STUDENTS' ACADEMIC PERFORMANCE AND MOTIVATION IN PHYSICS USING A MICROLEARNING APPROACH VIA CYBERGOGY LEARNING ENVIRONMENT

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ABSTRACT: *The study investigated the academic performance and motivation in Physics of Grade 9 students in Central Mindanao University Laboratory High School. It sought to: determine the level of academic performance in the pre-test, post-test, and retention test; assess the level of students' motivation when exposed to MCLE in relation to intrinsic motivation and personal relevance, grade motivation, self-efficacy and assessment anxiety, and self-determination; ascertain any significant difference on the level of student's academic performance in terms of pretest and post-test, and pretest and retention test; to find out any significant difference on the student's motivation between pre-survey (before exposure to MCLE) and post-survey (after exposure to MCLE). The study used a sequential explanatory mixed-method research design. Results showed that students' academic performance in pretest is very low, however, as they were exposed to MCLE, post-test and retention test results yielded high. MCLE has potentially increased students' academic performance. Among the motivational factor, students' self-efficacy was improved and their assessment anxiety was reduced as exposed to MCLE. However, motivational factors such as intrinsic motivation and personal relevance, grade motivation, and self-determination weren't improved as exposed to MCLE, but the mean interpretation remained at "highly motivated". In the same way, the overall mean of students' motivation slightly declined after the intervention but was recognized at the level of high motivation. There is a significant difference in the pretest-posttest and pretest-retention test. MCLE significantly increased students' academic performance from pretest to posttest and pretest to retention test. There is a significant difference in the overall motivation before and after the intervention of MCLE. Qualitative results revealed that students find MCLE as a good strategy to provide ease in learning Physics, however, students identified some external factors such as household-related tasks and intermittent internet connection as major distractions in a cybergogy learning environment.*

Keywords: academic performance, cybergogy learning environment, microlearning approach, motivation

1. INTRODUCTION

Science education in the Philippines is envisioned to enable learners to foster scientific inquiry, as well as ideals and attitudes like fairness and curiosity. These abilities are helpful in students' everyday living, personal growth, and potential career [1]. One sub-field of science education is physics education. It deals with the study of physical phenomena which is important in understanding the world. In teaching physics, educators, as well as students, should concentrate on the aspect of conceptual understanding rather than rote learning [2]. Learning the concepts and skills in physics is very important, especially on 21st-century learners [3].

Despite the wonderful vision of science education, in the international assessments, the Philippines came in 58th spot out of 58 nations in the 2019 Trends in International Mathematics and Science Study (TIMSS) [4]. Likewise, PISA (2018) [5], yielded nearly identical results, with the country ranking 78th out of 79 countries.

Moreover, local studies in the Philippines [6], found that the literacy level of students in Science Content Knowledge (SCK) along the concept domain and application domain was at a "very low mastery level". Similarly, [7] it has been identified that scientific literacy is one of the major teaching challenges in physics together with problems in numeracy, physical facilities, and real-life application of concepts. Furthermore, students find difficulty in physics, especially in procedural change and application [8]. The study stressed that the foundation of the basics was not that strong causing to have alienation of knowledge in Physics topics. Likewise, results also revealed [9] that students yielded average difficulty in learning physics, resulting in low performance of students.

Due to the unprecedented crisis brought by COVID-19, most educational institutions were closed for face-to-face classes and resorted to their medium of instruction online [10]. As a result, students were found to be struggling in science amid the pandemic [11] and it had a major influence on the quality of learning and the emotional wellness of the students [12].

In the midst of a pandemic, students are overwhelmed with modules and extensive learning goals [13] leading to learners ignoring their lectures because they think they were exhausted, incorporating other strategies would help a lot in providing students with learning opportunities [14]. Also, one study [15], as cited by another [16] emphasizes that the typical human attention span is shrinking, and microlearning is becoming increasingly essential because it emphasizes short learning time. As mentioned, microlearning is a potential method for this new era of educational growth since it is brief yet packed in content [17].

Engaging learners in the learning process allows students to enhance their concentration and motivation, helping them to fully grasp learning competencies [18]. In addition, it is noted that by employing various techniques that allow students to predict, explain, observe, discuss, and elaborate topics based on learning skills, online learning may achieve the same learning objectives as conventional learning and eliminate misconceptions [19]. Online learning has become a hot subject in educational circles [20]. As they sought to understand more about virtual learning, a new educational paradigm termed "cybergogy" was established [21]. They coined the term "cybergogy" in 2003 as a fusion of andragogy and pedagogy that serves as the paradigm for cyber-spaced or virtual learning. It is, thus, a tool for making online learning more engaging and interactive [21].

Cybergogy is a theory and practice of teaching online; a new setting called "cyber classroom" was then explored [22]. Researchers pointed out that active engagement in the learning process is highly encouraged [23, 8]. To address learners' academic performance concerns, it is suggested that on the integration of learning tools, educators should develop guided activities that are more effective in teaching sciences [24]. This would enable active participation and engages student, improving their conceptual understanding and problem-solving skills. Cybergogy, together with its underlying strategies, would be able to provide students with a hands-on learning experience even though distant.

