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Animation-based 7E Learning Model on Plant and Animal Cells for Grade 7 Learners

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Abstract

One common problem faced in education recently is the students' low performances in the field of Biology. It is a challenge to both teachers and students to teach and learn some biology concepts especially those at a molecular level. Thus, this study aimed to develop an animation-based 7E lesson, designed to enhance Grade 7 learners' academic performances towards plant and animal cells. The researcher also developed video animations that introduced the structures and functions of plant and animal cells, fostering students' curiosity and motivation to explore further. The developed 7E lesson and video animations were anchored on the learning competencies from the Department of Education. Both learning materials went through a series of validations, evaluations, and revisions, considering the comments and suggestions from the thesis adviser, panel members, and experts. The developed animation-based 7E lesson was rated excellent and video animations were rated very satisfactory. This denotes that both were valid and acceptable learning materials. The results of this study also show that the Animation-based 7E Learning Model holds promise for transforming science education by leveraging technology to create engaging and effective learning experiences.

Keywords: 7E Learning Model, video animations, cells

1. Introduction

Taking a stroll back in history, education made a massive leap from being the traditional "chalk and talk" method to pedagogies where students are given bigger roles in the classroom which encourages them to be more involved in the lesson. However, the rapidly changing world and the advancement of the Fourth Industrial Era continue to influence today's educational landscape. Educators are challenged by the demanding task of educating Generation Z to keep them abreast of the digital world (Pinatil, 2022). In response to these challenges, the educational system has to change towards a new

paradigm in which learning should be borderless and student-centered and should focus on how to learn rather than how to gain (Bulbul, 2010). According to Mecit (2006), using learning cycles is one of the best ways to achieve such approaches in a classroom. The learning cycle is an inquiry-based teaching approach or model that is based on constructivism with three fundamental objectives; conceptual understanding, process skills, and critical thinking in learners (Nicol, et. Al., 2020). In the study of Zhang, et al. (2024), an active inquiry learning, centered in 7E teaching mode was implemented in cell biology courses to enhance the learning effects of postgraduate students. The study demonstrates that the implementation effectively meets the needs of the majority of students, fosters their interest in learning, enhances their performance in comprehensive questioning, and enhances their innovative abilities in scientific research.

The 7E learning cycle is one of the manifestations of the learning cycle. In today's science curriculum, the 7E learning cycle model is a valuable recommended instructional strategy (Balta & Sarac, 2016), as it imposed a strong emphasis on the value of eliciting prior information or understanding of the learner, as well as the transferability of learning, which is the most important component in science education (Sharma & Sankhian, 2018). The 7E learning cycle model is a learner-centered model that consists of seven organized and interrelated phases in which students play an active role and experience diverse scientific inquiry. This approach also encourages students to actively create their concepts by engaging with their surroundings—both physical and social (Warliani, et al., 2017). The study of Ibrahim, et al. (2022), utilizes the 7E Learning Cycle on cell concepts and the results proved that the approach enhances better understanding and promotes meaningful learning. In addition, Anggrisia and Fatimah (2018) stated that the Learning Cycle 7E model is anticipated to be able to improve the scientific literacy component that has been established by PISA.

According to Shapley et al. (2011), technology-supported lessons will inspire more innovative approaches to teaching and learning. Animation, which combines audio and visual elements, may aid in the process of encoding information, storing it in long-term memory, and recovering it. It engages multiple senses at once, making them more captivating and involving (Olalekan & Oludipe, 2016). In Biology, animations play an important role when complicated events are abstract or cannot be directly observed and are particularly useful in visualizing processes at the molecular level (Bell et al., 2012; Brame, 2016). It was proven that animation improve students' visualization skills (Mnguni & Moyo, 2021) and is an effective tool to improve understanding and reduce misconceptions about cell concepts (Kalimuthu, 2017).

According to Buckley (2018), studying biology helps us understand the environment we live in and how our biological systems function as a whole. Thus, understanding its concepts is vital to our growth. However, it has been claimed in various studies that students' conceptual understanding and performance towards biology or science as a whole is low. This claim is evident in the result from PISA 2018, where the Philippines scored lower in science than in most of the countries and economies that participated. Taking on the second-lowest rank out of 79 countries. The Philippines also ranked 55th out of 137 participating countries in terms of higher education and 76th out of 137 countries in the quality of math and science education according to the World Economic Forum (2018). Furthermore, results from the Trends in International Mathematics and Science Study (TIMSS, 2019), supported these facts when the Philippines came in last out of 58 countries in mathematics and science.

