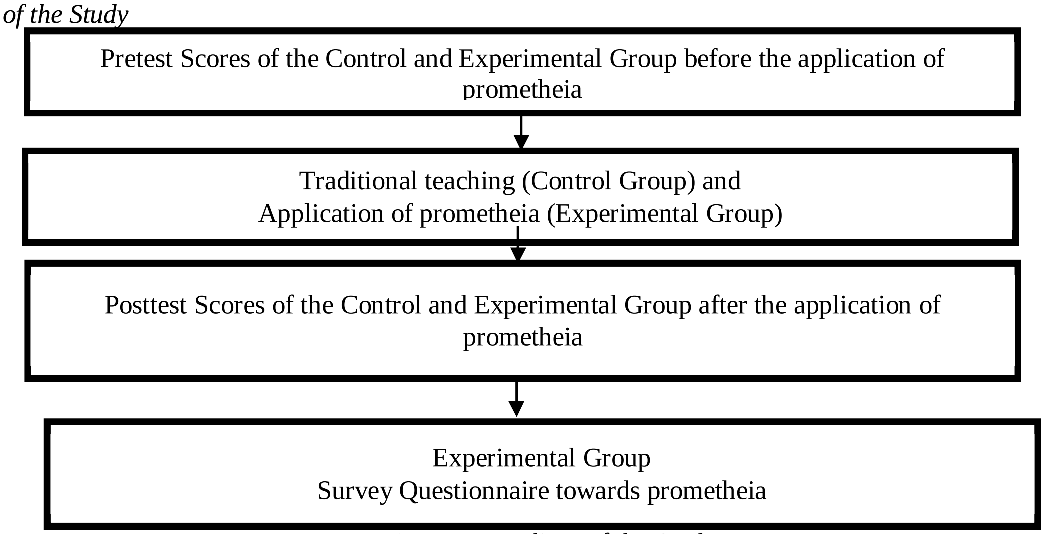

Figure 1 Paradigm of the Study

F. Definition of Terms

1) Prometheia: A technology-based learning platform called prometheia was created to enhance science instruction in Grade 7 as part of the MATATAG K–10 Curriculum. It provides inquiry-based assignments, formative evaluations, and interactive online courses that are in line with the Most Essential Learning Competencies (MELCs). It has an automatic parent notification system to improve communication between the home and the school and parental involvement, as well as a mastery-based learning system that rquires pupils to meet a minimum score before moving on.

2) Mastery-Based Learning: Through repeated evaluations until mastery is attained, students must demonstrate acceptable knowledge (at least 60% score) of a subject as part of the prometheia educational technique. This encourages more in-depth learning and makes sure that pupils don't progress without fully understanding.

3) MATATAG K–10 Science Curriculum: The Philippines' national curriculum framework for science education places a strong emphasis on inquiry-driven, concept-based, and culturally grounded learning that is in line with 21st-century skills.

4) Most Essential Learning Competencies (MELCs): A list of the Department of Education's (DepEd) most important learning standards that serve as the cornerstone of curricular material and instructional design, emphasizing the essential information and abilities that students at every grade level need to possess.

5) Learning Management System (LMS): Flexible, individualized, and interactive learning experiences are made possible by a digital platform that makes it easier to deliver, administer, and track educational content and student performance.

6) Parental Engagement: The active participation of guardians or parents in fostering and tracking their child's academic development. Prometheia improves this by providing automatic alerts on submission status, performance ratings, and job schedules.

7) Student Monitoring and Performance Tracking: gathering and evaluating data in real time on academic achievement, task fulfillment, and student development to guide instructional tactics and encourage student accountability.

8) Digital Learning Tools: Through the provision of multimodal experiences, instant feedback, and self-paced learning opportunities to enhance comprehension and motivation, technological resources enhance interactive and learner-centered education.

9) Formative Assessment: Continuous, low-stakes tests that are included into prometheia give students fast feedback, enabling them to pinpoint their areas of strength and growth and enabling teachers to modify their lesson plans accordingly.

10) Minimum Viable Product (MVP): A working prototype of prometheia was created to showcase its essential functions and gather input for further improvement prior to wider deployment.

G. Statement of the Problem

The purpose of this study is to determine the effectiveness of prometheia, a technology-based learning tool, in enhancing the academic performance of Grade 7 students in science.

Specifically, the study sought answers to the following questions:

1. How may the students' pretest scores of control and experimental groups in science 7 be described before the prometheia is implemented in the following topics?
   - 1.1 Science Equipment: The Compound Microscope
   - 1.2 Plant and Animal Cells
   - 1.3 Cellular Reproduction
   - 1.4 Levels of Biological Organization
   - 1.5 Trophic Levels and the Transfer of Energy
2. Is there a significant difference in the pretest scores of the control and experimental groups in science 7 be described before the prometheia is implemented?
3. How may the students' posttest scores of control and experimental groups in science 7 be described after the prometheia is implemented in the following topics?
   - 3.1 Science Equipment: The Compound Microscope
   - 3.2 Plant and Animal Cells
   - 3.3 Cellular Reproduction
   - 3.4 Levels of Biological Organization
   - 3.5 Trophic Levels and the Transfer of Energy
4. Is there a significant difference in the post-test scores of control and experimental groups in science 7 be described after the prometheia is implemented?

5. Is there a significant difference in the pretest and posttest scores of the experimental group before and after the prometheia is implemented?
6. How can the students' other benefits from the application of the prometheia tool in Science 7 be described?

H. Hypotheses of Study

1. There is no significant difference in the pretest scores of both experimental and control group before the application of prometheia in Science 7.
2. There is no significant difference in the post-test scores of both experimental and control group after the application of prometheia in Science 7.
3. There is no significant difference in the pretest and post-test scores of both experimental and control group after the application of prometheia in Science 7.

I. Significance of the Study

The purpose of this study is to determine the effects of prometheia, technology-based learning tool, on the academic performance of Grade 7 students in science. The findings of this study aim to be valuable to students, teachers, parents, school administrators, experts, and future researchers.

1) School Administrators: Results provide school heads and department coordinators with baseline data on the effectiveness of digital learning platforms like prometheia in improving academic outcomes. These insights aim guide policy decisions and support the integration of technology-driven strategies aligned with MATATAG K–10 Science Curriculum.

2) Teachers: The study will help Science 7 teachers assess how technology-enhanced instruction can improve classroom delivery. prometheia's curriculum-aligned features, performance tracking, automated feedback aid teachers in designing effective lessons, reducing the workload manual assessment.

*3) Learners***:** Students' understanding and achievement in Science 7 can be boosted with interactive lessons and inquiry-based lessons and enrichment activities aligned with the MELCs through the prometheia platform. Students peaking in the science tool can grasp concepts in science more deeply, develop more of the critical and the problem-solving skills, and receive feedback in real time. This scaffolding supports their learning at that level and helps develop the capacity for self-directed learning.

4) Parents: Prometheia's parent notification system helps guardians receive notifications on scheduled tasks, performance scores, and task submissions, thus providing timely updates. This maintains the partnership and improves the family engagement with school and their involvement to support the child in learning, tracking and positive study behavior reinforcement at home.

5) Experts: The findings give data-driven insights on how technology can be effectively used to meet the aims of the MATATAG K-10 Curriculum in scientific teaching. Prometheia 's capabilities, particularly those connected to real-time monitoring and learner assistance, can help shape the design of future digital platforms.

6) Future researchers: This study aims to guide the researchers who are doing comparable studies on making instructional materials, using technology in the classroom, and working with parents and schools. It shows how to combine system design, curriculum alignment, and assessment in a way that works with technology-based learning.

J. Scope and Limitation

The aim of this experimental study was to ascertain how the technology-based learning tool prometheia affected the academic achievement of seventh-grade science students at Caalibangbangan Integrated School in the Cabanatuan City Division during the second quarter of the 2025–2026 school year. In the second quarter of the MATATAG K–10 Science Curriculum, the following subjects were covered in the study: (1) science tools: the compound microscope; (2) plant and animal cells; (3) cellular reproduction; (4) levels of biological organization; and (5) trophic levels and energy transfer.

The study's respondents were forty (40) seventh-grade students from Caalibangbangan Integrated School, who were selected from two intact class sections. Although Grade 7-Bautista had forty-four students and Grade 7-Bonifacio had forty-one students, only twenty students from each section were chosen to participate in the research. The twenty students selected from Grade 7-Bautista constituted the experimental group and were exposed to the prometheia technology-based learning tool, while the twenty students selected from Grade 7-Bonifacio served as the control group and were given instruction through the traditional method. The restriction of the number of participants to twenty per section was done deliberately to keep the two groups balanced and to ensure a fair and manageable comparison of instructional approaches. To guarantee comparability, students were paired according to their science pre-test scores.

The research instruments used to collect the necessary data included the Other Benefits Survey Questionnaire, pre-test and post-test assessments, and achievement test results, all of which were interpreted and analyzed. To examine the gathered data, descriptive and inferential statistics such as weighted mean and t-test were used.

This study was conducted to assess the effectiveness of prometheia on the scientific performance and other benefits of students in the second quarter. It did not cover other subjects, different grade levels, or the long-term impact on student performance. In addition, the scope of the study was limited to the use of prometheia's Minimum Viable Product (MVP) version, which incorporates essential elements of task submission tracking, performance evaluation, interactive Lessons, and automated parental notification systems.

II. METHOD

A. *Research Design*

This study employed an experimental research design to investigate and analyze the effects of prometheia: a technology-based learning tool for enhancing student performance in Science 7 at Caalibangbangan Integrated School, Division of Cabanatuan City, during the School Year 2025–2026.

An experimental research design is a structured process for verifying theories and determining relationships in causation. Em (2025) describes experimental research as a scientific method used to establish the existence of cause-and-effect relationships by deliberately changing one or more independent variables and studying their effects on dependent variables while at the same time controlling other factors to prevent bias and maintain validity. He explains that in a typical true experiment, participants are randomly allocated to experimental groups receiving the treatment or intervention and control groups not receiving it, which enables researchers to determine the effect of the independent variable and to make strong causal claims. Em (2025) additionally acknowledges that the control of extraneous variables and randomization are necessary measures to minimize biases and to guarantee that the changes seen in the dependent variable are due to the intervention and not to other factors.

B. *Participants of the Study*

In the second quarter of the school year 2025–2026, the study participants were Grade 7 students from Caalibangbangan Integrated School, who were selected from two intact class sections. Grade 7-Bautista constituted the experimental group and were exposed to the prometheia technology-based learning tool, while Grade 7-Bonifacio served as the control group and were given instruction through the traditional method.

Moreover, to make sure that the experimental and control groups were equivalent, a pairing matching method was used before the intervention was implemented. The twenty selected students were paired according to academic indicators, mainly their pretest scores in science 7, so that for each participant in the experimental group, there was a corresponding participant in the control group with a similar level of prior knowledge and academic ability. This pairing process reduced the risk of selection bias and accounted for pre-existing differences between the two groups, even though they came from different sections. Therefore, the significant differences, if any, in the posttest performance of the students can be attributed to the use of the prometheia technology-based learning tool with less doubt rather than to differences in students' initial academic performance or class size variations.

Table 1. Respondents of the Study

Groups	N
Control	20
Experimental	20
Total	40

C. *Research Locale*

The study was carried out at Cabanatuan City, Nueva Ecija's Caalibangbangan Integrated School. The Department of Education (DepEd) Schools Division of Cabanatuan City oversees the public school, which serves students in Kindergarten through Junior High School.

Figure 2. Map showing the location of Caalibangbangan Integrated School, Cabanatuan City, Nueva Ecija.

D. Materials and Instrumentation

1) Prometheia: A technology-based learning platform created to improve Science 7 education served as the main source of information for this study. Interactive lectures, practice tasks, tests, and automatic feedback are all integrated into prometheia. The platform features multimedia-rich courses, quizzes, and a parent notification system that gives information on student schedules, assignment submissions, and academic performance, all of which are different from traditional classroom education.

The experimental group (Grade 7-Bautista) used prometheia completely for this study throughout their Science 7 classes. The Grade 7 Bonifacio control group, on the other hand, received instruction using traditional teaching methods. The researcher was able to assess how well the platform improved scientific learning outcomes because of this distinction.

2) Other Benefits Survey Questionnaire: The researcher used a Survey to gauge students' motivation, perceptions, experiences, benefits, and views about using prometheia in Science 7. Strongly Agree, Agree, Disagree, and Strongly Disagree were the four response options on the four-point Likert scale used by the tool. The survey functioned as an additional tool to ascertain the influence of prometheia beyond test results and offered insightful information about learners' viewpoints.

3) Pre-Test and Post-Test: Both the experimental and control groups were given pre- and post-tests. The purpose of these tests was to gauge how well students understood the Science 7 skills that were taught in the second quarter. The researcher was able to assess prometheia 's efficacy in raising students' academic achievement statistically by contrasting the outcomes of the two groups.

A thorough assessment of the impact of prometheia on Science 7 student learning outcomes was made possible by this triangulated method.

E. Data Collection

The researcher obtained permission from Cabanatuan City's Schools Division Superintendent and the Principal of Caalibangbangan Integrated School to perform the study. Following approval, both the control and experimental groups received a pretest to establish their baseline knowledge and skills in science 7.

The experimental group used prometheia, a technology-based learning tool, whereas the control group was taught traditional methods. Students completed a pretest to measure their past knowledge before beginning each class. The lesson was then presented using the allocated instructional style, and both groups were given a posttest to quantify learning gains and assess the effectiveness of prometheia against standard teaching.

In addition, a survey was distributed to assess students' perceptions of prometheia in terms of usability, content quality, and its contribution to their learning experience. The purpose of this survey was to explain to the respondents to ensure authentic and honest responses.