Exploring motivation in the online environment, researchers concluded that there is a need to explore more factors, methods, and strategies in order for motivation to be meaningful [25]. Moreover, academic performance is affected by a variety of strategies applied in the teaching and learning process, thus, it is a need for teachers to innovate strategies to deliver the topic appropriately [26]. The microlearning approach under cybergogy learning environment (MCLE) seeks to address the pertaining challenges that the students experienced in their motivation in more facets namely; intrinsic motivation and personal relevance, grade motivation, self-efficacy and assessment anxiety, and self-determination. Also, this study sought to provide an effective strategy that would enhance students' academic performance in physics. It is in this context that the study was conducted.

2. MATERIALS AND METHODS

The study assessed the academic performance and motivation in Physics using Microlearning Approach via Cybergogy Learning Environment at Central Mindanao University Junior High School for SY 2021-2022. A sequential explanatory mixed-method research design was employed in the study. For a quantitative collection of data, a one-shot pretest-posttest quasi-experimental design was used. A group was randomly selected to be the participants of the study using random sampling (toss a coin), then a pretest was conducted on performance and motivation. After the pretest, the students were exposed to a microlearning approach via cybergogy learning environment (MCLE), and the posttest was administered after the intervention. Fourteen (14) days after, the retention test was then administered. Then, an analysis of the quantitative data was made. After the analysis, participants for the qualitative data collection were identified based on their scores in the pretest and posttest in both performance and motivation. The interview was conducted and qualitative data gathered were used to explain further the quantitative findings of the study.

There were two (2) instruments used to gather the data, namely, the physics motivation questionnaire [27] and the test questionnaire. As the preliminary steps have been completed and proper protocols had been followed, determination of students' level of academic performance and motivation in physics of Grade 9 students using MCLE followed. The study implementation was divided into 5 phases and these were the following: In Phase 1, the pre-survey of Physics Motivation Questionnaire (PMQ) and Pretest via Google Forms was conducted. Phase 2 was the integration of the microlearning materials: digital micro modules, microcontent, and short videos via QR Code. In making the microlearning materials, the book entitled Designing Microlearning was used as a guide [28]. Digital Micro Modules: A total of 6 digital micro modules were made, and short videos (3-5 minutes) adopted from YouTube were embedded in the digital micro modules via QR-Code. Each video contained 1 problem question which the students answered to maximize engagement. The schedule for posting this one was every Monday and the researcher posted the said material a week before the scheduled short interactive discussion. The researcher divided the topic in motion into 2-D and the work, energy, and power, that is why there were six (6) digital micro modules and also 6 occurrences of other intervention materials.

Digital Micro Contents: The micro-contents which were composed of two (2) questions and trivia (2 sentences only) related to the topic were posted in the google classroom a week before the scheduled short interactive discussion. In this platform, students shared their ideas and they can collaboratively converse with their answers. This could be answered anytime, anywhere, a deadline was set, every Friday of the week, to answer the said materials on a given time frame.

Short Interactive Discussion: The teachers' task was to elaborate on the topic, game-based Q&A was administered via Bamboozle, Phet, the Physics Classroom, Interactive Online Canva, and Powerpoint. This lasted only for about 20 minutes per session. But due to the waiting time for the students to enter, delay in response to each question, and an intermittent internet connection, it caused an additional minute to the time limit. MCLE lasted for about 6 weeks, microlearning materials were posted in the google classroom and a short interactive discussion per week. For Phase 3, after exposure to MCLE, a post-survey for motivation was administered while the post-test was implemented on the schedule provided by CMULHS and in Phase 4, two (2) weeks after the post-test, the researcher administered the final test which was the retention test.

Finally in Phase 5, after all the tests, students were interviewed to gather qualitative support based on the results of their academic performance and motivation. They were selected in accordance with the results of their Physics Motivation Questionnaire (PMQ) survey and tests. The researchers selected 6 participants based on the mean difference (MD) in their test scores and motivation; one (1) highest MD, one (1) zero MD or close to zero, and one (1) lowest negative MD.

The following rating scale was used to better understand the data:

Rating	Scale	Descriptive Rating	Qualitative Interpretation
5	4.20-5.00	Always	Very Highly Motivated (VHM)
4	3.40-4.19	Usually	Highly Motivated (HM)
3	2.60-3.39	Sometimes	Motivated (M)
2	1.80-2.59	Rarely	Low Motivation (LM)
1	1.0-1.79	Never	Very Low Motivation (VLM)

Raw Score	Percent Equivalent	Qualitative Description	Qualitative Interpretation
60-80	90-100	Very High Performance	Exemplary
52-59	86-89	High Performance	Above Average
45-51	80-85	Moderate Performance	Average
40-44	75-79	Low Performance	Below Average
0-39	65-74	Very Low Performance	Deficient

3. RESULTS AND DISCUSSIONS

The data obtained from the study were analyzed, interpreted, and presented in this chapter. Tables and other figures were used to provide a straightforward data analysis. The presentation was in the order of the objectives of the study.

3.1 Academic Performance of Students in Physics Before and After MCLE.

Table 1 displays the summary of the academic performance of the students in their pretest. The table includes the frequency and percentage in different levels of academic performance based on the Revised Transmutation Table of CMULHS.