According to Rogayan Jr and Dollete (2019), the current condition of science education is caused by the lack of suitable, flexible, and research-based learning resources, making it difficult for teachers to teach some science topics and principles. Another factor that contributes to this issue is the use of the traditional way of teaching. This method does not correspond to the needs of today's generation or the type of society in which they live.

Thus, in this study, the researcher will make use of the 7E learning cycle method accompanied by animations to cultivate a spirit of discovery and enjoyment of learning by stimulating students' curiosity and inquiry. It would also provide them with the necessary skills and information to learn on their own or in collaboration with others, and to use this knowledge and learning in a variety of settings.

2. Objectives of the Study

This study seeks to:

1. Conduct a pre-assessment of teachers to determine their familiarity with the 7E learning cycle and the challenges they face in teaching the topic of Plant and Animal Cells.
2. Develop an animation-based 7E lesson plan on plant and animal cells.
3. Create video animations on the parts and functions of the plant and animal cells.
4. Determine the academic performance of the students through the use of pre-tests and post-tests.
5. Determine the significant difference in the student's academic performance between pre-test and post-test.
6. Measure the student's engagement in the implementation of the animation-based 7E model lesson.

3. Methods

This study utilized an experimental research design of the quasi-experimental type—specifically, the one-group pretest-posttest design with support from both quantitative and qualitative data. The participants of this study were Grade 7 learners from a public national high school in Iligan City, Lanao del Norte, and in-service teachers who participated in the needs assessment process.

The development of the Animation-based 7E Lesson followed the ASSURE model developed by Heinrich, et al., (1996).

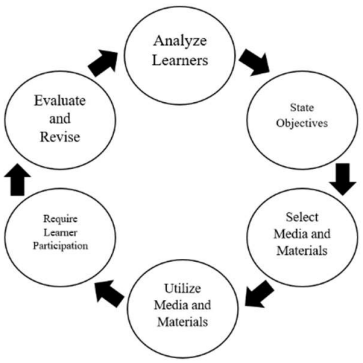

Figure 1. Steps in the Development of the Animation-based 7E Lesson

3.1 Analyze Learners

To analyze the needs of the learners, the researcher conducted a needs assessment interview. The needs assessment questionnaire was adapted and modified from the work of Guiritan (2023). The questionnaire had two sections; the first part dealt with the learning competencies that the students were having difficulties with, while the second part consisted of questions on the problems encountered in the classroom and the strategies that may be effective in resolving such issues. Before the assessment, a letter of permission to the principal and a letter of consent to the key informants were given.

3.2 State Objectives

The Animation-based 7E Lesson was anchored on the Most Essential Learning Competencies (MELCs) from the Department of Education. The objectives used in the lesson plan were derived from the learning competencies chosen from the MELCs.

3.3 Select Media and Materials

The results of the needs assessment interview were the basis for selecting instructional materials. To address most of the problems encountered in the classroom, the researcher opted for the integration of video animations into the 7E learning cycle.

3.4 Utilize Media and Materials

This stage focuses on how the media and technology will be implemented. Designing the instructional materials and activities in the lesson must be done. The researcher developed an animation-based 7E lesson and video animations used in the lesson. Tools were also designed to measure students' engagement during the lesson.

3.4.1 Development of the Animation-based 7E Lesson on Plants and Animal Cells. The primary aim of the 7E learning cycle is to highlight the increasing importance of provoking previous understandings and transferring the concepts to new contexts. The 7E model lesson plan consists of seven discrete elements that are designed to achieve the primary goal of the model. The following are the elements of the 7E model lesson plan along with the implemented activities.

Elicit. To draw students' prior knowledge the students played a game called the emoji quiz. The words used in the game were from the previous topic. This was followed by a fill-in-the-blank activity, wherein the words that complete the sentences were the ones they got from the game.

Engage. Directing students' attention towards the new learning situation, here the students were shown two of the developed video animations on plants and animal cell organelles. The video was followed by questions concentrated on what they just watched. The questions were constructed in a way that students think about what they haven't known yet.

Explore. To build onto students' interest, here they were given an activity called "build a cell". The class was divided into groups with five members each. Each group was given blank plant and animal cells and their organelles. The students work together and build plant and animal cells using the materials given to them. They were going to identify which of the organelles belong to the plant cell or the animal cell. Afterward, the students were instructed to make a Venn diagram showing the difference between plant and animal cells according to the presence or absence of certain organelles. One representative from the group was assigned to explain their group's work in front.