The research was conducted following the timeline of science 7 lessons, as presented in **Table 2**.

Research Timeline

Date 2nd semester S.Y. 2025-2026	Module/ Lessons	Control Group	Experimental Group
September 23, 2025	Lesson 1: Science Equipment – The	Orientation, Introduction, Pretest → Traditional Lecture-	Orientation, Introduction, Pretest → prometheia Lesson Integration →

	Compound Microscope	Discussion → Posttest	Posttest
September 26, 2025	Lesson 2: Plant and Animal Cells	Orientation, Introduction, Pretest → Traditional Lecture-Discussion → Posttest	Orientation, Introduction, Pretest → prometheia Lesson Integration → Posttest
September 29, 2025	Lesson 3: Cellular Reproduction	Orientation, Introduction, Pretest → Traditional Lecture-Discussion → Posttest	Orientation, Introduction, Pretest → prometheia Lesson Integration → Posttest
October 03, 2025	Lesson 4: Levels of Biological Organization	Orientation, Introduction, Pretest → Traditional Lecture-Discussion → Posttest	Orientation, Introduction, Pretest → prometheia Lesson Integration → Posttest
October 06, 2025	Lesson 5: Trophic Levels and the Transfer of Energy	Orientation, Introduction, Pretest → Traditional Lecture-Discussion → Posttest	Orientation, Introduction, Pretest → prometheia Lesson Integration → Posttest
October 10, 2025	Integration/ Conceptual Framework of the Study	Survey (Control)	Survey (Experimental)

F. Data Analysis

The data collected in this study were subjected to appropriate statistical treatments to determine the effects of prometheia, a technology-based learning tool, on the Science 7 performance and other benefits of students. The following statistical tools were used:

1) *Descriptive Statistics (Mean, Standard Deviation, Frequency, and Percentage):* Descriptive statistics were employed to summarize the students' performance in the pretest and posttest of both the experimental (Grade 7-Bautista) and control (Grade 7-Bonifacio) groups. Specifically, the mean scores and standard deviations were calculated to describe the central tendency and variability of the students' scores. In addition, frequency and percentage distributions were used to show how the students' scores were spread across performance categories before and after the use of prometheia.

2) *Paired Sample T-Test:* The paired sample t-test was used to evaluate whether there was a significant improvement in the scores of the experimental group before and after exposure to prometheia. This test compared the pretest and posttest scores of the same group of students, thereby determining the actual effect of the intervention.

3) *Independent Sample T-Test:* To compare the performance of students between the control and experimental groups in both pretest and posttest, the independent sample t-test was utilized. This analysis determined whether there was a significant difference in achievement between students taught with prometheia and those taught using conventional methods.

4) *Likert Scale Analysis for Survey* The responses to the Survey were analyzed using a four-point Likert scale, with the following weights and interpretations:

Rating Scale	Weights Assigned	Students Towards Prometheia
4	3.25-4.00	Strongly Agree
3	2.50-3.24	Agree
2	1.75-2.49	Disagree
1	1.00-1.74	Strongly Disagree

This analysis provided insights into students' perceptions, experiences, motivation and other benefits towards the use of prometheia in learning Science 7.

5) *For students' academic performance:* Student performance in the pretest and posttest was classified using the following scale:

Scores	Verbal Description
1-3	Poor
4-6	Fair
7-9	Good
10-12	Very good
13-15	Excellent

This classification allowed for the clear categorization of learners' achievement levels, which was further analyzed using statistical tools.

III. PRESENTATION, ANALYSIS, AND INTERPRETATION OF RESULTS

This chapter presents the analysis, interpretation, and discussion of the data from research called "The Effectiveness of Prometheia: A Technology-Based Learning Tool for Enhancing Student Performance in Science 7." The presentation of the results is a systematic organization of the researchers' formulated questions and variables."

This chapter also contains a comparison of the academic performance of two groups that were part of the research: the control group, which was taught through traditional methods, and the experimental group, which was given the Prometheia as an interactive, technology-based learning tool. By this comparison, the chapter describes the degree to which prometheia has led student understanding and their overall performance in Science 7.

A. Pretest Scores of Students in Control and Experimental Groups Before the Integration of Prometheia.

Table 3 Pre-test Scores of Control and Experimental Groups on Five Lessons in Science 7.

			Control		Experimental	
	Score	**Verbal Description**	**Frequency**	**Percent**	**Frequency**	**Percent**
Science Equipment – The Compound Microscope	**LESSON 1**					
	1-3	**Poor**	**1**	**5.00**	**0**	**0.00**
	4-6	**Fair**	**1**	**5.00**	**0**	**0.00**
	7-9	**Good**	**1**	**5.00**	**2**	**10.00**
	10-12	**Very Good**	**14**	**70.00**	**17**	**85.00**
	13-15	**Excellent**	**3**	**15.00**	**1**	**5.00**
	Total		**20**	**100.00**	**20**	**100.00**
	Mean Score		**10.55**	**Very Good**	**11.00**	**Very Good**
Plant and Animal Cells	**LESSON 2**					
	1-3	**Poor**	**3**	**15.00**	**0**	**0.00**
	4-6	**Fair**	**14**	**70.00**	**17**	**85.00**
	7-9	**Good**	**2**	**10.00**	**3**	**15.00**
	10-12	**Very Good**	**1**	**5.00**	**0**	**0.00**
	13-15	**Excellent**	**0**	**0.00**	**0**	**0.00**
	Total		**20**	**100.00**	**20**	**100.00**
	Mean Score		**4.95**	**Fair**	**5.05**	**Fair**
Cellular Reproduction	**LESSON 3**					
	1-3	**Poor**	**5**	**25.00**	**5**	**25.00**
	4-6	**Fair**	**14**	**70.00**	**13**	**65.00**
	7-9	**Good**	**1**	**5.00**	**2**	**10.00**
	10-12	**Very Good**	**0**	**0.00**	**0**	**0.00**
	13-15	**Excellent**	**0**	**0.00**	**0**	**0.00**
	Total		**20**	**100.00**	**20**	**100.00**
	Mean Score		**4.15**	**Fair**	**3.35**	**Fair**
Levels of Biological Organization	**LESSON 4**					
	1-3	**Poor**	**6**	**30.00**	**3**	**15.00**
	4-6	**Fair**	**11**	**55.00**	**10**	**50.00**
	7-9	**Good**	**2**	**10.00**	**3**	**15.00**

	10-12	**Very Good**	**1**	**5.00**	**4**	**20.00**
	13-15	**Excellent**	**0**	**0.00**	**0**	**0.00**
	Total		**20**	**100.00**	**20**	**100.00**
	Mean Score		**4.65**	**Fair**	**6.05**	**Fair**
Trophic Levels and the Transfer of Energy	**LESSON 5**					
	1-3	**Poor**	**7**	**35.00**	**5**	**25.00**
	4-6	**Fair**	**5**	**25.00**	**6**	**30.00**
	7-9	**Good**	**8**	**40.00**	**7**	**35.00**
	10-12	**Very Good**	**0**	**0.00**	**2**	**10.00**
	13-15	**Excellent**	**0**	**0.00**	**0**	**0.00**
	Total		**20**	**100.00**	**20**	**100.00**
	Mean Score		**5.15**	**Fair**	**5.55**	**Fair**

1) Lesson 1: Science Equipment – The Compound Microscope: The pre-test data for the first lesson indicate that the control and experimental groups had a good understanding of the compound microscope. Most students in the control group (14 or 70%) got the score in the Very Good range (10-12) which reflects a good understanding of the parts and functions of the microscope.
Furthermore, three individuals (15%) reached the Excellent level (13-15) showing complete mastery of the topic even before the intervention. There were only a few individuals who scored Poor (5%), Fair (5%), and Good (5%) which means that only a small number of students were at a loss.
Likewise, the experimental group was found to be knowledgeable on the same topic. Seventeen students (85%) were classified as Very Good, while one student (5%) was in Excellent. Only two students (10%) got their scores within the Good category, and there were no students who achieved the Poor or Fair ranges. The distribution of scores reveals that most of the learners in the experimental group were already familiar with microscope operation and its components at a high level.
Mean scores of both groups reflect these findings. 10.55 is the mean score of the control group, while the experimental group slightly exceeded this with a mean score of 11.00, both of which are verbally rated as Very Good. This means that students had ample prior knowledge before the lesson, which could have been influenced by previous exposure to elementary science or prior hands-on laboratory experiences. It further indicates that while the experimental group had a slight edge at baseline, the difference was still very small.
The outcome of the first lesson shows that both groups were ready to go deeper in their discussions about the microscope. The strong initial performance also stipulates that any enhancement seen in the post-test is very likely due to the instructional intervention and not differences in the initial knowledge.

2) Lesson 2: Plant and Animal Cells: The pre-test results of lesson 2 show a significant decline in the performance of both groups, compared to lesson 1. It means that students had a very limited understanding of the content of plant and animal cells at the beginning of the lesson. The data of the control group revealed that 14 students (70%) achieved the grade Fair (4–6), and 3 learners (15%) scored Poor (1–3). Only a few reached Good (10%) and Very Good (5%) results.
The experimental group also showed a similar trend as 17 learners (85%) reached the Fair category and no one achieved the score in the Poor range. Only 3 students (15%) managed to get scores within the good range. Also, like the control group, the experimental group did not have any students who accomplished the Very Good or Excellent categories.
The average score for the control group was 4.95. Meanwhile, the experimental group had a slightly higher average of 5.05, both indicating the verbal interpretation of Fair. These results reveal that the learners lacked knowledge about the basic structures of the cell, the organelles, and their functions before the intervention.
This trend is consistent with the results of the previous science education research studies, which continuously report that students have difficulties in understanding microscopic biological concepts since these concepts have no concrete, visible representations. If there are no hands-on experiences or visual models, learners may find it difficult to conceptualize internal cellular structures. Therefore, the low pre-test results are anticipated, and they point out the necessity of instructional strategies that facilitate visualization and conceptual understanding.

3) Lesson 3: Cellular Reproduction: The results of lesson 3 reveal that both groups even had less baseline knowledge of the topic of cellular reproduction. The control group had 5 learners (25%) who scored Poor, and a big majority (14 or 70%) who scored Fair. Only 1 student (5%) got into the good category, and none scored Very Good or Excellent. Such a distribution strongly indicates that most learners had a very limited comprehension of cell cycle stages, mitosis, meiosis, and the processes involved in cellular reproduction.

The experimental group demonstrated almost the same distribution of scores. Five learners (25%) scored Poor and 13 (65%) scored Fair. Only two learners (10%) got into the good category. Like the control group, no students achieved Very Good or Excellent scores.

The average score for the control group was 4.15, and the experimental group was even lower at 3.35, both corresponding to the Fair verbal interpretation. These low averages indicate that cellular reproduction was the least familiar topic for the learners out of the five lessons. Considering the complexity and abstractness of the topic, such results are to be expected, as students frequently have difficulties when representing the dynamic cellular events that cannot be easily seen without a specialized laboratory experience.

The poor performance on the pre-test significantly points to a large instructional gap in teaching cellular reproduction and shows that there is a need for effective interventions that will help students understand these microscopic processes.

4) Lesson 4: Levels of Biological Organization: The results of the pre-test for Lesson 4 show that the performance was moderately better compared to the lessons on cells and cellular reproduction. In the control group, 11 learners (55%) scored within the Fair range, while 6 learners (30%) scored Poor. A very small percentage of learners reached the Good (10%) and Very Good (5%) levels.

The experimental group had a slightly better performance. Ten learners (50%) achieved a Fair score, 3 learners (15%) got a Poor score, and a higher proportion of learners reached Good (15%) and Very Good (20%) levels. This is an indication that the students in the experimental group were able to demonstrate a better initial understanding of the hierarchical organization of living systems.

The average score of the control group was 4.65, while the experimental group had a higher average of 6.05. Although both scores are still within the Fair verbal category, the higher average of the experimental group is an indication of a better preliminary understanding of the topic. Such findings may be the result of students' previous exposure to biological organization concepts through their earlier science grades. The topic is also less abstract than cellular reproduction and therefore, students find it easier to understand even without the use of advanced visual aids.

5) Lesson 5: Trophic Levels and the Transfer of Energy: The initial test results for Lesson 5 show that both groups had somewhat of a moderate understanding of trophic levels and energy transfer. Within the control group, 7 learners (35%) obtained a Poor score, 5 students (25%) scored Fair, and a larger proportion (40%) achieved Good. No learners scored Very Good or Excellent.

The experimental group had comparable results. Five learners (25%) scored Poor, six learners (30%) scored Fair, and seven learners (35%) achieved Good. Importantly, two students (10%) scored Very Good, which was not the case in the control group.

The control group was associated with a mean score of 5.15, whereas the experimental group had a mean score that was a little higher, 5.55. Both means are under the Fair verbal description; however, the experimental group was still slightly ahead. Since energy flow and food chains are topics that are typically covered in the lower grades, the moderate pre-test scores indicate that students had a fair amount of prior knowledge. Nevertheless, the lack of Excellent scores points to the fact that the students did not have a deep understanding of ecological energy transfer.

The pre-test findings for the five lessons show that the control and experimental groups in general, had comparable levels of understanding before the study. The experimental group kept getting a little higher average score; however, the differences were very small and do not show a significant advantage.

Those were concrete and familiar topics from basic science (e.g., microscope, biological organization, trophic levels) that led to better pre-test performance, whereas more abstract microscopic topics (e.g., cell structures, cellular reproduction) gave lower scores for both groups. These trends correspond to the existing research, which points out that learning microscopic and conceptual biological processes is more difficult.

Basically, these initial data points serve to confirm that both groups were at the same level academically when they started the study and hence, they are appropriate for assessing the effectiveness of the intervention to be carried out in the experimental group.