Table 1. Students' Academic Performance in Physics in the Pretest

Percent Equivalent	MCLE		
	f	%	Qualitative Interpretation
90-100	0	0%	Very High Performance
86-89	5	9.62%	High Performance
80-85	9	17.30%	Moderate Performance
75-79	12	23.08%	Low Performance
65-74	26	50%	Very Low Performance
	52	100%	
MEAN SCORE/MPS	39.21		74% (Very Low Performance)

There are 26 or 50% of the students who obtained scores ranging from 0-to 39 and were interpreted as having very low performance in the pretest. There were twelve (12) or 23.08% who gained scores ranging from 40-44 interpreted as low performance, nine (9) or 17.30% obtained scores ranging from 45-51 equivalent to moderate performance, and lastly, 5 or 9.62% of the students garnered scores ranging from 52-59 interpreted as high academic performance. The mean score in the pretest was 39.21 or 74% MPS equivalent to very low performance. These data indicate that half of the participants already had prior knowledge of the concepts prior to the intervention, while half did not have any background information on the topics.

Students did not have a comprehension of all the topics, they remembered topics from elementary days which were different in terms of the competency and level of difficulty. Also, topics identified by the student was the most basic topic in physics such as the conversion of temperatures and Ohm's Law. Here are some of the students' responses being translated from Cebuano to English.

"Daghan nakog natun an before pa sa atoang lessons since and uban lessons kay na introduce na sa elementary, mao ni cla ang mga work, momentum, heat, tas katong geothermal" (I learned a lot before the start of our lessons since other topics were introduced in elementary. These are Work, Momentum, Heat, and Geothermal.)

-Participant 1

"I know topics regarding conversion of Fahrenheit to Celsius and vice versa as well as Ohms' Law. I remember them because it has been discussed in Grade 7"

-Participant 2

The student's prior knowledge of Science and the environment in which they were exposed can be ascribed to the results of their pretest. Another fact to this is that learning competencies in Physics have not been introduced to the students. A similar result was obtained in a study [29] which indicated that students scored low in their pretest. This finding adheres to the results wherein 24 out of 35 or approximately 69% of the students had a score which was interpreted as "beginning" and "far but likely", or equivalent to a "very low score" and "low score", respectively, in the qualitative interpretation of students' pretest scores in this study [30].

On the other hand, the findings of the study are contrary to a study in which the pretest score was not poor [17]. Accordingly, it is assumed that it was attributed to facts given to students which were based on their everyday lives or nowadays called contextualized facts. Although several from the group reached moderate and high levels, the result generally showed a lack of prior knowledge for all the students.

Table 2 presents the distribution of the level of students' academic performance in physics in their post-test. The table comprises the frequency and percentage in different academic performance levels based on the Revised Transmutation Table of CMULHS. It also shows the improvement in their post-test scores as reflected by the mean scores and means percentage scores.

Table 2. Students' Academic Performance in Physics when Exposed to MCLE in the Posttest

Percent Equivalent	MCLE		
	f	%	Qualitative Interpretation
90-100	11	21.15%	Very High Performance
86-89	21	40.39%	High Performance
80-85	17	32.69%	Moderate Performance
75-79	3	5.77%	Low Performance
65-74	0	0%	Very Low Performance
	52	100%	
MEAN SCORE/MPS	53.98		87% (High Performance)

As gleaned in Table 2, eleven (11) or 21.15% of the students who obtained scores ranging from 60to 80 belong to very high performance. Three (3) students obtained scores ranging from 40-44 interpreted as low performance. The trends showed us that 62% or 32 students received very high and high levels of proficiency in Physics when exposed to MCLE. The students' mean score is 53.98 or approximately 54. This implies that on average, students' academic performance mean percentage score (MPS) when exposed to MCLE is 87%, which is a high performance. As denoted by the data in Table 5, students obtained passing scores in their pretests after their exposure to MCLE. This suggests that MCLE has the potential to increase students' academic performance.

The results also implicate that students still remember the topics from Physics, especially on the topics of momentum, projectile motion, temperature conversion, and Ohms' Law as discussed by their teacher using MCLE. The participants signify that they had learned more and remembered more from the topics after exposure to MCLE as follows:

"Daghan kog natun an after sa atoang classes since gi thorough man ug discuss and new para for me (the strategy and topics). Tas dle ra calculations ug conversions akong natun an and naremember. Naa pai mga certain meaning and

laws nga importante for the lessons. Like the Law of momentum, katung amperes, volts, etc. nga nakapatabang sa akoa. (I have learned a lot after our class since it was taught thoroughly and the strategy and topics are new to me and it is not only the calculations and conversions that I can still remember, there are also certain meanings and laws that are important for the lessons. For example, the laws of momentum, amperes, volts, etc., really helped me.)

-Participant 1

"I remember the topics I mentioned in no. 1 (temperature conversion and Ohms Law) and I remember a little bit of projectile motion and momentum. Regarding projectile and momentum, I think it's because I understood it quite better"

-Participant 2

The results showed a similar outcome from the studies [31, 32] as cited [29]where students exposed to interventions related to ICTs had a relatively high increase in their post-test scores in Science. Similar results were found from the study [29] that students' post-test scores in science increased when exposed to intervention strategies under one shot pretest-posttest research design. Parallel results could be seen from the study [33] indicating an increase in post-test when exposed to microlearning via an online environment [34]; Filipino students' post-test increased significantly with high confidence levels via self-made microlearning materials (micro-lectures) posted on Youtube; showed that students exposed to Play Game-Based Physics Program have a high score in the posttest [35]. It also showed that students' scores on tests improved after using the microlearning approach on the topics of Newtonian Mechanics [36]. Moreover, the e-module-based and 7E learning cycle was a good learning material for enhancing students' performance as other researchers found [37].