Explain. The topic was introduced to the students through video animations. There were two video animations shown, one for the plant cell and one for the animal cell. The functions of each organelle were explained in the video. The videos were followed by questions that were focused on the functions. The implementer emphasized some keywords that helped the students understand and internalize each function. After each video, a mini-activity was done, where each group was assigned two organelles. A representative of the group went in front and picked two rolled papers from a bowl. The paper consists of pictures of a random organelle. The group worked together to label organelle, give its function, and explain their work in front. After the activity, the

differences between the plant and animal cells were explained further and simplified using a table.

Elaborate. In this phase, to assess the transfer of learning, the students were given another activity with their groups. Each group was provided with a large blank paper and a printout of the organelles' names and functions. The students were going to draw/design a plant and animal cell and their organelles. Label their work and match the functions of each organelle. One representative from the group presents their work in front.

Evaluate. To examine the students' conceptual understanding of the lesson, the implementer conducted a 30-item post-test.

Extend. In this phase, the students were given a chance to see a real cell plant and animal cell. Using a microscope, the students were grouped and examined two slides the implementer provided. This was followed by questions and short discussions that led to the importance of a cell and its role in the real world.

3.4.2 Development of Video Animations on Plant and Animal Cells. There were four video animations developed in this study. There were two characters in the video, Cody the little boy, and Helios the sunflower. Cody represents the animal cell and Helios represents the plant cell. There were four video animations developed: (1) Animal cell organelles, (2) Plant cell organelles, (3) Function of the Animal Cell organelles, and (4) Function of the Plant Cell organelles.

Video Animation 1: Animal Cell Organelles. The first video runs for 2 minutes and 47 seconds. The video animation explained what animals are made of and showed the ten organelles of the animal cell: (1) cell membrane, (2) cytoplasm, (3) nucleus, (4) endoplasmic reticulum, (5) lysosome, (6) Golgi bodies, (7) mitochondria, (8) ribosomes, (9) vesicle, and (10) centrosome.

Video Animation 2: Plant Cell Organelles. The second video animation runs for 1 minute and 47 seconds. The video explained what plants are made of and showed the ten organelles that are present in a plant cell: (1) cell wall, (2) cell membrane, (3) chloroplast, (4) nucleus, (5) vacuole, (6) endoplasmic reticulum, (7) Golgi bodies, (8) mitochondria, (9) ribosomes, and (10) cytoplasm.

Video Animation 3: Functions of the Animal Cell Organelles. The video runs for 3 minutes and 33 seconds. It showed and explained the functions of each organelle that were present in the animal cell: (1) the cell membrane is the outermost layer of the animal cell which controls what enters and exits the cell such as water, nutrients and waste and thereby protects and supports the cell, (2) cytoplasm is a jelly-like substance where organelles are embedded and is the medium for chemical reactions, (3) the nucleus controls all activities of the cell and contains DNA, (4) lysosomes contains digestive enzymes for proteins, fats, and carbohydrates that transports undigested material to the cell membrane for removal, (5) endoplasmic reticulum is referred to as the “highway” of the cell that moves materials around to other parts and has two components which are the smooth endoplasmic reticulum in which not ribosomes are attached and the rough endoplasmic reticulum that has attached ribosomes on it, (6) golgi bodies are a set of flattened sacs that serve as the packaging and distribution center of the cell, (7) the mitochondria break down food and release energy to the cell - the “Powerhouse” of the cell, (8) ribosomes are made up of RNA and other proteins which has main function of synthesizing proteins, (9) the vesicle carry materials in and out of the cell and stores nutrients and water a cell might need to survive, and (10) the centrosomes which help to organize the microtubules and the cell division process.

Video Animation 4: Function of the Plant Cell Organelles. The fourth video animation runs for 4 minutes and 7 seconds. It showed and explained the functions of each organelle that were present in the plant cell: (1) the cell wall is the outermost layer of the plant cell which gives the cell its shape and protection and it also allows materials to

pass to and from the cell membrane, (2) the chloroplasts are the one responsible for photosynthesis, (3) cell membrane is the second layer in the plant cell that is semi-permeable and controls what enters and exits the cell such as water, nutrients, and waste and thereby protects and supports the cell, (4) cytoplasm is a jelly-like substance where organelles are embedded which is the medium for chemical reactions, (5) the nucleus controls all activities of the cell and contains DNA, (6) endoplasmic reticulum is referred to as the "highway" of the cell that moves materials around to other parts and has two components which are the smooth endoplasmic reticulum in which not ribosomes are attached and the rough endoplasmic reticulum that has attached ribosomes on it, (7) Golgi bodies are a set of flattened sacs that serve as the packaging and distribution center of the cell, (8) mitochondria break down food and release energy to the cell - the "Powerhouse" of the cell, (9) ribosomes are made up of RNA and other proteins which have the main function of synthesizing proteins, and (10) vacuole carry materials in and out of the cell and stores nutrients and water a cell might need to survive. The last part of the fourth video animation emphasizes the difference between plant and animal cells according to the presence and absence of certain organelles. References were shown at the end of the video as well.