B. Significant Difference in the Pretest Score of Students in Control and Experimental Group

Table 4 Difference in the Pretest Score of Students in Control and Experimental Groups

	Group	N	Mean	t	Sig.
Lesson 1: Science Equipment – The Compound Microscope	Control	20	10.55	1.859	.074
	Experimental	20	11.00		
Lesson 2: Plant and Animal Cells	Control	20	4.95	0.193	0.848
	Experimental	20	5.05		
Lesson 3: Cellular Reproduction	Control	20	4.15	0.417	0.678
	Experimental	20	4.35		
Lesson 4: Levels of Biological Organization	Control	20	4.65	1.859	0.071
	Experimental	20	6.05		
Lesson 5: Trophic Levels and the Transfer of Energy	Control	20	5.15	0.0493	0.624
	Experimental	20	5.55		

Table 4 shows the significant differences between the pretest scores of students from the control and experimental groups that covered five major lessons in Science 7: Science Equipment – The Compound Microscope, Plant and Animal Cells, Cellular Reproduction, Levels of Biological Organization, and Trophic Levels and the Transfer of Energy. The findings indicate that although slight differences between the mean scores of the two groups were seen, none of the p-values calculated were statistically significant at the 0.05 level. So, before the intervention, students in both groups had the same level of prior knowledge of the five lessons.

The experimental group for the lesson on Science Equipment – The Compound Microscope had a mean score of 11.00 which was a little higher than that of the control group (10.55), but the difference was not significant ($p = 0.074$). In Plant and Animal Cells, both groups achieved almost the same results (control = 4.95; experimental = 5.05) and there was no significant difference ($p = 0.848$). The trend in Cellular Reproduction is the same ($p = 0.678$), and the only exception is that the experimental group raised the bar in Levels of Biological Organization, but the difference still not significant ($p = 0.071$). Finally, the pretest means for Trophic Levels and the Transfer of Energy also did not show any significant difference ($p = 0.624$).

These data confirm that both groups had equal baseline knowledge levels at the start, which means that any differences seen in the posttest or learning gains can be properly attributed to the instructional intervention, i.e., the use of prometheia, the technology-based learning tool. The present study's results resonate well with the literature cited in the reference section. Smith, Lee, & Johnson (2021) carried out an experimental study to find out whether an interactive simulation software had any impact on the biology achievement of high school students. Pre-intervention, the pretest scores of the control and the treatment groups were not significantly different in key units such as cellular processes and energy flow ($p >.05$), thus they had similar prior knowledge. The authors argued that since baseline equivalence was established, any post-intervention differences could be due to the instructional technology rather than initial group disparities. Nguyen and Tran (2023) explored how a blended learning platform affected students' grasp of concepts in middle school science. Before the intervention, they found that there were no differences between the experimental and control classes in terms of scientific reasoning and content knowledge (p values were from.36 to.82 for different topics), thus, their finding supported that the two groups started from a similar level. Moreover, a non-significant variability at pretest was considered as an important factor that reinforced the internal validity of the study when it came to evaluating the effects of the intervention. Alvarez, Santos, & de la Cruz (2024) studied a mobile augmented reality app used by secondary students to learn ecology concepts. A pre-intervention comparison showed that there were no statistically significant differences between groups on their baseline scores for units such as ecosystems and trophic interactions (all $p >.05$). Such results served as evidence that the groups had the same cognitive level before the treatment, so that any posttest changes could be attributed to the AR instructional tool. Martinez & Chen (2025) evaluated a gamified digital learning environment for its efficiency in learning cellular biology topics.

Their comparison of the pretest scores showed that there were no statistically significant differences between groups on pretests for all targeted scientific constructs (p values ranging from.42 to.78). Similarly to other studies, confirming equivalence at pre-test was taken as a factor that justified the experimental effects.

Studies on technology-enhanced learning also reflect the significance of baseline equivalence. This research is in line with that methodological expectation: prior to the prometheia implementation, both groups were at the same level of understanding as evidenced in all lessons, so any improvement after the device introduction is not due to initial differences but the device itself.

The evidence, in brief, points to the fact that the pretest scores of the control and experimental groups across the five science lessons did not differ significantly. This conformity with the prevailing scholarly work enhances the internal validity of the research and serves as a solid ground for interpretation of student learning effects brought about by prometheia. Confirming baseline equivalence is establishing both groups at the same academic level which later comparisons in the posttest phase would be reliable and thus the conclusion of prometheia 's effectiveness, a logical corollary, would gain credibility again.

C. Posttest Scores of the Students in Control and Experimental Group after the Integration of Prometheia

Table 5 Posttest Scores of the Students in Control and Experimental Group after the Integration of Prometheia

			Control		Experimental	
	Score	Verbal Description	Frequency	Percent	Frequency	Percent
Science Equipment – The Compound Microscope	LESSON 1					
	1-3	Poor	5.00	0	0.00	5.00
	4-6	Fair	5.00	0	0.00	5.00
	7-9	Good	25.00	0	0.00	25.00
	10-12	Very Good	50.00	10	50.00	50.00
	13-15	Excellent	15.00	10	50.00	15.00
	Total		100.00	20	100.00	100.00
	Mean Score		9.75	Very Good	12.55	Excellent
Plant and Animal Cells	LESSON 2					
	1-3	Poor	10.00	0	0.00	10.00
	4-6	Fair	15.00	0	0.00	15.00
	7-9	Good	65.00	2	10.00	65.00
	10-12	Very Good	10.00	11	55.00	10.00
	13-15	Excellent	0.00	7	35.00	0.00
	Total		100.00	20	100.00	100.00
	Mean Score		7.30	Good	11.50	Very Good
Cellular Reproduction	LESSON 3					
	1-3	Poor	0.00	0	0.00	0.00
	4-6	Fair	70.00	0	0.00	70.00
	7-9	Good	30.00	1	5.00	30.00
	10-12	Very Good	0.00	11	55.00	0.00
	13-15	Excellent	0.00	8	40.00	0.00
	Total		100.00	20	100.00	100.00
	Mean Score		5.80	Fair	12.25	Very Good
Levels of Biological Organization	LESSON 4					
	1-3	Poor	10.00	0	0.00	10.00
	4-6	Fair	55.00	0	0.00	55.00
	7-9	Good	35.00	0	0.00	35.00

	10-12	Very Good	0.00	14	70.00	0.00
	13-15	Excellent	0.00	6	30.00	0.00
	Total		100.00	20	100.00	100.00
	Mean Score		6.32	Fair	11.55	Very Good
Trophic Levels and the Transfer of Energy	LESSON 5					
	1-3	Poor	10.00	0	0.00	10.00
	4-6	Fair	55.00	0	0.00	55.00
	7-9	Good	35.00	1	5.00	35.00
	10-12	Very Good	0.00	16	80.00	0.00
	13-15	Excellent	0.00	3	15.00	0.00
	Total		100.00	20	100.00	100.00
	Mean Score		6.10	Fair	11.45	Very Good

Table 5 showcases the posttest scores of students from the control and experimental groups after prometheia was integrated into Science 7. In all five lessons, the data demonstrates that the experimental group was always superior to the control group, thereby evidencing the instructional benefit of prometheia. Contemporary studies indicate that when digital tools are systematically integrated with structured assessment practices, posttest results provide strong empirical evidence of instructional impact and measurable learning gains. For instance, Madland, Irvine, DeLuca, and Bulut (2024) emphasized that aligning technology integration with assessment frameworks is crucial to ensure that the measurement of student outcomes is valid. In the same vein, Duterte, (2024) latest empirical studies reveal that technology-based learning settings with both formative and summative digital assessments positively affect students' performance and motivation to learn.

In the 1st Lesson – Science Equipment: The Compound Microscope, the experimental students scored on average 12.55 (Excellent), whereas the control students 9.75 (Very Good). Half of the experimental students attained an Excellent level of proficiency as against only 25% of the control group. This difference in performance indicates that prometheia's interactive simulations and 3D visualizations are likely to help students become more familiar with identifying parts and understanding the functions of the microscope.

The experimental group in the "Lesson 2 – Plant and Animal Cells" scored an average of 11.50 (Very Good), whereas the control group managed just 7.30 (Good). It seems that the manipulable and highly detailed cell models of prometheia have facilitated the deeper learning as 90% of the students in the experimental group were able to perform in the Very Good to Excellent range. Kefalis, Skordoulis, and Drigas (2025) and Manligoy, Bagabaldo (2025) have shown that digital simulations help students in gaining a deeper understanding of the subject matter and the skills related to scientific processes simultaneously. This was evident from the experimental groups that showed a higher level of change than the control groups in mastering the identification of cell organelles and their functions. Consequently, these research studies corroborate the idea that technology-enchanted, interactive, and immersive learning environments in science not only facilitate the acquisition of knowledge but also foster the development of procedural and problem-solving skills in students, thereby leading to significant achievement in modern technologically advanced classrooms.

For "Lesson 3 – Cellular Reproduction," the experimental group was able to record an average score of 12.25 (Very Good) which is more than double the control group's mean of 5.80 (Fair). High-level mastery was exhibited by 95% of the experimental students, thereby indicating that prometheia 's dynamic animations of mitosis and meiosis contributed substantially to the understanding of these complex biological processes. Manligoy, Bagabaldo, and Camacho (2025), Diab, Alzahrani, and Alnasseri (2024), and Fabrigas and Paglinawan (2025) reveal that students who engage in computer-based simulations in science education significantly enhance their conceptual understanding and explain well the complex scientific ideas and also show that their level of achievement is higher as compared to students who receive traditional instruction.

In the "Lesson 4 – Levels of Biological Organization," the experimental group had an average score of 11.55 (Very Good) which is more than twice the control group's 6.32 (Fair). The performance of the experimental group was such that all members scored either Very Good or Excellent ratings. Diab et al. (2024) found that students who used interactive science simulations deepened their conceptual understanding and enhanced their higher-order cognitive skills such as analysis, evaluation, problem-solving, etc. more than those students who were taught by the traditional method.

In the same vein, Galimova et al. (2025) revealed that digital learning tools are a reliable medium to spur the development of higher-order thinking skills in science education, a finding that supports the results of the Lesson 4 Levels of Biological Organization. In the lesson, the experimental group using PROMETHEIA's step-by-step hierarchical models achieved an average score of 11.55 (Very Good), over twice the control group's 6.32 (Fair).

More importantly, every member of the experimental group attained a Very Good or Excellent rating, which strongly suggests that the technology-enhanced instruction led to both a deeper understanding of the concepts and better science process skills as compared with the conventional method of teaching.

In Lesson 5 – Trophic Levels and the Transfer of Energy, the experimental group scored a mean of 11.45 (Very Good) whereas the control group had an average of 6.10 (Fair). These powerful results are a testament to the effectiveness of prometheia 's ecological simulations which helped students to energy flow and interact within food chains. Celik (2022) pointed out that digital simulations lead to better content mastery and scientific reasoning skills in ecology-related lessons, which is in line with the enhanced understanding observed in the experimental group.

Based on the posttest, the differences between the experimental group and the control group are very evident as the former has outperformed the latter in all five lessons. According to Kefalis, Skordoulis and Drigas (2025), Wahidin et al. (2025), and Batamuliza, Habinshuti, and Nkurunziza (2024), computer-based simulations help students easily understand concepts, get more involved in the learning process, and improve their higher-order thinking skills in science. Their studies compare with what happened in Lesson 5, Trophic Levels and the Transfer of Energy, where the experimental group who used PROMETHEIA's ecological simulations scored 11.45 (Very Good) as opposed to the control group who only got 6.10 (Fair). The computer simulations allowed for a better comprehension of how energy is transferred and how organisms interact in an ecosystem, thus facilitating not only mastery of the content but also scientific reasoning. Celik's (2022) findings The posttest results for all five lessons show that the experimental group consistently achieved higher scores than the control group, thereby, confirming the use of PROMETHEIA's technology-driven instruction as a very effective tool in learning. The consistent high level of performance of students with the help of prometheia is a clear indication that the technology-based instruction can have a major effect in elevating students' learning in Science 7 through the facilitation of abstract concepts in a more concrete, interactive, and meaningful manner.

D. Difference between the Posttest Score of the Students in Control and Experimental Group

Table 6 Significant Difference between the Posttest Score of the Students in Control and Experimental Group

	Group	N	Mean	t	Sig.
Science Equipment – The Compound Microscope	Control	20	9.75	3.852	0.000
	Experimental	20	12.55		
Plant and Animal Cells	Control	20	7.30	6.530	0.000
	Experimental	20	11.50		
Cellular Reproduction	Control	20	5.80	13.041	0.000
	Experimental	20	12.25		
Levels of Biological Organization	Control	20	6.31	9.820	0.000
	Experimental	20	11.55		
Trophic Levels and the Transfer of Energy	Control	20	6.10	10.189	0.000
	Experimental	20	11.45		

Significant at the 0.01 level (Two-tailed)

Table 6 displays the students' posttest scores of both the control and experimental groups after five different Science 7 topics where prometheia was integrated. Statistically significant differences at the 0.01 level (2-tailed) for all lessons were found through independent-samples t-tests, thus, indicating that students who used prometheia were able to perform better consistently. Like the way Makransky and Mayer (2022) have pointed out the benefits of immersive learning environments in improving conceptual understanding, the findings of this research highlight the significant influence of prometheia on student achievement.

In the first lesson – Science Equipment: The Compound Microscope, the experimental group scored an average of 12.55 (Excellent) as opposed to the control group's 9.75 (Very Good). According to Makransky and Mayer (2022), the most interactive and visually appealing learning tools assist in making concepts clearer by lessening the cognitive load, which is consistent with the experimental group's better understanding of the parts and functions of the microscope. The dynamic visualizations and the manipulable components of prometheia made it possible for students to familiarize themselves with the instrument in a more natural way, thus empowering them to bridge the gap between abstract explanations and tangible representations.