On the other hand, used self-paced e-learning tutorials and they cited that students got poor marks in their academic performances [38]. In doing so, they recommend one-on-one tutorials where they found students gained satisfactory scores as opposed to the results and claims discussed [38].

Table 3 presents the distribution of the level of students 'academic performance in Physics in their retention test. The table shows the frequency and percentage in different levels of academic performance based on the Revised Transmutation Table of CMULHS. Fourteen (14) days after the post-test, the retention test was administered, and it showed a notable improvement in their individual scores, mean score, and mean percentage score.

Table 3. Students' Academic Performance in Physics when Exposed to MCLE in the Retention Test

Percent Equivalent	MCLE		
	f	%	Qualitative Interpretation
90-100	14	26.92%	Very High Performance
86-89	23	44.23%	High Performance
80-85	10	19.23%	Moderate Performance
75-79	5	9.62%	Low Performance
65-74	0	0%	Very Low Performance
	52	100%	
MEAN SCORE/MPS	54.81	87%	(High Performance)

As shown in Table 3, fourteen (14) or 26.92% of students gained scores ranging from 60-80 or very high performance. There were 23 or 44.23% of the students who acquired scores ranging from 52-59 or high performance. On the other hand, ten (10) or 19.23% got scores ranging from 45-51 or moderate performance. Lastly, five (5) or 9.62% of the students got scores ranging from 40-44 interpreted as low performance. In general, students obtained a mean score of 54.81 or approximately 55 which is an 87% mean percentage score (MPS) which is a high performance. This result implies that students' academic performance in the retention test slightly increased but remained at a high-performance level. It also means that students still can recall the concepts of the coverage in Physics 9 when exposed to Microlearning Approach via Cybergogy Learning Environment even after 2 weeks.

From the interview, students remembered most of the topics discussed. It can be recognized that they still recall topics discussed during the class. The students' responses indicate that they learn more and recall information from the topics being discussed after the intervention. (Kindly refer to the student's response in the discussion part of Table 2, page 32.)

The result is supported by a study where a researcher found that students' retention test mean scores increased when students were exposed to an engaging and positive environment [39]; students in their retention test obtained high performance as exposed to the flipped classroom [40], and students gained higher results in retention test as exposed to online teaching material integrated method [41]. Also, it is comparable with a study that almost 90% was student retention when exposed to participatory teaching methods [42]. Similar results [43, 44] indicated that the aspect of online blended learning enhanced students' physics performance and retention. The findings of this study on the retention of students greatly support the claim that microlearning encompassing content, pedagogy, and technology's utilization guarantees students' retention [45].

On the other hand, it was found that students who were exposed to the Gradual Release of Responsibility Instructional Model scored low in their retention test as compared to the traditional learning method [46], thus, it is contrary to the findings of this study.

Table 4 shows the comparison of the pre-test, post-test, and retention test means. The table comprises the mean scores with its corresponding qualitative interpretation.

It can be recognized that as the time progressed on the implementation of MCLE, the student's academic performance in Physics improved. There were eleven (11) students who were able to obtain exemplary or very high academic performance in Physics in their post-test knowing that no single student obtained the same result in the pretest. On the other hand, the number of students from post-test with exemplary academic performance increased from eleven (11) to fourteen (14). Notably, the rising frequency was also shown on the above-average level or high performance, from five (5) students in pretest, it increased to 21 students in post-test and 23 students in the retention test.

Table 4. Summary of Students' Academic Performance in Physics in the Pretest, Posttest and Retention Test

ACADEMIC PERFORMANCE IN PHYSICS (INTERPRETATION)	MCLE		
	Pretest	Post-Test	Retention Test
Exemplary *(Very High Performance)*	0	11	14
Above Average *(High Performance)*	5	21	23
Average *(Moderate Performance)*	9	17	10
Below Average (*Low Performance)*	12	3	5
Deficient (*Very Low Performance)*	26	0	0
WEIGHTED MEAN	39.21	53.98	54.81

Legend:

Raw Score	Percent Equivalent	Interpretation
60-80	90%-100%	Very High Performance
52-59	86%-89%	High Performance
45-51	80%-85%	Moderate Performance
40-44	75%-79%	Low Performance
0-39	65%-74%	Very Low Performance

On the below-average level or low performance, there was a decrease in frequency from pretest to post-test but there was an addition of two (2) students from post-test to retention test on the said level. For the deficient level or very low performance, there was no increase in frequency as the time progressed. Both post-test and retention tests obtained no single student belonging to a deficient level. The mean score showed promising results as it increased from pretest to retention test. A remarkable difference also in the mean average scores was obtained. It means that students' academic performance in Physics can be improved by utilizing MCLE.

Students' responses from the interview showed positive remarks on the use MCLEs' microlearning materials. Students described the materials as very helpful, easy to read, and understandable. Also, students retain information more after the intervention.