3.4.3 Development of the Students' Engagement Checklist. To measure the students' engagement during the implementation of the Animation-based 7E Lesson, the researcher developed a questionnaire checklist that would be given to the students after the lesson. The checklist consists of ten statements that describe the students' behavior or experiences during the lesson. The students would check the YES column or the NO column according to their responses. The last part of the questionnaire was the comments section, in which students were encouraged to give feedback.

3.4.4 Development of the Teachers' Observation Checklist. Using a questionnaire checklist, teachers would observe the students during the implementation of the Amination-based 7E Lesson. It was emphasized that the observations would be focused on the students' engagement during the class. The teachers' observation checklist consists of ten observable statements that describe students' engagement during the lesson. The teacher would check the OBSERVE column or the NOT OBSERVE column according to their responses. The last part of the questionnaire was the comment section, in which feedback would be highly appreciated.

3.4.5 Face Validation. All of the developed instructional material and research instruments went through face validation by the thesis adviser and panel members. Comments, suggestions, and ratings were the basis for the research instruments' revision.

3.4.6 First Revision. After the materials and instruments were face-validated, comments and suggestions from the thesis adviser and panel members were consolidated and incorporated for the first revision. After the first revision, the research instruments were subjected to validation from experts.

3.4.7 Expert Validation. The developed instructional material and research instruments were validated by experts. The animation-based lesson, students' engagement checklist, and teachers' observation checklist were validated by six in-service teachers while the video animations were validated by five in-service teachers, four of them were both an ICT expert and a science teacher and one was a biology teacher. All of the evaluators were from the Department of Education. Comments, suggestions, and ratings were the basis for the research instruments' second revision.

3.4.8 Second Revision. Based on the experts' ratings, comments, and suggestions, the learning materials and research instruments undergone another revision. After the second revision, the research instruments were ready for pilot testing.

3.5 Require Learning Participation

This step of the ASSURE instructional model was to test or practice the materials that were designed.

3.5.1 Pilot Testing. A pilot test was conducted in one of the public schools in Iligan City. One section of Grade 7 learners with a total number of 34 students was involved and participated in the testing.

3.6 Evaluate and Revised

After the pilot test, the materials and technology used in the lesson as well as the teaching strategy were evaluated. The students' engagement checklist and teachers' observation checklist served as feedback from the students and teachers and were used as the foundation of the revision of the instructional materials.

4. Results and Discussions

The developed animation-based 7E lesson, video animations, and checklists went through face validation, expert validation, pilot testing, and implementation. The following subsections discuss the results.

4.1 Needs Assessment Interview

Six in-service biology teachers from the Department of Education participated in the needs assessment interview. An approval letter from the school principal was acquired and a letter of consent from the respondents was given.

4.1.1 Summary of Responses from the Needs Assessment. The first part of the needs assessment questionnaire determines which learning competencies the students were having difficulties with. In summary, the learning competencies that state: "Differentiate plant and animal cells according to the presence or absence of certain organelles" and "Explain why the cell is considered the basic structural and functional unit of life" were among the two learning competencies that the students were having difficulties with. Key informants STNA 1, 2, and 4 agreed to the first learning competency mentioned, while STNA 1, 3, 5, and 6 opted for the latter. This result was in unison with various local studies by (Buitre, 2023; Santos, Lim, & Rogayan, 2021; Bautista, Berdan, & Errabo, 2020) wherein the topic of plant and animal cells was one of the highest-ranked topics where students have low conceptual understanding and was considered as one of the least mastered competencies.

The second part of the needs assessment questionnaire was categorized into five (5): (1) problems encountered in teaching plants and animal cells, (2) familiarity with the 7E learning cycle, (3) familiarity with video animations, (4) opinion on the integration of technology in teaching plant and animal cells, and (5) opinion on inquiry-based learning in teaching plant and animal cells. In summary in the first category, there were six common problems encountered in teaching the topic of plant and animal cells. One key informant mentioned that students were having difficulties with interpreting the structure and the functions as well as differentiating each organelle. The complexity of the terms and the lack of equipment for experiments in schools were also stated by two informants.

However, difficulties in visualization ranked first in the problems encountered in teaching plants and animal cells which was mentioned by four of the key informants. These problems were also mentioned in the study of Starbek et al., (2010). Starbeks' study pointed out that the size, terminologies, and complexity of the analysis necessary were the reason why concepts at the molecular level like plant and animal cells are both challenging to teach and learn (Rundgren & Yao, 2014).