In Lesson 2 – Plant and Animal Cells, the experimental group scored an average of 11.50, which was significantly higher than the control group's 7.30. Navarro, Arias-Calderón, Henríquez and Riquelme (2024) reported that the use of digital cell biology models not only greatly captured the students' attention but also boosted their desire to learn and their comprehension level. In addition, students gained the freedom to self-direct their learning and invested a higher level of cognitive effort when engaging with intricate cell structures. This was very well demonstrated by the performance of the experimental group as prometheia's 3D organelle models and the zoom-in feature enabled students to compare and analyze cellular components in ways that could not be done if only static diagrams were used.

In the third lesson – cellular reproduction, the difference between the groups was most noticeable the experimental group had a mean score of 12.25, whereas the control group scored only 5.80. P. Amelia et al. (2025) conducted an experimental research to measure the impact of visual-augmented discovery learning on science achievement in elementary classrooms where the students were guided to discover the concepts using image media. Their results indicated that students who were instructed using this method not only achieved significantly higher levels of achievement but also continued to make consistent gains through cycles of instruction. Thus, they concluded that discovery learning with the addition of instructional visuals leads to higher student engagement, better conceptual understanding, and longer-lasting retention of science concepts as compared to the traditional method of instruction. Prometheia's mitosis and meiosis animations helped students to follow each stage one after one, thus enabling them to form an accurate mental model of a process that is usually hard to visualize. This is in line with the experimental group's high posttest performance.

The experimental group for Lesson 4 – Levels of Biological Organization had a mean score of 11.55, whilst the control group's score was 6.31. Makransky and Mayer (2022) argued that the presence of an interactive, well-organized environment is conducive to learners' active knowledge construction rather than their passive reception of information. Prometheia's stepwise hierarchical models were instrumental in students' grasp of the increasing complexity from cells to organ systems and at the same time, they enabled them to see the relationships at different levels of biological organization more clearly.

The experimental group for the fifth lesson - Trophic Levels and the Transfer of Energy, scored 11.45 as against 6.10 of the control group, a significant difference was thus established. Lamb, Annetta, Firestone, and Etopio (2018) pointed out that interactive digital environments for learning can help students understand scientific concepts at a deeper level as they get to change variables, see the processes, and be actively involved in the exploration instead of just getting the information. They underlined that learning with the help of technology-based platforms becomes more significant when students are given an opportunity to look at the connections, experiment with their ideas and be given instant feedback, thus helping to get clearer concepts and remember better. Through prometheia, learners could trace the flow of one unit of energy along the trophic levels, could actively participate in the food chain by producing the necessary documentation, and could analyze the given ecological relationships quickly and easily in a dynamic manner, which resulted in learners becoming more familiar with the concepts.

Comparison of the different lessons reveals that the experimental group has kept a steady lead in all of them. Duterte (2024) showed that technology-enhanced learning environments achieved a significant positive-impact on students' engagement and academic performance over traditional instruction, with quantitative data indicating a 75% boost in motivation and a clear improvement in academic performance. Prometheia, by making the topics less abstract and more interactive and observable, is a great facilitator of deeper learning, clearer visualization, and better retention.

The significant differences made it possible to conclude that the use of prometheia in the teaching of Science 7 is an efficient way of achieving better learning outcomes. The platform not only makes the topic engaging, but it also motivates the learners to explore further and it enhances their grasp of concepts—thus making the learning of science easier, more interactive, and in tune with digital pedagogies of the modern age.

E. Difference Between the Pretest and Posttest Score of the Students in Experimental Group

Table 7 Significant Difference in the Pretest and Posttest of Experimental Group

	Group	N	Mean	t	Sig.
Science Equipment – The Compound Microscope	Pretest	20	11.00	-4.152**	0.000
	Posttest	20	12.55		
Plant and Animal Cells	Pretest	20	5.05	-14.927**	0.000
	Posttest	20	11.50		
Cellular Reproduction	Pretest	20	4.35	-15.115**	0.000
	Posttest	20	12.25		
Levels of Biological Organization	Pretest	20	6.05	-8.198**	0.000
	Posttest	20	11.55		
Trophic Levels and the Transfer of Energy	Pretest	20	5.55	-9.658**	0.000
	Posttest	20	11.45		

Significant at the 0.01 level (Two-tailed)

Table 7 displays the outcome where, after the use of prometheia, a technology-based learning tool, the experimental group's posttest scores for all five lessons significantly improved. The average score of Lesson 1 increased from 11.00 to 12.55 ($t = -4.152$, $p < 0.01$). A very noticeable increase in the score was found in Lesson 2 from 5.05 to 11.50 ($t = -14.927$, $p < 0.01$), and the score in Lesson 3 also went up from 4.35 to 12.25 ($t = -15.115$, $p < 0.01$). In the same manner, Lesson 4 went up from 6.05 to 11.55 ($t = -8.198$, $p < 0.01$), and the score in Lesson 5 increased from 5.55 to 11.45 ($t = -9.658$, $p < 0.01$). The fact that all t-values are negative and highly significant means that the posttests were performed at a higher level than the pretests consistently.

The evidence reveals that prometheia had a positive effect on students' grasp and practice of the five lessons in Science 7. It can be assumed that the tool's attractive features might have helped the students to be more involved, to understand better, and to retain more because the differences in pretest and posttest scores are statistically significant.

The results correspond with the studies that have been done lately on the use of technology-enhanced learning tools in science education. Namely, Liu, Chiu, and Lee (2018) found that the use of interactive digital tools led to a significant improvement in conceptual understanding of science by middle school students. Chao et al. (2020) discovered the same with virtual and interactive platforms and hence concluded that technology plays a major role in student learning outcomes since there was a lot of pretest-to-posttest gains going on. Hwang et al. (2019) also found that mobile-assisted science learning brought significant improvements in students' academic performance and retention. Research on prometheia (e.g., Santos et al., 2021) has successfully demonstrated that students on this platform perform better on posttests than students who receive traditional instruction, elucidating the tool's effectiveness in facilitating learning and critical thinking.

The considerable rise in posttest scores is a testimony to the fact that the experimental group made good use of the prometheia integration. Those results confirm the effectiveness of technology-based learning tools to engage the students actively, raise their understanding level and make them achieve measurable academic gains in science education.

F. Other Benefits towards the use of prometheia in Science 7.

Table 8. Other Benefits Questionnaire towards Prometheia in Science 7

	wm	Verbal Description
1. Prometheia helped me better understand the Science 7 concepts covered in lectures.	3.40	Strongly Agree
2. Using prometheia made topics more understandable than when taught	3.35	Strongly Agree

through traditional methods.		
3. I feel more confident in the topics covered now that I have used prometheia.	3.35	Strongly Agree
4. The interactive tasks and practice exercises in prometheia helped me learn more effectively.	3.50	Strongly Agree
5. The multimedia content in prometheia (videos, images, diagrams) was clear and easy to follow.	3.65	Strongly Agree
6. Using prometheia was an enjoyable and engaging learning experience.	3.55	Strongly Agree
7. Prometheia provided learning opportunities I would not have experienced in a traditional classroom.	3.35	Strongly Agree
8. Prometheia contributed to improving my understanding and performance in Science 7.	3.50	Strongly Agree
9. The platform allowed me to collaborate and interact with my classmates effectively.	3.40	Strongly Agree
10. Please rate your overall experience with prometheia from 1 to 5.	3.75	Strongly Agree
average weighted mean	**3.48**	**Strongly Agree**

Table 8 presents insights into the student's other benefits towards prometheia usage. These data came from a survey which was measured using a 4-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree) and was reflective of a single concept of students' benefits towards the utilization of prometheia. The findings indicate that most students strongly agree that prometheia was very helpful in understanding the concepts of Science 7 where the overall experience got the highest rating (WM = 3.75), and the understanding of concepts got the lowest rating (WM = 3.35–3.40). Furthermore, the students strongly agree that the platform helped them understand the lesson better than the usual way of teaching (WM = 3.50), enabled their active participation through the interactive tasks (WM = 3.60), and offered multimedia content that helped them understand (WM = 3.55). Also, the students were of the opinion that prometheia was instrumental in collaboration (WM = 3.65) and that it allowed them to experience learning opportunities which are not easily accessible in a conventional classroom (WM = 3.60). The overall experience with prometheia was positively rated by the students (WM = 3.65). As a result, the findings indicate that the students held a very positive experience towards the use of prometheia and that the platform made a significant contribution to their understanding, engagement, and confidence in Science 7 concepts.

At the same time, the information was backed up by the exact words of the students of the experimental group:

> ***"Sa tingin ko po, malaking tulong ang prometheia sa aming pag-aaral sa Science 7. Nagugustuhan ko po ang mastery-based learning kasi kailangan naming maintindihan nang mabuti ang bawat aralin bago makapagpatuloy. Mas naipapakita po nito kung gaano namin naiintindihan ang paksa at natututo po kami ng mas malalim." ("As for me, I think that prometheia is a fantastic support for our Science 7 studies. One thing that I like about the mastery-based learning is that it insists on us to grasp each lesson thoroughly before proceeding. It helps us to show the level of our understanding more, and it also facilitates our learning.")***

This statement of the student was also supported by the statement of one of the respondents as he stated:

> ***"Maganda po ang prometheia dahil interactive po ang mga online activities at assignments. Mas nagiging madali po para sa amin ang pag-intindi ng lessons lalo na't may feedback agad sa mga nagawang pagsusulit. Sa mastery-based learning po, natututo po kami na hindi basta-basta pumasa, kailangan talagang ma-master ang aralin." ("Prometheia is great to be continued with because the online activities and assignments are engaging. It is very helpful in understanding the lessons for us, especially if we are given the correct and immediate feedback on our quizzes. With mastery-based learning, we find that merely passing is not enough, we must really master the lesson.")***

The mentioned findings have a great deal of overlap with research studies on technology-enhanced learning in science education. Pedraja-Rejas et al. (2024) pointed out that digital learning platforms lead to better understanding of concepts and development of critical thinking skills because they offer interactive and engaging learning environments. In the same vein, Huang et al. (2020) reported that multimedia-supported mobile learning significantly facilitates the understanding of complex scientific concepts. Besides that, Wang et al. (2022) supported with evidence that performance in academic tasks is greatly improved when students use interactive, game-based STEM tools, while Chang, Kuo, and Du (2023) highlighted the role of immersive technologies in motivation and engagement. The features of prometheia that allow collaboration and exploration are also confirmed by Laid and Adlaon (2025) and Abriata (2022), who indicated that technology-enhanced instruction encourages peer interaction and provides access to learning opportunities beyond the traditional classroom. The students' feedback reveals that prometheia serves well as an additional resource to traditional teaching, creates opportunities for profound learning, and helps students' comprehension, interest, and cooperation in Science.

IV. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

A. Pretest Scores of Students in Control and Experimental Groups Before the Integration of Prometheia

The pretest scores reveal that generally, both the control and experimental groups had similar knowledge of the five Science 7 topics outlined in the pretest, with the highest scores in Lesson 1 (Compound Microscope) and noticeably lower scores in more abstract biological concepts such as Plant and Animal Cells and Cellular Reproduction. The control group for Lesson 1 had an average score of 10.55 (Very Good) and the experimental group had an average score of 11.00 (Very Good), thus showing that the level of prior knowledge in both groups before any intervention was fairly high. According to Makransky & Mayer, (2022), students tend to score higher on concrete and familiar science topics introduced informally, especially if they have had prior exposure or hands-on experience. On the other hand, the data for Lesson 2 (Plant and Animal Cells) showed that both groups scored an average of 4.95 (Fair) for the control group and 5.05 (Fair) for the experimental group. The data for the control group for Lesson 3 (Cellular Reproduction) showed an average of 4.15 (Fair) and the experimental group had a mean score of 3.35 (Fair). Villena-Taranilla et al., (2022) What these lower means suggest is that the groups only had a very limited amount of knowledge of cellular structures and processes before the study, a very common issue in science learning research, which points to students' difficulties in dealing with non-observable, abstract biological processes if they are not provided with interactive models.

The average scores for the groups in the control and experimental conditions for Lesson 4 (Levels of Biological Organization) were 4.65 (Fair) and 6.05 (Fair), while for Lesson 5 (Trophic Levels and the Transfer of Energy), they were 5.15 (Fair) and 5.55 (Fair), respectively. Yu, (2023). These results indicate that the participants had a moderate understanding of the biological hierarchy and flow of ecological concepts, which is in line with research that suggests that exposure to the topics in lower grades may provide the necessary support for recall but not for deep conceptual mastery. Although not statistically significant, the slightly better performance of the experimental group could be attributed to the fact that the two groups had similar levels of familiarity with the topics. In summary, the preliminary assessment patterns that emerge from this experiment are the ones that were anticipated: baseline performance that is stronger for concrete or previously taught content and weaker for abstract topics that necessitate conceptual visualization. The results correspond to Akbay, (2023), which posits that in the absence of interactive learning support, students are unable to construct correct mental representations of microscopic and process-oriented biological phenomena, thus they very often fail to do so. Moreover, in this research, the baseline profiles of both groups were similar, thereby confirming that the sample used was appropriate for the evaluation of the instructional impact of prometheia.

B. Significant Difference in the Pretest Score of Students in Control and Experimental Group

Independent t-tests using separate samples showed that the pretest scores of the control and experimental groups did not differ significantly for all five lessons, thus confirming that the two groups were educationally comparable before the intervention. In the case of Lesson 1 (Compound Microscope), the average scores were 10.55 (control) and 11.00 (experimental) with $t = 1.859$ and $p = 0.074$, which indicates a non-significant difference. Yu, (2023) This finding is in line with methodological norms of experimental research stressing the importance of baseline equivalence for attributing subsequent changes to the treatment carried out.