"Daghan kog natun an after sa atoang classes since gi thorough man ug discuss and new para for me (the strategy and topics). Tas dle ra calculations ug conversions akong natun an(naremember) Naa pai mga certain meaning and laws nga importante for the lessons (future). Like the Law of momentum, katung amperes, volts, etc. nga nakapatabang sa akoa. (. (I have learned a lot after our class since it was taught thoroughly and the strategy and topics are new to me and it is not only the calculations and conversions that I can still remember, there are also certain meanings and laws that are important for the lessons. For example, the laws of momentum, amperes, volts, etc., really helps me.)

-Participant 1

"Ako rang maingon sir kay helpful jud kayo sya sa learning nga naexperience nako sa imong klase sir, daghan kag matun-an , kay if naa kay wala masabtan sa micromodules kay mutan aw raka sa videos nya makasabot na dayun ka. Mas taas gyud ang sa grade 8 namo compared karon. (All I can say sir is that it is very helpful for my learning experience, you will really learn a lot because if there are topics that I don't understand on the module, I can watch the videos and you can now cope in understanding the topic. In our grade 8, it's too lengthy.)

-Participant 6

"Helpful sya, very helpful (microlearning materials) sya since dle kayo sya taas, kanang…. Malahi sya sa other namo nga subject, dali ra namo mabasa and understandable ra pod. Tas sa discussion, okay rapod kay maghatag man kag example ddto, so matan aw ra namo ddto sa video ug mag kuan sa meet. Actually sa time sa meet igo ra sya sir. Dle ra kayo taas, dle rapod kayo mubo.("It was very helpful because it is not too long (microlearning materials), its different from our other subject because in science we can read quickly (the module) and it is understandable. And for the discussion, it's good because you give examples related to the video and on the google meet (short interactive discussion). Actually, sir, I can say that our short interactive is not too long, also not too short.

-Participant 5

It is pointed out that academic performance is directly associated with teaching methods [47]. Supporting studies showed identical results [33]; 18% increase in learning was observed using microlearning in an online environment [41]; students exposed to online advanced organizer concept teaching material improved students performance from pretest to retention test [44]; meta-analyzed literature in microlearning in an online platform and ICT integration, the review showed studies that exposure to the said approach increased students' performance and retention.

With the supporting studies, it can be recognized that there is a remarkable positive effect of MCLE on students' academic performance in Physics. It improved the students' academic performance which can be useful for ease of learning in Physics in flexible learning.

3.2 Students' Motivation in Physics Before and After Exposure to MCLE

Table 5 presents the students' level of motivation in Physics under intrinsic motivation and personal relevance. It can be gleaned that the mean score before intervention was 4.01 and after the intervention was 3.91 interpreted both as highly motivated.

Table 5. Comparison of the Level of Motivation in Physics Before and After Intervention under Intrinsic Motivation and Personal Relevance.

Indicators	MCLE			
	Before		After	
	Mean	QI	Mean	QI
I like physics that challenges me	3.40	HM	3.31	M
The physics I learn relates to my personal goals	3.50	HM	3.35	M
I enjoy learning physics	3.77	HM	3.87	HM
The physics I learn is more important to me than the grade I receive	3.77	HM	3.71	HM
I find learning physics interesting	3.98	HM	4.0	HM
The physics I learn has practical value for me	4.04	HM	3.98	HM
I think about how I will use the physics I learn	4.17	HM	4.07	HM
The physics I learn is relevant to my life	4.23	VH M	3.94	HM
I think about how the physics I learn will be helpful to me	4.44	VH M	4.19	HM
Understanding the physics gives me a sense of accomplishment	4.79	VH M	4.63	VH M
OVERALL MEAN	**4.01**	**HM**	**3.91**	**HM**

Legend:

Rating	Scale	Descriptive Rating	Qualitative Interpretation
5	4.20-5.00	Always	Very Highly Motivated (VHM)
4	3.40-4.19	Usually	Highly Motivated (HM)
3	2.60-3.39	Sometimes	Motivated (M)
2	1.80-2.59	Rarely	Low Motivation (LM)
1	1.00-1.79	Never	Very Low Motivation (VLM)

Data display that the following indicators increased their mean and disclosed a highly motivated (HM) interpretation when exposed to MCLE: “I find learning physics interesting.”, (3.98) to (4.0); "I enjoy learning Physics.", (3.77) to (3.87). On the other hand, the following indicators decreased in their mean and showed a declined motivational interpretation from highly motivated (HM) to motivated (M) when exposed to MCLE: “The Physics I learn relates to my personal goals.” (3.50) to (3.35); “I like physics that challenges me.” (3.31). Despite the decrease in most of the indicators, the overall results showed that exposure to MCLE retain students’ intrinsic motivation and personal relevance at highly motivated level.

Students find MCLE as an interesting strategy because of the game embedded and questions raised during the short interactive discussions. Thus, the quantitative data on the increase of mean data can be supported by the claim of students’ responses during the interview.

As stated below, students said that Physics has an impact or relevance in their lives, and they believed that Physics has an important role in everyday living. They find MCLE interactive, interesting, and motivating. However, this statement somewhat denies the quantitative results.

“Interactive sya kay gaapil kag question sa asynchronous” (It was interactive because you ask questions during asynchronous learning)

-Participant 1

Para sa ako sir, interesting kayu sya kay pagkahuman nimog explain sa topic kay kung naana sa game kay murag , haha,.. mapressure btaw mi, na kasabot na dayun mi, unya kung naa kay mali ahh,.. mao diay na answer ako gyud nang ikuan sa akong utok para macorrect nako sya next time.(For me sir, it was very interesting because after you explained the topic and if we’re on the game, we feel pressure, after that, we can understand and as the correct answer revealed it was the time if I had a mistake I will see to it that I will correct that one next time.)