In terms of familiarity with the 7E learning cycle and video animations, one of the six key informants was not familiar with the 7E learning cycle. Fortunately, however, all of the informants were familiar with video animations. The fourth category collected the key informant's opinion on the integration of technology in teaching plant and animal cells. In general, the integration of technology in teaching plants and animal cells would eventually enhance instruction by helping the learners analyze, understand, and visualize the concepts, which may lead to engaging and interactive learning. Furthermore, it had also been mentioned that technology integration would improve students' retention given that the complexity of terms and differentiating each organelle were some of the problems mentioned in the first category. In line with this, Micklos et al., (2011) stated that more and more molecular-level concepts and phenomena are being taught using technology visualization tools like animations to mitigate issues in the said concepts. In terms of the key informants' opinion on using inquiry-based learning in teaching the topic of plant and animal cells, the method would encourage learners to actively explore, investigate, discover, and familiarize the concepts about the topic. The usage of the method would make the lesson clear and enjoyable as well. This was complemented by the study of Astalini et al., (2023) wherein the inquiry-based learning model was an instructional strategy that was capable of motivating learners to learn more actively and explore to discover new things.

Lastly, a comment and suggestion from one of the key informants states: "Teaching plant and animal cells using the 7E learning cycle and technology integration will surely increase students' engagement and collaboration". Findings from the study of Tepla et al. (2022) showed that animations in the teaching process significantly increased students' intrinsic motivation for learning natural sciences.

4.2 Expert Validation

All the developed instructional materials and research instruments in this study underwent validation from experts.

4.2.1 Validation of the Animation-based 7E Lesson. The revised animation-based 7E lesson plan was expert-validated, the evaluators were six in-service teachers from the Department of Education. The rubric used to evaluate the lesson plan was adapted and modified from the work of Tecson, et al. (2021).

Table 1. Experts' Validation Results of the Animation-based 7E Lesson Plan

Components	Average Mean	Interpretation
Learning Objectives	3.83	Excellent
Learning Content	3.78	Excellent
7E Lesson Stages	3.64	Excellent
Overall Rating	3.75	Excellent

There were three components considered in rating the developed animation-based 7E lesson plan: (1) Learning Objectives, (2) Learning Content, and (3) 7E Lesson Stages. The learning objectives received a rating of 3.83, learning content received a rating of 3.78, and the 7E lesson stages received a rating of 3.64, with a total rating of 3.75. All of the components including the overall rating received the highest interpretation which was

"excellent". This denotes that the developed animation-based 7E lesson plan had guaranteed its level of quality as an intervention in this study. However, experts emphasized addressing the recommendations accordingly. Anggrisia and Fatimah (2018) stated that a well-constructed 7E lesson would produce a calm, engaging, and enjoyable learning environment.

4.2.2 Validation of Video Animations. The revised video animations were expert-validated; the evaluators were five in-service teachers from the Department of Education. Four of them were both ICT experts and science teachers and one was a biology teacher. The evaluators were provided with an evaluation rating sheet for non-print materials adopted from the Department of Education, along with the developed video animations.

Table 2. Experts' Validation Results of the Video Animations

Factors	Average Mean	Interpretation
Factor A: Content Quality	3.96	Very Satisfactory
Factor B: Instructional Quality	3.9	Very Satisfactory
Factor C: Technical Quality	3.85	Very Satisfactory
Factor D: Other Findings	4	Very Satisfactory
Overall Rating	3.93	Very Satisfactory

There were four factors considered in the evaluation of the video animations: (1) content quality, (2) instructional quality, (3) technical quality, and (4) other findings that consist of different kinds of errors. The content quality received a rating of 3.96, instructional quality received a rating of 3.9, the technical quality received a rating of 3.85, and other findings received a rating of 4, with an overall rating of 3.93. All of the factors including the overall rating received the highest interpretation which was "very satisfactory". The result indicates the level of quality the video animations hold as supplementary teaching material to the 7E Lesson Plan in teaching plant and animal cells. All of the evaluators also agreed to recommend the utilization of video animations in public schools which would provide material that is abstract or cannot be seen with the naked eye by visualizing the material so that it can be discussed and portrayed (Wardoyo, 2015).

4.2.3 Validation of the Students' Engagement Checklist. The students' engagement checklist went through expert validation by six in-service teachers from the Department of Education. The rubric used to evaluate the checklist was adapted and modified from the work of Konstantinidis, (2016).