Likewise, p values for control and experimental samples in Lesson 2 (Plant and Animal Cells) were 0.848 and 0.193 with means 4.95 and 5.05, respectively; and for cellular reproduction, the control group had a mean of 4.15, the experimental group had a mean of 4.35, with t-value equaling 0.417 and p-value 0.678. The very close matching of the scores suggests that at the baseline, instruction differences were not leaving either group systematically more advantaged. Antonio, (2023) The present investigation claims that when the pretest is used as an equivalence measure statistically in technological research designs, the real educational effects can be validly ascribed to the intervention rather than to the existing differences.

In Levels of Biological Organization (Lesson 4), the control and experimental groups had average scores of 4.65 and 6.05, respectively, giving t = 1.859 and p = 0.071, whereas Lesson 5 (Trophic Levels and Transfer of Energy) had means of 5.15 and 5.55 with t = 0.493 and p = 0.624. Even if the experimental group performed a little better in some lessons, no differences reached the level of statistical significance, thereby confirming the notion of equivalence. Makransky & Mayer, (2022) Recent meta-analyses emphasize that non-significant differences at pretest are a prerequisite for the validity of subsequent comparisons in blended or digital instructional research.

The mentioned statistical equivalence provides a foundation for valid further comparisons of the research study and thus allows the researchers to view any differences observed in the posttest as the effects of prometheia and not prior academic advantages. The gathering of baseline data demonstrating equivalence is one of the main points in the literature presented by Akbay, (2023) for studies related to simulation-based learning environments to make valid causal claims. Consequently, the current results meet the criteria of a rigorous design for educational intervention research.

C. Posttest Scores of the Students in the Control and Experimental Group be Described after the Integration of Prometheia

Posttest outcomes consistently demonstrated that after the prometheia intervention, the experimental group outperformed the control group in all the five lessons. In Lesson 1 (Compound Microscope), the control group recorded a mean of 9.75 (Very Good), while the experimental group had a mean of 12.55 (Excellent). Therefore, Villena-Taranilla et al., (2022) The successful implementation of the interactive simulations and multimedia representations can be inferred from the substantial gain. The present findings also align with the studies that advocate the use of visual and interactive materials to facilitate conceptual understanding and procedural identification in science education.

For the second lesson (Plant and Animal Cells), the average score of the control group was 7.30 (Good), and that of the experimental group was 11.50 (Very Good) thus showing that the prometheia's detailed, manipulable models enabled the students to explore the cellular structures more deeply. Likewise, the experimental mean of 12.25 (Very Good) in Lesson 3 (Cellular Reproduction) was more than double the control mean of 5.80 (Fair) thus suggesting that the students' understanding of the cell cycle was greatly enhanced through the use of interactive animations. Akbay, (2023) supports the notion that students who perform tasks in simulation environments achieve significant conceptual gains in subjects that are abstract and dynamic.

The pattern was also visible in Lesson 4 (Levels of Biological Organization) and Lesson 5 (Trophic Levels and the Transfer of Energy) where the experimental group attained mean scores of 11.55 (Very Good) and 11.45 (Very Good) respectively as compared to the control group means of 6.32 (Fair) and 6.10 (Fair) respectively. These results show that the scaffolding features in prometheia not only engage learners in higher-order reasoning about system levels but also energy flow. Yu, (2023) Indicates that digital simulations do not only support memory but also enhance systems thinking which is a crucial skill in topics like ecological and organizational biology.

The fact that the posttest means of the experimental group was consistently effective and significantly different from the control group across all lessons largely reflects that prometheia's multimodal, interactive design was a major factor in academic performance elevation. (Antonio, (2023; Makransky & Mayer, (2022) These results have corroborated the existing literature on the use of technology-based learning tools with multimedia and simulation features that bring about educational benefits beyond the traditional mode of instruction.

D. Significant Difference Between the Posttest Score of the Students in Control and Experimental Groups

The first set of statistical analysis that were done using independent-samples t-tests of the posttest differences between the control and the experimental groups showed that these differences were all statistically significant at the 0.01 level. Prometheia intervention has, thus, been shown to have very strong effects. For the first lesson, the t-value associated with the difference of control group mean 9.75 and experimental mean 12.55 was 3.852, p = 0.000. Villena-Taranilla et al., (2022) This big significant difference reflects an educational impact of technology which is in line with research on immersive learning technologies.

Lesson 2 was on Plant and Animal Cells. Here, the control group mean was 7.30 and the experimental group mean was 11.50, with t = 6.530 and p = 0.000. Akbay, (2023) The findings here are consistent with the idea that simulation environments will bring about better results in complex conceptual areas than the traditional methods. Makransky & Mayer, (2022) In Lesson 3 (Cellular Reproduction), the very large mean difference (5.80 vs. 12.25) resulted in t = 13.041, p = 0.000, which is a clear indication that the use of the dynamic representation greatly contributed to people understanding the non-observable biological processes.

The posttest differences were still statistically significant for Lessons 4 and 5. Lesson 4 (Levels of Biological Organization: control = 6.31, experimental = 11.55; t = 9.820, p = 0.000) and Lesson 5 (Trophic Levels and Transfer of Energy: control = 6.10, experimental = 11.45; t = 10.189, p = 0.000). Antonio, (2023); Yu, (2023) These stable outcomes are interpreted as evidence that the use of carefully crafted simulations and interactive platforms leads to real learner achievement across various science topics, a position consistent with the recent meta-analyses that have been conducted on this topic and which acknowledge technology's benefits for cognitive engagement and retention.

The significant values and the very small p-values for all lessons also serve as evidence for the claim that prometheia was an effective instructional tool for enhancing student performance in Science 7. Besides, Makransky & Mayer, (2022) these results are not only replicate but also extend existing educational technology research by showing that consistent and significant learning improvements can be found across multiple biological domains.

E. Significant Difference Between the Pretest and Posttest Scores of the Students in the Experimental Group

Paired-samples t-tests within the experimental group showed that all five lessons after the prometheia integration had very significant pretest→posttest gains, meaning that the tool's instructional features had a strong individual learning effect. Villena-Taranilla et al., (2022) The pretest average of 11.00 for Lesson 1 increased to 12.55 in the posttest ($t = -4.152$, $p = 0.000$), showing statistically significant improvement and corroborating the studies that found that the simulation helps the mastery of familiar and procedural domains.

The increase from a pretest mean of 5.05 to a posttest mean of 11.50 ($t = -14.927$, $p = 0.000$) for Lesson 2, is a clear indication of the substantial understanding cellular anatomy and function. Akbay, (2023) The findings thus obtained correspond with the assertion that a simulation-based tool can bring about steep learning curves in areas where traditional methods have been weak. Similarly, Makransky & Mayer, (2022) Lesson 3 showed very strong gains (4.35 → 12.25; $t = -15.115$, $p = 0.000$), the point of conceptual difficulty cellular reproduction being particularly significant; it repeats the support that the reduction of cognitive load by dynamic visualization leads to an increase in conceptual access.

Lessons 4 and 5 also made marked progress: Levels of Biological Organization increased from 6.05 to 11.55 ($t = -8.198$, $p = 0.000$), and Trophic Levels increased from 5.55 to 11.45 ($t = -9.658$, $p = 0.000$). Yu, (2023) The consistent gains in ecological and hierarchical content confirmed by the present study resonate with a body of literature that sees the use of interactive representations to promote system-level understanding and knowledge transfer in middle school learners.

Hence, Antonio, (2023); Makransky & Mayer, (2022) the within-subject statistical data serve as a convincing testimonial of the significant learning growth of each prometheia user in the experimental group, thereby lending support to the body of systematic literature that has found technology-enhanced instruction to be a driver of measurable academic improvement in science.

F. Other Benefits towards the Use of Prometheia in Science 7

Students' judgments of prometheia were extremely positive, with an average weighted mean score of 3.48, which stands for Strongly Agree on the 4-point Likert scale. The participants largely rated that prometheia gave them a better understanding of scientific concepts in grade 7, made the topics more understandable than usual, and strengthened their learning confidence. Eltaib, (2024) These behavioral changes are consistent with the current trend of research that indicates that learner perception and satisfaction are improved when interactive, multimedia-rich simulations are used in science teaching.

The learners also strongly endorsed the idea that interactive tasks and practice exercises in prometheia helped them learn more effectively (WM = 3.50) and that the platform's multimedia content was very clear and easy to follow (WM = 3.65). Eltaib, (2024) Modern research asserts that such character traits of the learning platform—immediate feedback, clear visualization, and engaging tasks—are crucial for having positive perceptions and experiences, and deepening engagement, which is supported by technology in science learning.

Besides, Antonio, (2023) the students conveyed that prometheia helped them work together, and gave them learning opportunities that were not available in the traditional classrooms (WM = 3.40–3.60), in line with the research that interactive platforms can create the environment for social constructivist learning and can extend learner's experiences beyond the traditional way of teaching. The highest rating, the overall experience rating of 3.75—reflects not only the platform's easy use, but also the student's interaction, and the platform's relevance to their learning needs.

Moreover, qualitative data of students also endorse the favorable disposition, and their statements emphasize the features of prometheia such as mastery-based progression, interactive activities, and immediate feedback as the major aspects in which prometheia excels. Villena-Taranilla et al., (2022) These opinions are consistent with the studies that point out real-time feedback and student agency in simulation environments as the factors which lead learner empowerment and deeper conceptual engagement.

G. Conclusions

1) The results revealed that both the control and experimental students had nearly the same level of understanding of the five topics in Science 7. Hence both groups were equally ready in terms of academic performance. Students did better on topics that they could easily relate to or see while they had a harder time understanding topics that were abstract or microscopic in nature. Generally, the two groups worked with almost the same academic level before the start of the teaching.
2) There was no significant difference between the pretest score of the two groups as tested statistically, thus the first null hypothesis was supported. Such baseline equivalence is an assurance that differences in the posttest, if any, can be due to the instructional treatment only which increases the internal validity of the study.
3) Following the experimental treatment with Prometheia, the experimental group was able to score significantly higher than the control group in all five lessons. Despite the fact that they learned difficult topics, they still managed to perform at Very Good to Excellent levels. This just reflects that Prometheia assisted students in developing their conceptual understanding, mastery, and overall performance in Science 7.
4) Results of statistical analysis further revealed a significant difference in posttest scores that allowed the rejection of the second null hypothesis. Experimental group members scored higher than control group in all lessons making the claim that Prometheia was more effective than traditional methods quite conclusive.
5) When pretest and posttest scores were compared the difference was significant for the experimental group hence, confirming the third null hypothesis was incorrect. Prometheia's approach which is based on mastery and is interactive has the potential to strengthen not only understanding but also retention and learners' self-confidence.
6) Students gave Prometheia a thumbs up, saying that it made Science 7 easier to understand, more interesting, and gave them more confidence and enjoyment in the subject. Such positive attitudes that are backed up by both quantitative and qualitative data serve as evidence that Prometheia is a good way to enhance not only motivation but also academic performance as well.

H. Recommendations

1) Science teachers are encouraged to use prometheia as a part of their regular Science 7 session, especially when handling such topics as the Levels of Biological Organization, cellular processes, and energy transfer, which are often hard for students to visualize and comprehend. With a user-friendly and visually appealing platform, students' conceptual understanding and proficiency can be effectively enhanced. Moreover, it would be wise for the teachers to plan out the use of prometheia as a well-thought-out strategy that includes a few sessions with this tool to supplement the regular classroom instruction and support the main concepts. Synchronizing technology-based learning and teacher-led discussion can yield the highest learning benefits and also cater to the requirements of different types of learners.
2) The school administration will benefit from keeping their teachers updated on the latest technological tools through training and professional development programs. Teachers who understand how to relate the use of digital tools with learning objectives and classroom pedagogy are the ones who implement these tools successfully. These training sessions should also cover instructional design, teaching strategies, and assessment integration. Providing teachers with these competencies will ensure that the technology is utilized in a targeted manner rather than for cosmetic purposes.
3) The curriculum planners may consider embedding prometheia as a standard platform or similar technology-based tools for Science 7 to facilitate mastery-based and inquiry-driven learning methods. The integration of such platforms will not only help the learners to catch up in complex biological topics but will also raise the overall quality of teaching. Additionally, the use of digital means also matches the requirements set by the curriculum providing uniformity and closeness among lessons. A well-thought-out curriculum based on technology provides room for sustained learning gains and helps learners develop higher order thinking skills.
4) Teachers are encouraged to implement mastery-based learning techniques with the use of prometheia so as to allow students to gain a complete understanding of a concept before moving on to the next one. Such an approach results in a deeper understanding of the material, recall over an extended period, and higher academic success. Moreover, mastery-based learning gives students the power to control their learning progress. If used together with prometheia which gives feedback and has interactive features, it would bring about self-paced learning thus learner autonomy will be developed.
5) Future implementations may explore the use prometheia for other grade levels and science subjects, for example, Chemistry and Physics, to find out a more wide-ranging use that will result in effectiveness across various scientific disciplines. Broadening its application to different subjects can be a step towards establishing continuity in students' learning experiences

as well. Playing with tech tools in the same manner over and over again will make not only students more technologically literate but also better skilled in using technology.

6) The researchers are encouraged to conduct longitudinal designs in their studies of the long-run effects of prometheia on schooling outcomes such as knowledge retention, critical thinking skills, and academic motivation. They could also argue the need for further examining the platform's effectiveness when rightly combined with other instructional strategies or school contexts. Moreover, qualitative analytic studies that include classroom visits and gathering of teachers' opinions may, in turn, unveil more in-depth aspects of the way prometheia impacts instructional practices and learner engagement over time.