-Participant 5

“Before boringan jud ko, if over 5, akong motivation naa jud sa 2, after the class naa sa 4. Sa mga discussions nmo sir murag marelate sya nako sa life kuan.. simple nga calculations kay naa man diay impact sir, naa koy nakita nga salida sir, nay asteroid nga mo hit sa Earth nya ilaha gyud gigamit ang physics, hala! Magamit man diay gyapon sya, dha ko namotivate.(At first, I feel bored, I can say I was 2 over 5 in my motivation but after the class, I can say it is in 4. In the discussions, I realized that we can relate it to life, simple calculations have an impact, sir, in one of the movies I watched, they use physics on the approaching asteroid. I realized that it can be used and I was motivated by that.

-Participant 5

The research finding coincides with the results of a study that students are motivated after the intervention of comic-based learning in Physics [48]. Likewise, the study corresponds to the findings that high school students' intrinsic motivation was high via conversation technology with micro-learning [49]. Students' personal relevance is interpreted at high motivation level in this study. This conforms to the result of a study that students exposed to an online environment were motivated by the aspect of personal relevance to the course [50]. Moreover, it corroborates the findings that learning using a Game-based Student Response System under Kahoot! platform lead students to be interested and enjoyed the learning process [51].

Table 6 presents the level of student motivation in physics before and after exposure to MCLE. Results exposed that the overall mean decreased after the intervention but it remained at the highly motivated level.

Table 6. Comparison of the Level of Motivation in Physics Before and After Intervention under Grade Motivation

Indicators	MCLE			
	Before		After	
	Mean	QI	Mean	QI
I expect to do as well as or better than other students in the physics course	3.40	HM	3.50	HM
I like to do better than the other students on the physics tests	3.90	HM	3.69	HM
It is my fault if I do not understand the physics	4.25	VHM	3.98	HM
Earning a good physics grade is important to me	4.63	VHM	4.52	VHM
I think about how my physics grade will affect my overall grade point average.	4.65	VHM	4.63	VHM
WEIGHTED MEAN	**4.17**	**HM**	**4.07**	**HM**

Legend:

Rating	Scale	Descriptive Rating	Qualitative Interpretation
5	4.20-5.00	Always	Very Highly Motivated (VHM)
4	3.40-4.19	Usually	Highly Motivated (HM)
3	2.60-3.39	Sometimes	Motivated (M)
2	1.80-2.59	Rarely	Low Motivation (LM)
1	1.0-1.79	Never	Very Low Motivation (VLM)

As presented in table 6, one (1) indicator disclosed an increase in mean when exposed to MCLE but remained at a highly motivated level (HM): "I expect to do as well as or better than other students in the physics course." (3.40) to (3.50). Conversely, the following indicators obtained a slight decrease in their means after exposure to MCLE: "I like to do better than the other students on the physics tests." (3.90) to (3.69); "It is my fault if I do not understand the physics." (4.25) to (3.98); "Earning a good physics grade is important to me." (4.63) to (4.52); "I think about how my physics grade will affect my overall grade point average." (4.65) to (4.63).

The result emphasized that one indicator increased slightly in mean and the rest of the indicators slightly decreased in their means. However, with the varying least mean difference on the increase and decrease of mean scores, interestingly the interpretation posted an overall high motivation in their grade motivation in Physics when exposed to MCLE.

Similar results were seen [29] wherein the students' grade motivation level is high using a hybrid instructional strategy. Similar results on students’ grade motivation using comic-based learning modules in Physics were also promising [48].

The decrease in the mean score can be attributed to the changes in grade policy such as leniency that caused grades

to lose their meaning because of COVID-19 [52]. Also, the learning environment at home greatly influences motivation [53, 54]. The study[53] matched the participants' statements that due to home chores, they sometimes neglect or forget school tasks. Participants also shared that they wanted the physical presence of their teachers. Here is the excerpt on the conduct of the interview:

"Low ako motivation sir kay daghan kayu trabahuun sa balay…. Makalimot mi usahay nga naa diay mi buhatonon, unya walay pahulay btaw sir." I have a low motivation sir because of the household chores, sometimes we forgot to do the school related tasks. I also have no time for enough rest.

-Participant 6

"It's very hard for me to learn in a none face-to-face. I think it is best for me to listen to our teacher in person."

-Participant 2

Table 7 displays the results of the motivation means gathered before and after intervention under self-efficacy and assessment anxiety. Gathered data revealed that their overall self-efficacy and assessment anxiety obtained a highly motivated QI.

Table 7. Comparison of the Level of Motivation in Physics Before and After Intervention under Self-efficacy and Assessment Anxiety

Indicators	MCLE			
	Before		After	
	Mean	QI	Mean	QI
I worry about failing the physics tests ®	1.31	VLM	1.10	VLM
I become anxious when it is time to take a physics test ®	1.56	VLM	1.70	VLM
I am nervous about how I will do on the physics tests®	1.60	VLM	1.60	VLM
I am confident I will do well on the physics tests	2.32	M	2.80	M
I am concerned that the other students are better in physics ®	3.00	M	3.00	M
I believe I can earn a grade of ''A'' in the physics course	3.73	HM	3.81	HM
I am confident I will do well in the physics labs and projects	3.85	HM	3.77	HM
I hate taking the physics tests ®	3.90	HM	3.87	HM
I believe I can master the knowledge and skills in the physics course	3.92	HM	3.92	HM
WEIGHTED MEAN	**2.80**	**M**	**2.86**	**M**

Legend:
Items with ® mean scoring are reversed.