Table 3. Experts' Validation Results of the Students' Engagement Checklist

Categories	Average Mean	Interpretation
Focus	3.83	Excellent
Clarity	3.67	Excellent
Writing Style	3.67	Excellent
Length	3.83	Excellent
Spelling and Grammar	4	Excellent
Overall Rating	3.8	Excellent

There were five categories considered in the evaluation of the checklist: (1) focus, (2) clarity, (3) writing style, (4) length, and (5) spelling and grammar. Both focus and length categories received a rating of 3.83, clarity and writing style received a rating of 3.67, and the spelling and grammar category received a rating of 4, with an overall rating of 3.8. All categories including the overall rating received the highest interpretation which

is "excellent". Self-reported engagement questionnaires capture what is known as 'personal engagement,' representing the student's self-perception of their overall engagement levels Seda Cetin et al. (2018).

4.2.4 Validation of the Teachers' Observation Checklist. The teachers' observation checklist went through expert validation by six in-service teachers from the Department of Education. The rubric used to evaluate the checklist was adapted and modified from the work of Konstantinidis, (2016).

Table 4. Experts' Validation Results of the Teachers' Observation Checklist

Categories	Average Mean	Interpretation
Focus	3.83	Excellent
Clarity	3.5	Excellent
Writing Style	3.67	Excellent
Length	4	Excellent
Spelling and Grammar	4	Excellent
Overall Rating	3.8	Excellent

There were five categories considered in the evaluation of the checklist: (1) focus, (2) clarity, (3) writing style, (4) length, and (5) spelling and grammar. Both length and the spelling and grammar categories received a rating of 4, focus received a rating of 3.83, clarity received a rating of 3.5 and the writing style category got a rating of 3.67. As a whole, the checklist received a rating of 3.8, which was interpreted as "excellent". This result denotes that the developed checklist for the teachers' observation was excellent in quality and was recommended for the utilization of the present study given that the comments and suggestions would be addressed accordingly. According to Gargallo, (2018) quality research requires good measuring instrument, which is important in the teaching and learning process.

4.3 Pilot Testing

The academic performance of the students was determined by the pre-test and post-test conducted before and after the pilot testing. The students' engagement was measured through the students' engagement checklist and teachers' observation checklist. The results were as follows:

Table 5. Achievement Test Results of the Pre and Post-Test Scores During Pilot Testing

Variables	Mean	Mean Difference	SD
Pre-test	11.412	4.7353	2.883
Post-test	16.147		4.825

Table 5 revealed the summary of the students' performance in the pre-test and post-test during the pilot testing. The mean score of the students in the pre-test was 11.412 while in the post-test was 16.147. Thus, the mean scores of the students during the post-test scores were way higher than in the pre-test. This means that the 7E instructional strategy enhances students' performance and academic achievement, arouses their interest, and reduces misconceptions (Rogayan, 2022). Moreover, according to scholars (Stith, 2004; and Barak, Ashkar, and Dori, 2010), when a competent and motivated educator delivers animation systematically, it provides a valuable technique to transmit dynamic and complicated sequences of events to students more successfully.

Table 6. Paired Sample T-test of the Pre and Post-Test Scored during Pilot Testing

Variables	df	t	P - value	Interpretation
Pre-test	33	-5.8762	1.3891E-06	Significant
Post-test				

The table above presented the paired sample t-test results for the pre-test and post-test scores during pilot testing. It had been revealed that the p-value is 1.3891E-06 which is lesser than $\alpha = 0.05$ which denotes that there is a significant difference between the pre-test and the post-test during the pilot testing. This result was complemented by the study done by Dap-og and Orongan, (2022) wherein the adaptation of the 7E learning cycle model in employing Computer-Assisted Instruction (CAI) significantly increased students' academic performance and improved their engagement levels for affective, cognitive, and behavioral domains.

Table 7. Frequency and Percentage Distribution of the Students' Engagement during Pilot Testing

Students Experiences/Behavior	Frequency		Percentage	
	YES	NO	YES	NO
I paid attention to the teacher and/or to my classmates during the class.	34	0	100%	0
I answered questions that the teacher asked during the lesson.	33	1	97%	3%
I express my opinion during the lesson.	33	1	97%	3%
I asked questions about the lesson.	26	8	77%	23%
I actively participated in group activities.	34	0	100%	0
I collaborated with my groupmates during group activities.	34	0	100%	0
I focused on the activities we did in class.	33	1	97%	3%
I find the lesson very fun and interesting.	34	0	100%	0
I was able to connect my previous knowledge with the current lesson.	34	0	100%	0
I learned ideas and concepts that would be useful in the real world.	33	1	97%	3%
The animations made me interested in the lesson.	34	0	100%	0
I would like to have a lesson like this again.	34	0	100%	0

Table 7 shows the frequency and percentage distribution of the students' engagement during pilot testing. It has been determined that seven behaviors/experiences out of twelve got 100% of the total respondents' population answered YES. In four of the statements, 97% of the respondents checked YES and 3% were NO. The statement "I asked questions about the lesson" got the lowest percentage of YES at 77% and 23% NO. However, it can be inferred that the majority of the students were engaged during the lesson. This denotes that the intervention was able arouse students' interest, and motivate them to engage in the lessons (Rogayan, 2022).