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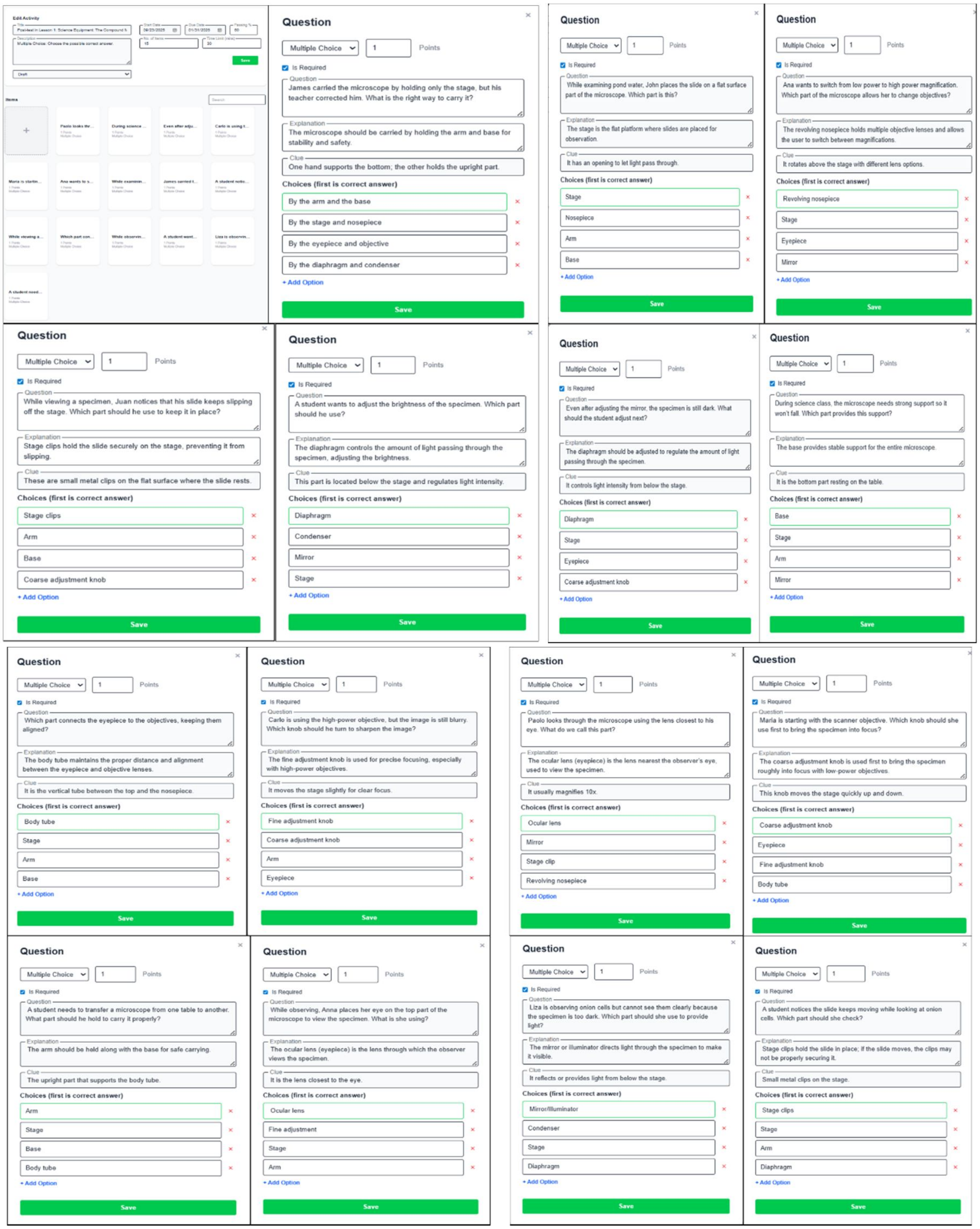
Appendix A.

Pretest and Posttest

The same instrument was used for both the pre-test and post-test, but the post-test items in prometheia were randomly re-arranged for each student.

Lesson 1: Science Equipment – The Compound Microscope



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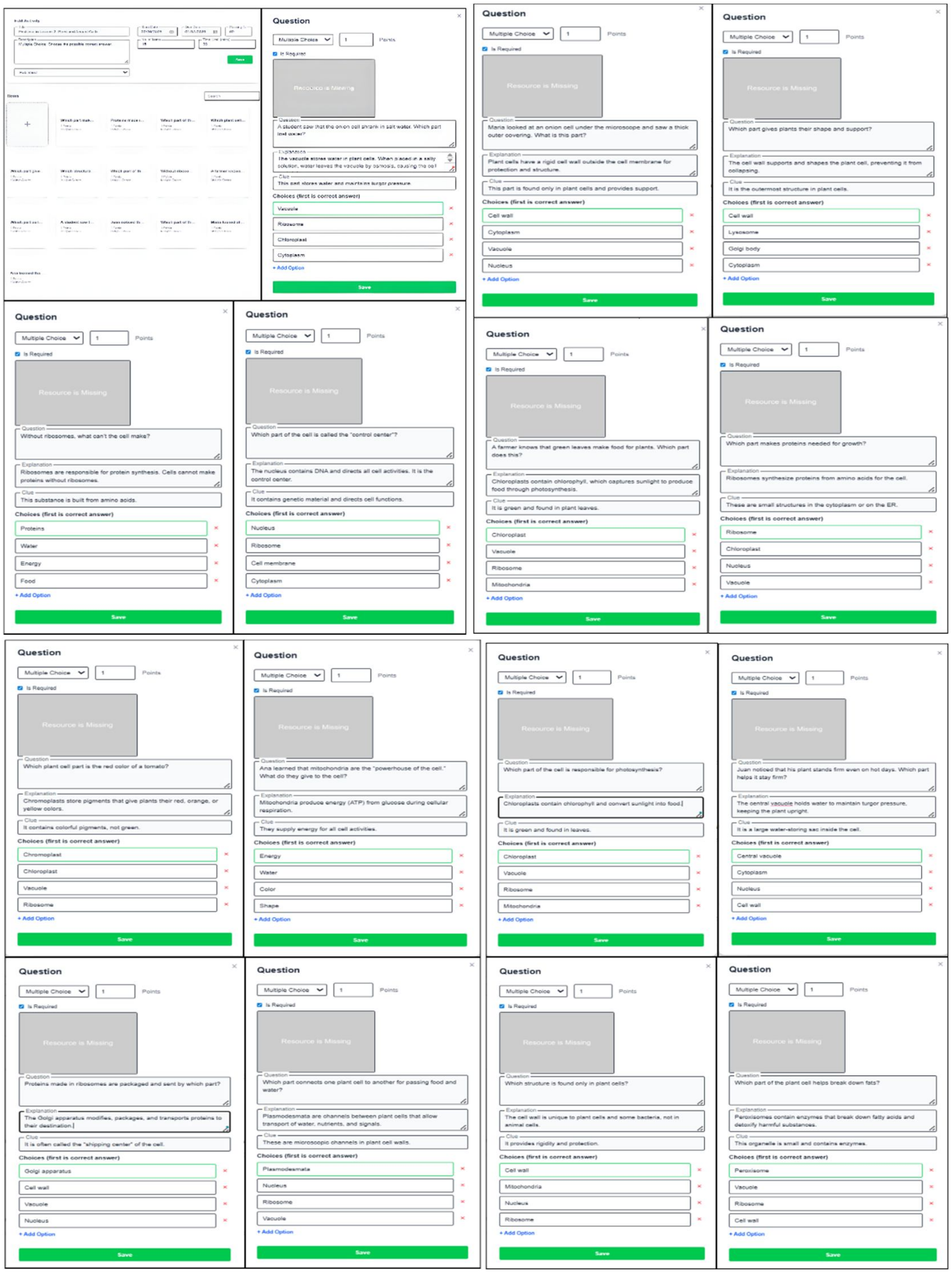
Lesson 2: Plant and Animal Cells



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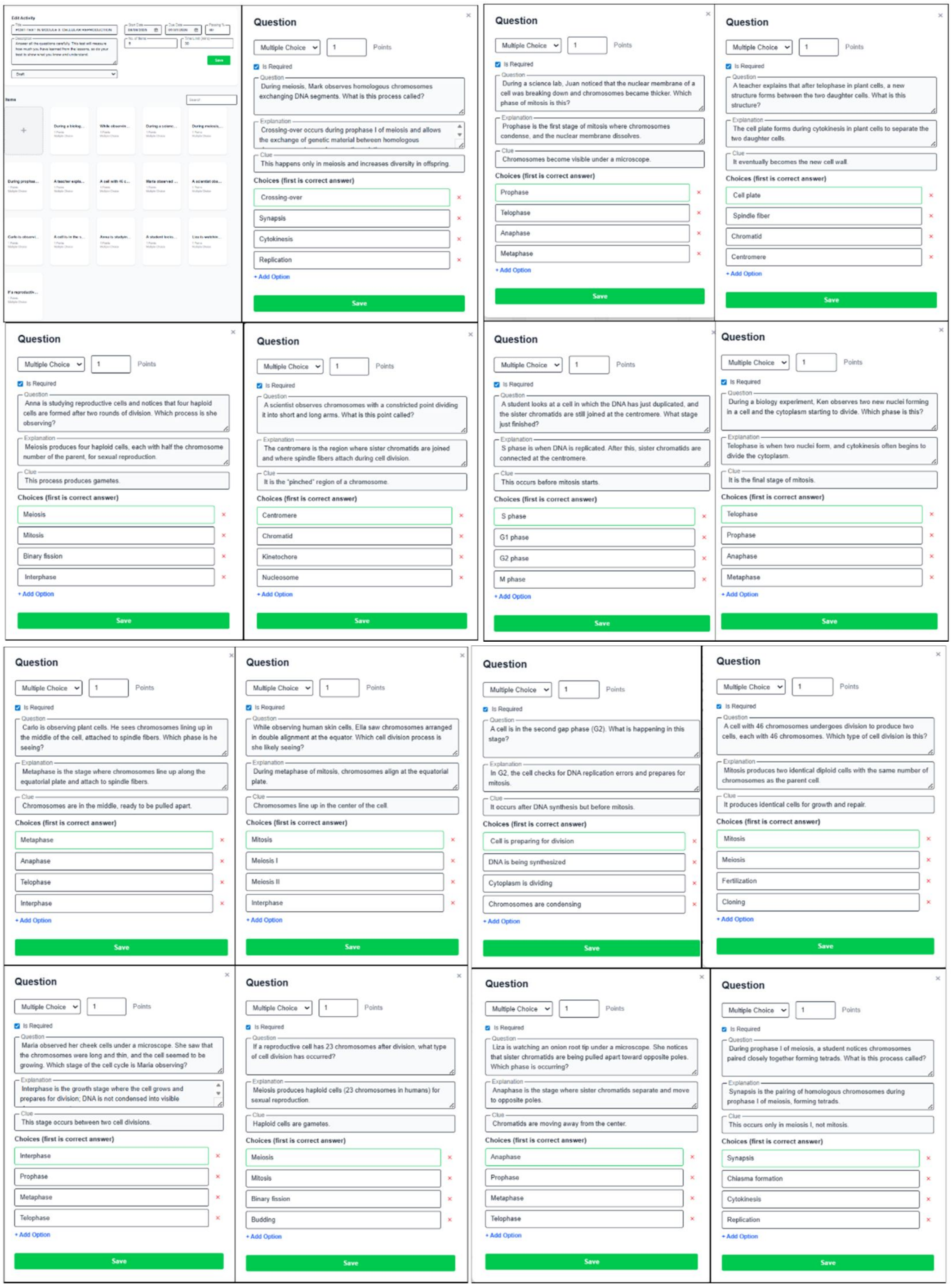
Lesson 3: Cellular Reproduction