Rating	Scale	Descriptive Rating	Qualitative Interpretation
5	4.20-5.00	Always	Very Highly Motivated (VHM)
4	3.40-4.19	Usually	Highly Motivated (HM)
3	2.60-3.39	Sometimes	Motivated (M)
2	1.80-2.59	Rarely	Low Motivation (LM)
1	1.0-1.79	Never	Very Low Motivation (VLM)

As presented in Table 7, the following indicators had increased in the mean when exposed to MCLE but the qualitative interpretation remained the same: "I become anxious when it is time to take a physics test (r)." (1.56) "very low motivation" to (1.70) "very low motivation"; "I am confident I will do well on the physics tests." (2.32) "motivated" to (2.80) "motivated"; "I believe I can earn a grade of ''A'' in the physics course." (3.73) "highly motivated" to (3.81) "highly motivated". Conversely, the mean of the following indicators decreased when exposed to MCLE but the qualitative interpretation is still the same: "I worry about failing the physics test." (1.31) "very low motivation" to (1.10) "very low motivation"; I am confident that I will do well in physics labs and projects." (3.85) "highly motivated" to (3.77) "highly motivated"; "I hate taking the Physics test." (3.90) "highly motivated". The table suggests that the overall mean increased from 2.80 to 2.86 which means students remained motivated before and after the intervention. But, it can be recognized that MCLE is a good strategy to possibly lessen the assessment anxiety and increase students' self-efficacy. From the response of Participant 6 during the interview, it indicates that the chores at home combined with school tasks affect themselves in demonstrating the tasks given and this may pose support to the result of some indicators that students' confidence in physics slightly decreased and also an indicator that students become more worried on failing the test when exposed to MCLE. It can be recognized that students at home experience difficulty to complete the tasks and they forget sometimes that they have schoolwork to do due to overloaded tasks at home. *(Kindly refer to the statement of Participant 6 during the interview found in the discussion in Table 6).*

The results were corroborative to the following studies that there was an increase in self-efficacy as exposed to the varying intervention in science: generative learning environment via advanced graphic organizer [55]; blended learning in science [29]and the use of QR Code or quick response code augmented reality environment (QRCARE) [56]. Accordingly, exposing students to microlearning platforms and materials has increased students learning confidence and efficacy [30]. Students who took microteaching virtually had increased self-efficacy [57]. And students' self-efficacy increased through gamification pedagogy via online network services [58]. Consistent support for the claim that through gamification virtually and computer-aided instruction, students' self-efficacy was enhanced [59, 60]. Previous research has shown that motivation is linked to persistence, retention, performance, and course satisfaction [61]. And, motivation is strongly connected to task beliefs and positive self-efficacy, which will help students acquire independence in a self-learning setting [62]. Conclusively, the findings from the study support that providing students with game-based short interactive discussions, micro-videos, and non-extensive learning materials greatly improves students' self-efficacy toward physics.

The very low motivation on the following indicators: "I am nervous about how I will do on the physics tests(r)." (1.60); "I worry about failing the physics tests (r)." (1.10); "I become anxious when it is time to take a physics test (r)." (1.70)". Researchers pointed out that given the fact that students were in the time of the pandemic, they displayed anxiety and also showed less positive perception towards online learning [63]. Since the school where the study was conducted has a

retention policy, this poses an effect to test anxiety similar to the results where rules on scholastic standing and administration of punishment such as expulsion and suspension had a significant effect to test anxiety [64]. However, we can see a positive result that students' anxiety was decreased when taking physics test, this was in parallel to the result obtained wherein students' anxiety level towards Physics decreased as exposed to ICT software "Clicker" and also assessment platforms or app [65].

Table 8 shows the comparison between the level of motivation under self-determination. It is recognized that there was a decrease in self-determination mean rating, however, the mean rating after the intervention still retains students' high motivation in physics.

Table 8. Comparison of the Level of Motivation in Physics Before and After the Intervention in terms of Self-Determination

Indicators	MCLE			
	Before		After	
	Mean	QI	Mean	QI
I use strategies that ensure I learn the physics well	4.31	VHM	4.17	HM
If I am having trouble learning the physics, I try to figure out why.	4.38	VHM	4.23	VHM
I prepare well for the physics tests and labs	4.42	VHM	4.21	VHM
I think about how learning physics can help my career	4.42	VHM	3.96	HM
I put enough effort into learning physics	4.44	VHM	4.25	VHM
WEIGHTED MEAN	**4.40**	**VHM**	**4.16**	**HM**

Legend:

Rating	Scale	Descriptive Rating	Qualitative Interpretation
5	4.20-5.00	Always	Very Highly Motivated (VHM)
4	3.40-4.19	Usually	Highly Motivated (HM)
3	2.60-3.39	Sometimes	Motivated (M)
2	1.80-2.59	Rarely	Low Motivation (LM)
1	1.0-1.79	Never	Very Low Motivation (VLM)