Table 8. Frequency and Percentage Distribution of the Teachers' Observation during Pilot Testing

Students Behavior	Frequency		Percentage	
	Observe	Not Observe	Observe	Not Observe
Students are paying attention to the lesson.	2	0	100%	0
Students proactively contribute to the class by: Expressing thoughtful ideas or reflective answers.	2	0	100%	0
Ask questions that are related to the lesson.	2	0	100%	0
All students are focused on the learning activity with minimum disruptions.	2	0	100%	0
Students were involved in a collaborative activity, where individual group members were held accountable for being active participants.	2	0	100%	0
Students exhibit interest and enthusiasm.	2	0	100%	0
Students applied knowledge from previous lessons to current lessons.	2	0	100%	0
Students were presented with a media clip (video, audio, internet, newspaper, podcast) and were able to answer questions regarding the information.	2	0	100%	0
Students applied the knowledge they acquired from the video/discussion on the activities.	2	0	100%	0
Students answer questions regarding their output from the activities.	2	0	100%	0
Students show a transfer of learning through designing/drawing the cells and their organelles.	2	0	100%	0
Students participated in the evaluation of knowledge: Summative assessments	2	0	100%	0
Formative assessments	2	0	100%	0
Students are paying attention to the lesson.	2	0	100%	0
Students proactively contribute to the class by: Expressing thoughtful ideas or reflective answers.	2	0	100%	0
Ask questions that are related to the lesson.	2	0	100%	0
All students are focused on the learning activity with minimum disruptions.	2	0	100%	0
Students were involved in a collaborative activity, where individual group members were held accountable for being active participants.	2	0	100%	0
Students exhibit interest and enthusiasm.	2	0	100%	0
Students applied knowledge from previous lessons to current lessons.	2	0	100%	0
Students were presented with a media clip (video, audio, internet, newspaper, podcast) and were able to answer questions regarding the information.	2	0	100%	0
Students applied the knowledge they acquired from the video/discussion on the activities.	2	0	100%	0
Students answer questions regarding their output from the activities.	2	0	100%	0
Students show a transfer of learning through designing/drawing the cells and their organelles.	2	0	100%	0
Students participated in the evaluation of knowledge:	2	0	100%	0

Students Behavior	Frequency		Percentage	
	Observe	Not Observe	Observe	Not Observe
Summative assessments				
Formative assessments	2	0	100%	0

Table 8 presents the frequency and percentage distribution of the teachers' observations during pilot testing. All thirteen statements were observed during the pilot testing by the two teacher-observers. This result denotes that the lesson was engaging enough to maintain the student's attention and motivation in class. As Anisa, et. Al., (2020) found that the 7E learning cycle approach is successful in boosting students' motivation. It was also suggested by Mayer & Moreno, 2002) that animations aid in internalized learning and have tremendous possibilities in education and that they provide effective and significant impacts, particularly for challenging learning (Rosen, 2009).

4.4 Final Implementation Result

The academic performance of the students was determined by the pre-test and post-test conducted before and after the intervention. The students' engagement was measured through the students' engagement checklist and teachers' observation checklist. The results were as follows:

Table 9. Achievement Test Results of the Pre and Post-Test Scored during Final Implementation

Variables	Mean	Mean Difference	SD
Pre-test	11.969	4.8438	2.265
Post-test	16.813		5.602

Table 9 revealed the summary of the students' performance in the pre-test and post-test during the final implementation. The mean score of the students in the pre-test was 11.969 while in the post-test was 16.813. Thus, the mean scores of the students during the post-test scores were way higher than in the pre-test. This denotes that the intervention was successful in helping students raise their accomplishment levels in biology (Shaheen & Kayani, 2015).

Table 10. Paired Sample T-test of the Pre and Post-Test Scored during the Final Implementation

Variables	df	t	P - value	Interpretation
Pre-test	31	-5.3596	7.6567E-06	Significant
Post-test				

Paired sample t-test results for the pre-test and post-test scores during final implementation revealed that the p-value is 7.6567E-06 which is lesser than $\alpha = 0.05$ which denotes that there is a significant difference between the pre-test and the post-test during the final implementation, thus rejecting the null hypothesis of the study. This result was in unison with the study by Adesoji and Idika (2015) and Sarif, et al., (2022) which concluded that animation-based 7E learning cycle help students with visualization issues that serve as a foundation for their abstract thought which leads to successfully raising the academic achievement and favorable attitudes of the students.