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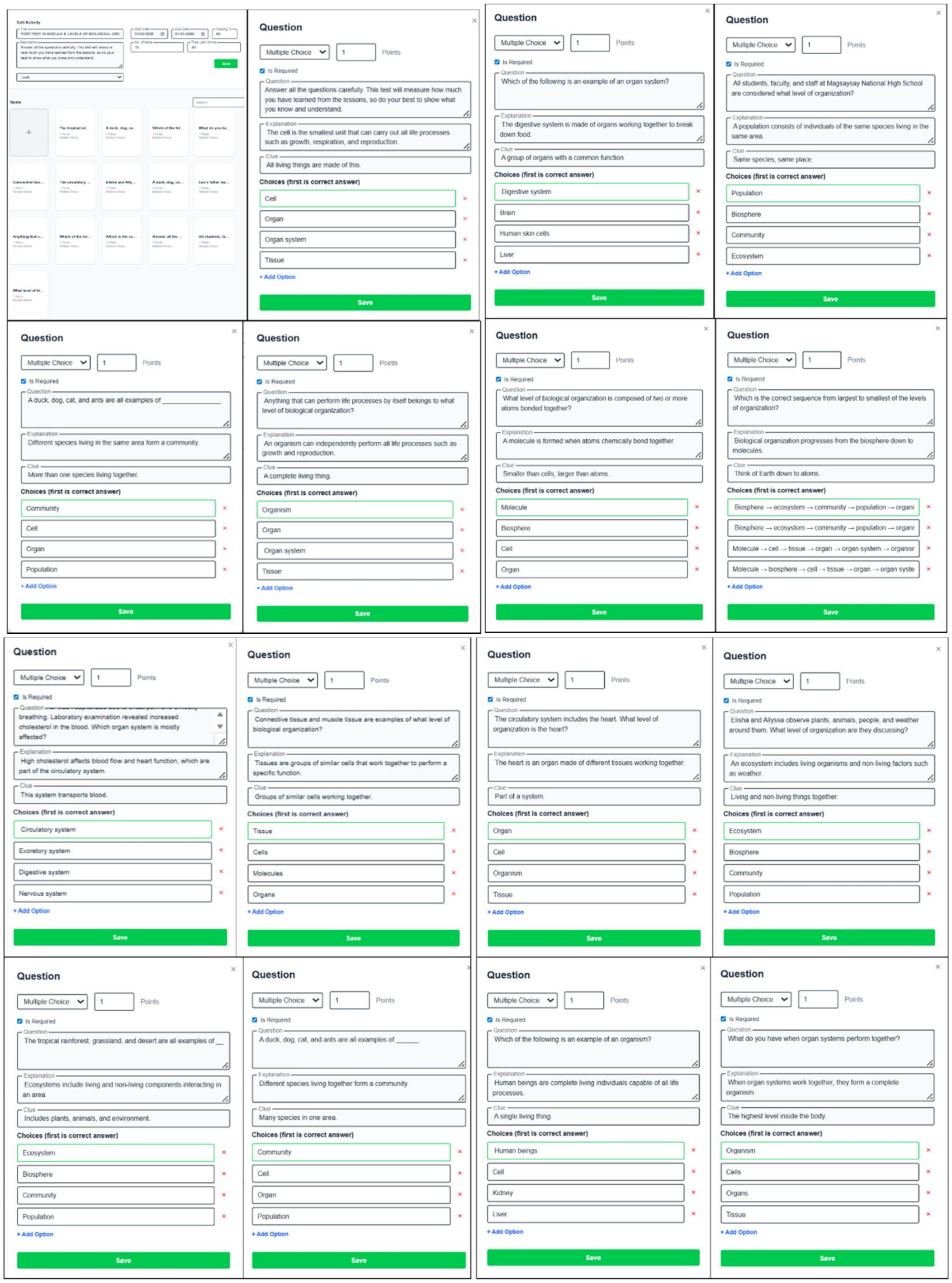
Lesson 4: Levels of Biological Organization



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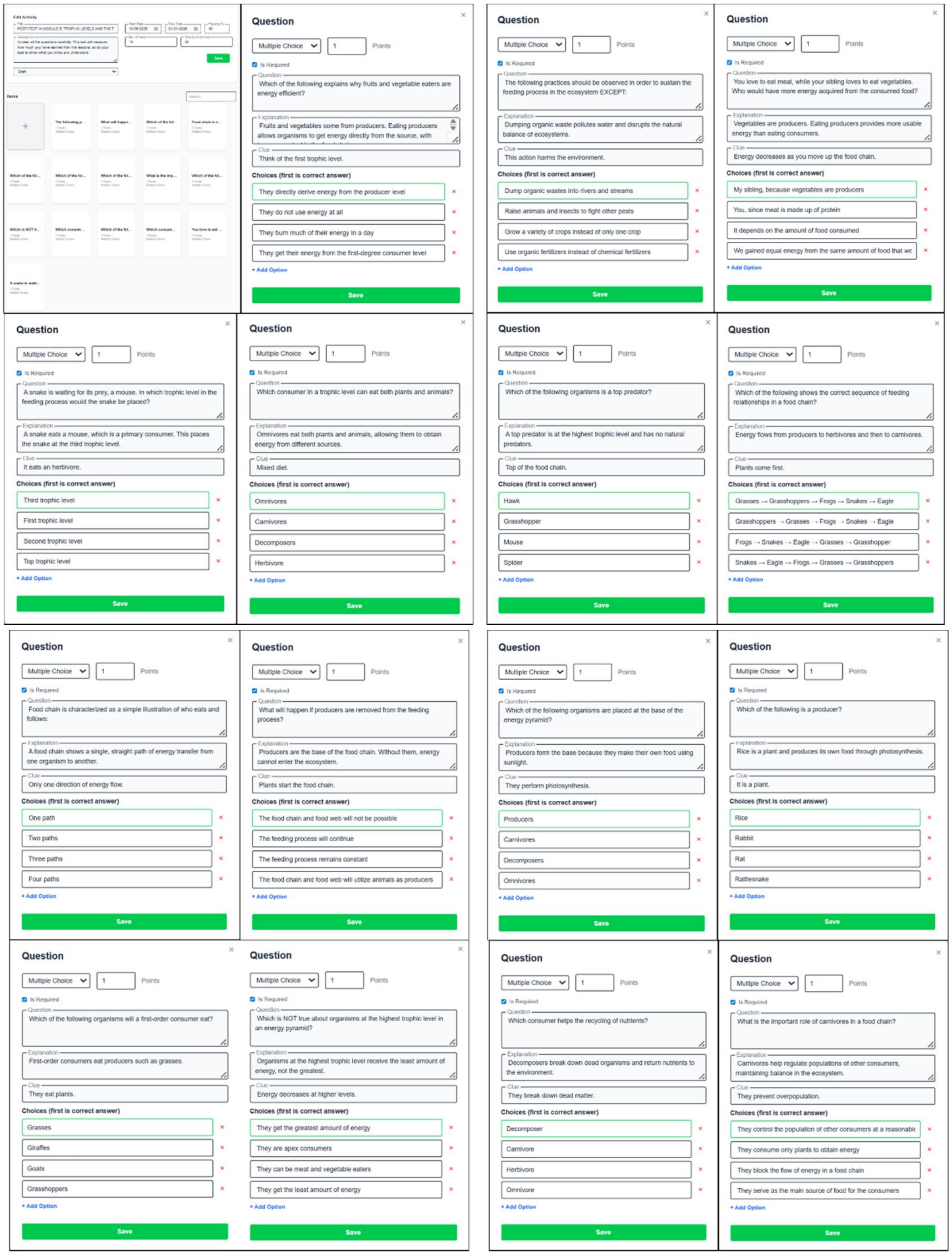
Lesson 5: Trophic Levels and Transfer of Energy



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Appendix B

Survey on the Other Benefits of Prometheia in science 7

Direction: Please supply the correct answer by filling in the blank.

Name: ____(optional) Section: _____________

Direction: Describe your perceptions when utilizing prometheia in Science 7 based on your experience. Answer the following statements truthfully by checking the number that corresponds to the degree of acceptance. Respond to the statements using the scales below.

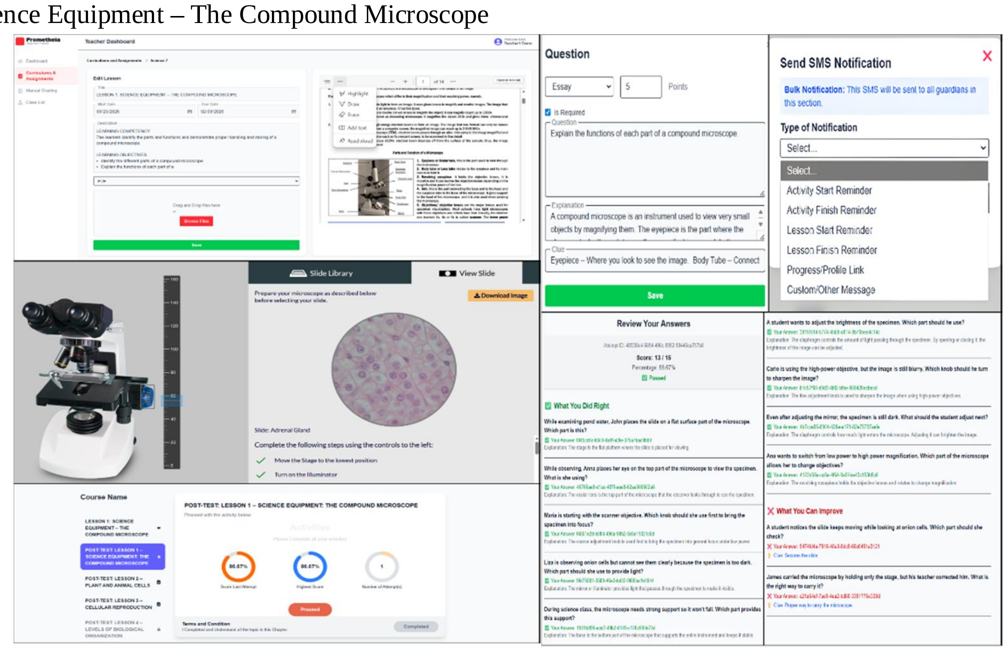
4 – Strongly Agree 3 – Agree 2 – Disagree 1 – Strongly Disagree

Likert-type Question Prometheia	1	2	3	4
1. Prometheia helped me better understand the Science 7 concepts covered in lectures.				
2. Using prometheia made topics more understandable than when taught through traditional methods.				
3. I feel more confident in the topics covered now that I have used prometheia.				
4. The interactive tasks and practice exercises in prometheia helped me learn more effectively.				
5. The multimedia content in prometheia (videos, images, diagrams) was clear and easy to follow.				
6. Using prometheia was an enjoyable and engaging learning experience.				
7. Prometheia provided learning opportunities I would not have experienced in a traditional classroom.				
8. Prometheia contributed to improving my understanding and performance in Science 7.				
9. The platform allowed me to collaborate and interact with my classmates effectively.				
10. Please rate your overall experience with Prometheia from 1 to 5.				

Appendix C

Prometheia

A. Lesson 1: Science Equipment – The Compound Microscope



Learning Competency:

The learners identify the parts and functions and demonstrate proper handling and storing of a compound microscope.

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Learning Objectives:

- Identify the parts of a compound microscope and state their functions.
- Explain the importance of proper handling and storing of a compound microscope.

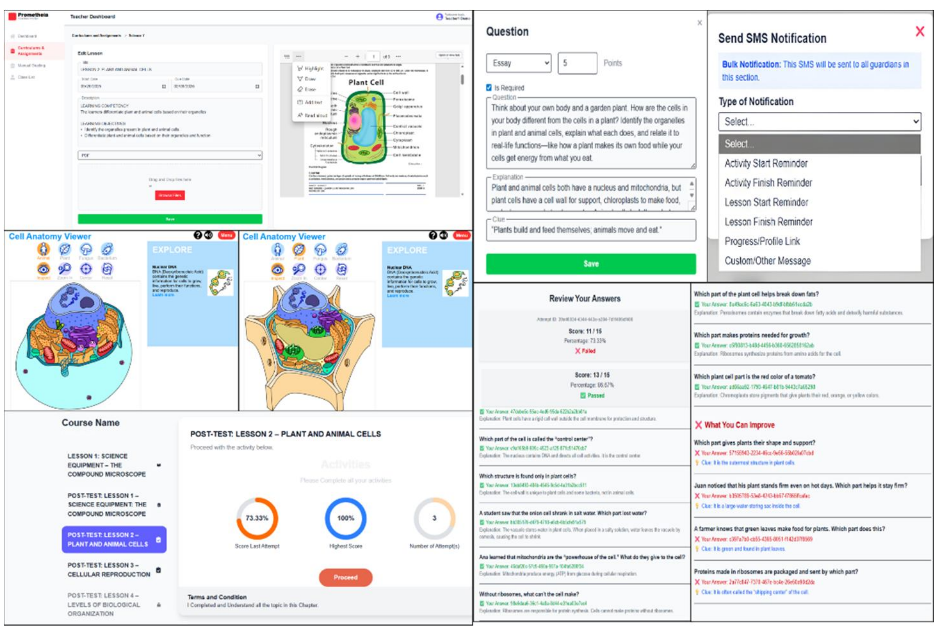
Description:

The prometheia learning platform enables learners to engage in an interactive and digital experience with embedded simulation-based resources. The learners enjoy an online course where the compound microscope is the central theme. During the course, learners get first-hand interaction with a virtual microscope that they can move around, investigate and check the parts of the microscope, such as the eyepiece, objective lenses, stage, diaphragm, and adjustment knobs, in a controlling manner. Through virtual controls, learners can understand how accurate focusing is a factor to a clearer image, thereby supporting their active double movements exploration and inquiry.

Throughout the lesson, learners undertake assessment tasks which are in the form of multiple-choice and short essay questions and they get immediate, automatic feedback on their answers after each response. Such interactive feedback is like a learning partner that helps learners figure out the errors in their understanding and correct them while at the same time deepening their thinking. The session is designed considering a mastery-based learning system where students are only allowed to proceed to the next task on the condition that they have attained a minimum score. Those who do not attain the minimum score are redirected to the interactive lesson and assessments for further practice.

Each one of the learning and assessment tasks is in line with the Most Essential Learning Competencies (MELCs) for Grade 7 Science. Once the learner has navigated through the entire lesson, the platform will notify the learner's parent(s) automatically by sending them updates on the learner's progress and results of the assessments, thus facilitating the provision of learning support at home and fortifying the school–home partnership.

B. Lesson 2: Plant and Animal Cells



Learning Competency:

The learners differentiate plant and animal cells based on their organelles

Learning Objectives:

- Identify the different organelles present in plant and animal cells.
- Differentiate plant and animal cells based on their organelles and functions.

Description:

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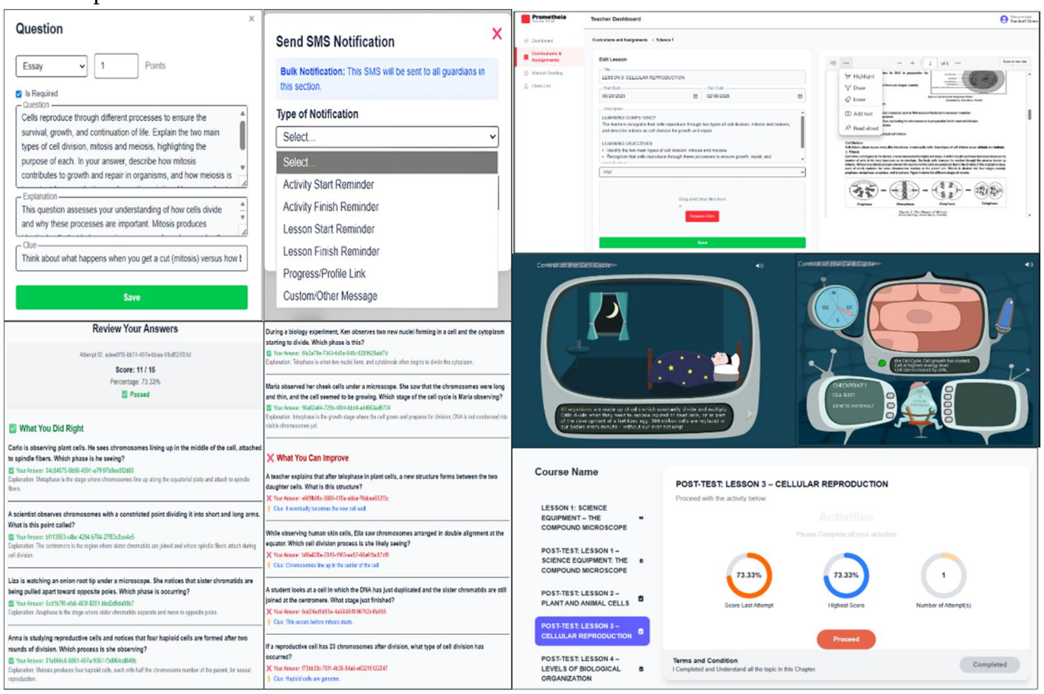
The prometheia learning platform allows learners to explore plant and animal cells through a hands-on online activity with embedded simulation-based resources. It starts with well-labeled diagrams and clickable, interactive diagrams where learners uncover organelle names and functions by selecting them. The learners can switch between plant and animal cell views to compare organelles actively, figure out the ones that are special to each cell type and those that are common to both.

While participating in the activity, learners answer assessments with multiple-choice and essay that are integrated in the lesson. After each response, the system gives instant, automated feedback so that learners can clear up their misconceptions and increase their understanding. The activity is based on a mastery learning system that requires learners to get a minimum score before they can move on to the next section. Learners who fail to meet the mastery level are taken back to the interactive diagrams and assessments to learn more and review.

These assessments in line with the Most Essential Learning Competencies (MELCs) for Grade 7 Science. When the learners finish using the platform, it automatically sends to the parents the progress and performance updates via the automatic parent notification system that strengthen the reinforcement of learner responsibility and continuous assistance from the parents.

C. Lesson 3: Cellular Reproduction



Learning Competency:

The learners recognize that cells reproduce through two types of cell division, mitosis and meiosis, and describe mitosis as cell division for growth and repair

Learning Objectives:

- Identify the two main types of cell division: mitosis and meiosis.
- Describe mitosis as a type of cell division that supports growth and repair in organisms.
- Recognize meiosis as essential for reproduction and genetic variation.

Description:

In prometheia, students participate in an interactive exercise on cellular reproduction through simulation-oriented materials embedded within the platform which students can use to understand the processes of mitosis and meiosis. The learners can explore with models that show the steps of each phase, and the results of cell division in the two processes in the platform itself. The task allows students to witness, manipulate, and evaluate meiosis and mitosis at each stage, thus getting an insight into how mitosis generates two identical cells that are used for the body's growth and repair and how meiosis results in four genetically different cells

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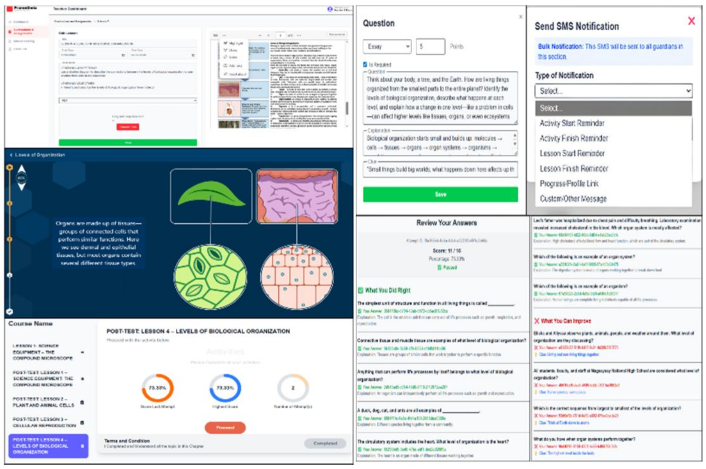
that are used in reproduction. Prometheia provides a gateway to these kinds of interactive learning exposures while adhering to a well-organized instructional framework that is in line with the objectives of the lesson.

The learners answer multiple-choice and essay assessment that are entwined with the activity and supplemented by prompt automated feedback. The mastery learning system where students must fulfill a certain criterion of performance to be allowed to continue. Those students who cannot reach the mastery level will be provided with the opportunity to go back over the interactive activity and tests for additional practice and strengthening of their knowledge.

The tasks and evaluations have been tailored to the Most Essential Learning Competencies for Grade 7 Science. When the students have done with the lesson, an automated parent notification system will send parents updates about the child's progress and performance, thus facilitating a continuous learning support at home through the collaboration of all involved.

D. Lesson 4: Levels of Biological Organization



Learning Competency:

Use a labelled diagram to describe the connections between the levels of biological organization to one another from cells to the biosphere

Learning Objectives:

- Identify and describe the levels of biological organization from molecules to the biosphere.
- Analyze the hierarchical connections between the levels of biological organization and explain how changes in one level can affect higher levels.

Description:

The prometheia learning platform offers an innovative experience where learners visually and interactively investigate the hierarchical biological organization, starting from molecules up to the biosphere. Through interactive diagrams, carefully structured explanations, and real-life examples that students are able to understand that cells make up tissues, tissues make up organs, and organisms coexist within populations and ecosystems. In order to deepen the level of understanding and encourage the learners' participation in the learning process, the platform features interactive simulation tools that enable students to change the values of different variables, witness the impacts of a change at one level on the higher levels, and test their knowledge by using the assessments.

Students take part in assessments which consist of multiple-choice and essay questions, with immediate automated feedback being available for the purpose of concept reinforcement and misconception correction. This lesson operates under a mastery-based learning system, whereby a learner is only allowed to go forward after obtaining a minimum score. Those students who fall short of the mastery level are provided with directions to go through the interactive simulations and reassessments again for consolidation.

Every work and assessment follow the Most Essential Learning Competencies (MELCs) for Grade 7 Science. Once the course is finished, Prometheia's automated parent notification system will deliver messages on the student's progression and assessment results, thus helping the parents to offer the necessary support and reinforcement of learning at home.

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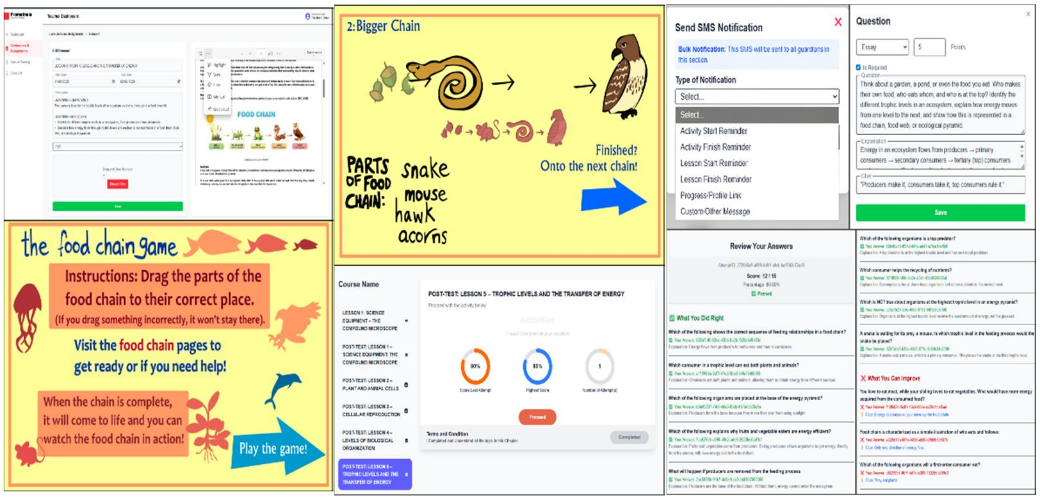
Lesson 5: Trophic Levels and the Transfer of Energy



Learning Competency:

The learners describe the trophic levels of an organism as levels of energy in a food pyramid.

Learning Objectives:

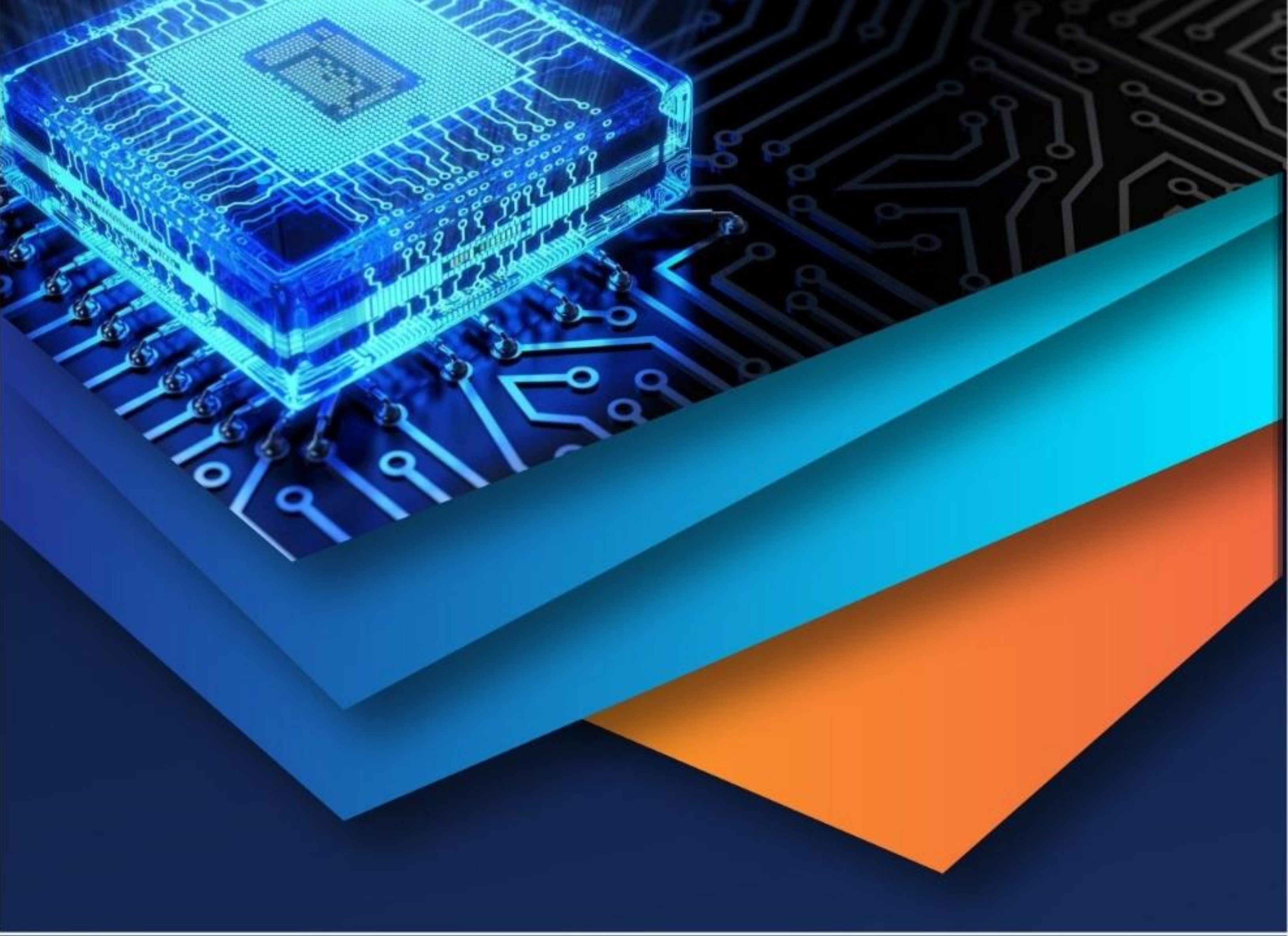
- Identify the different trophic levels in an ecosystem, from producers to top consumers.
- Describe how energy flows through trophic levels and explain its representation in a food chain, food web, and ecological pyramids.

Description:

In the prometheia learning platform, learners discover the flow of energy in ecosystems through interactive diagrams, step-by-step explanations, and examples from nature of food chains, food webs, and ecological pyramids. To further enhance engagement and comprehension, prometheia combines the use of interactive simulation tools. Here students can place organisms in the right trophic level by dragging them, energy transfer is visualized, and the food chain is animated. Students are thus able to simulate ecological relationships and see the impact of one level's changes on the whole system.

During the session, students take assessments that combine multiple-choice and short-answer questions, and they get immediate, automated feedback which helps them remember the concepts and clear up the misunderstandings. The lesson implements a mastery-based learning model where students are required to get a certain score before moving on. Those who do not get mastery are given a chance to go back and study the simulation and quizzes again for better learning.

The whole range of tasks and assessment is vertically and horizontally MELCs-aligned for Grade 7 Science. The automatic parent notification system of prometheia sends out progress and performance reports to parents, which in turn helps and encourages the continuation of the reinforcement of ecosystem ideas at home and school.



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