Table 11. Frequency and Percentage Distribution of the Students' Engagement During Final Implementation

Students' Behavior	Frequency		Percentage	
	Observe	Not Observe	Observe	Not Observe
Students are paying attention to the lesson.	2	0	100%	0
Students proactively contribute to the class by: Expressing thoughtful ideas or reflective answers.	2	0	100%	0
Ask questions that are related to the lesson.	2	0	100%	0
All students are focused on the learning activity with minimum disruptions.	2	0	100%	0
Students were involved in a collaborative activity, where individual group members were held accountable for being active participants.	2	0	100%	0
Students exhibit interest and enthusiasm.	2	0	100%	0
Students applied knowledge from previous lessons to current lesson.	2	0	100%	0
Students were presented with a media clip (video, audio, internet, newspaper, podcast) and were able to answer questions regarding the information.	2	0	100%	0
Students applied the knowledge they acquired from the video/discussion on the activities.	2	0	100%	0
Students answer questions regarding their output from the activities.	2	0	100%	0
Students show a transfer of learning through designing/drawing the cells and their organelles.	2	0	100%	0
Students participated in the evaluation of knowledge: Summative assessments	2	0	100%	0
Formative assessments	2	0	100%	0

Table 11 shows the frequency and percentage distribution of the students' engagement during the final implementation. It has been determined that eight behaviors/experiences out of twelve got 100% of the total respondents' population responded YES. In two of the statements, 97% of the respondents checked YES and only 3% were NO. One statement received 94% of the respondents answered YES and only 6% The statement "I asked questions about the lesson" got the lowest percentage of YES at 88% and 12% responded NO. However, it can be inferred that the majority of the students find the lesson engaging. The study of Fatimah and Anggrisia (2019), identified that the 7E learning cycle motivated students to be more productive and pique their interest at the same time utilization of animations in the classroom ignite students' interest, develop motivation, and meet students' satisfaction (Yakovleva and Goltsova 2016).

Table 12 presents the frequency and percentage distribution of the teachers' observations during the final implementation. All thirteen statements were observed during the final implementation by the two teacher-observers. This result denotes that the lesson was engaging enough to maintain the student's attention and motivation in class. It was shown that students were more actively involved in the process resulting in higher academic performance and interest (Balta, N., & Sarac, H. 2016).

Table 12. Frequency and Percentage Distribution of the Teachers' Observation During Final Implementation

Students Experiences/Behavior	Frequency		Percentage	
	YES	NO	YES	NO
I paid attention to the teacher and/or to my classmates during the class.	32	0	100%	0
I answered questions that the teacher asked during the lesson.	31	1	97%	3%
I express my opinion during the lesson.	30	2	94%	6%
I asked questions about the lesson.	28	4	88%	12%
I actively participated in group activities.	32	0	100%	0
I collaborated with my groupmates during group activities.	32	0	100%	0
I focused on the activities we did in class.	32	0	100%	0
I find the lesson very fun and interesting.	32	0	100%	0
I was able to connect my previous knowledge with the current lesson.	31	1	97%	3%
I learned ideas and concepts that would be useful in the real world.	32	0	100%	0
The animations made me interested in the lesson.	32	0	100%	0
I would like to have a lesson like this again.	32	0	100%	0

5. Conclusion

The result of the needs assessment interview found the need to develop an animation-based 7E lesson in teaching plants and animal cells for Grade 7 learners to address the challenges encountered in the teaching and learning process. This intervention helped provide learners with the visualization and interpretation they need in dealing with complex molecular concepts in Biology.

The developed animation-based 7E lesson was rated excellent at all components by the experts with a mean ranging from 3.64 to 3.83. On the other hand, the developed video animations were rated very satisfactory in all factors by the experts with a mean ranging from 3.85 to 4. This denotes that both the 7E lesson and video animations had a high standard of quality as an instrument of this study. Results from the paired sample t-test showed that there was a significant difference between the pre-test and post-test during the pilot test and final implementation. In addition, 100% of the total number of respondents rated the intervention excellent as the students' engagement and teachers' observation checklist got a rating of 77% and above. In conclusion, the integration of the 7E learning cycle and video animations in teaching plant and animal cells has a positive effect on the academic performances and engagement of the learners and is guaranteed to have features that will enhance the teaching and learning process.

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