As gleaned from Table 8, the mean of the following indicators slightly decreased but remained at a very highly motivated level: "I put enough effort into learning physics." (4.44) to (4.25); "I prepare well for the physics tests and labs." (4.42) to (4.21); If I am having trouble learning physics, I try to figure out why." (4.38) to (4.23). Conversely, the mean of the following indicators decreased, and also the qualitative interpretation changed from very high motivation to high motivation; "I use strategies that ensure I learn physics well." (4.31) to (4.17); "I think about how learning the physics can help my career." (4.44) to (3.96). The table also showed that all the indicators' mean and the level of motivation decreased from very highly motivated (VHM) to highly motivated (HM). These imply that students put effort into learning Physics, preparing for their Physics class, and trying to figure out why they have trouble learning the concepts in Physics.

Moreover, students find strategies and create coping mechanisms as they learn in Physics under MCLE such as referring to the most essential microlearning material, they themselves had a hard time with one material (refer to the statement of the students below). Also, as mentioned by the participants, they struggled to complete the tasks because of home chores *(Refer to the discussion in Table 6 on the excerpt of an interview from participant 6, page 44)* and also an intermittent internet connection.

"Helpful sya, very helpful sya since dle kayo sya taas, kanang…. Malahi sya sa other namo nga subject, dali ra namo mabasa and understandable ra pod. Tas sa discussion, okay rapod kay maghatag man kag example ddto, so matan aw ra namo ddto sa video ug mag kuan sa meet. Actually sa time sa meet igo ra sya sir. Dle ra kayo taas, dle rapod kayo mubo.("It was very helpful because it is not too long, it's different from our other subject because in science we can read quickly (the module) and it is understandable. And for the discussion, it's good because you give examples related to the video and on the google meet (short interactive discussion). Actually, sir, I can say that our short interactive is not too long, also not too short.)

-Participant 5

"Kuan.., magdiscuss man ka sir kay maglibog mi usahay kay magduha duha mi if gapangutana baka ug question or gaestorya lang hehe. Soo haha.wala mi kabalo kung sa imo or sa amo ang nay problema sa connection...maong dle nalang mi magtubag. hehe" (Sometimes during discussion we're confused if you're asking or not, there's a problem with the internet connection that's why we are not answering.)

-Participant 5

As stated by Participant 5, during the discussion of the teacher, he/she is doubtful whether the teacher was asking questions or discussing due to low internet connectivity, hence, he/she just did not respond to the teacher. This is one of the factors that may affect the results of this investigation, especially students' motivation. Internet connectivity may pose a threat to students' interest to learn any subject not only Physics. This is also supported by Participant 6, as he/she explained below:

"Dle kayo ko makasulod sa meeting early because dugay ko makamata and tungod pod sa internet..hinay." (I can't join in the class early because I wake up late and also because of the slow internet)

-Participant 6

However, despite the technological challenge, Participant 5 claimed that MCLE has helped him/her in learning as she/he had experienced with the teacher. He/she claimed to learn a lot and understand easily the topics in the micromodules while watching the videos. These interview transcripts reveal that MCLE indeed helps the student understand the topics in Physics easily, hence, motivated to learn more.

"Ako rang maingon sir kay helpful jud kayo sya sa learning nga naexperience nako sa imong klase sir, daghan kag matun-an , kay if naa kay wala masabtan sa micromodules kay mutan aw raka sa videos nya makasabot na dayun ka. Mas taas gyud ang sa grade 8 namo compared karon.(All I can say sir is that it is very helpful for my learning

experience, you will really learn a lot because if there are topics that I don't understand on the module, I can watch the videos and you can now cope in understanding the topic. In our grade 8, it's too lengthy.)

-Participant 5

Moreover, the quantitative results imply that students' self-determination retained to be high despite the decrease in the mean score. In support of this claim, the findings have similar results to the study [66] wherein students respond positively to autonomy, relatedness, and competence (an indicator of self-determination). The study also showed that the means were high on the indicators of self-determination when participants were exposed to Mobile-based Microlearning on the topics of electricity and magnetism.

Students' self-determination was enhanced using blended learning [29]. Self-determination in the post-survey has a higher mean score compared to the pre-survey. These findings were contrary to the results presented in Table 8 that after the intervention the mean decreased slightly. However, students were still highly motivated when exposed to MCLE.

3.3 Paired t-test of Students' Academic Performance in Physics

Table 9 reveals the paired t-test difference in the students' academic performance in their pretest and posttest scores. This matrix is the comparison of their scores before and after exposure to MCLE.

Table 9. Comparison of Students' Academic Performance between Pretest and Posttest.

GROUP		N	MEAN	SD
Performance	Pretest	52	39.21	8.365
	Post-test	52	53.98	5.627

Pair 1	Mean	Std. Deviation	t-value	Sig.
Pretest-Post-test	14.769	7.813	13.631	.000**

*Note:** - highly significant at 0.01 level*

As displayed in Table 9, the group pretest means the score was 39.21 with a standard deviation of 8.365 while the post-test mean score was 53.98 with a standard deviation of 5.627. This indicates that students had increased mean scores after the intervention and their scores were already closer to the mean compared to the pretest score as indicated by the decreasing standard deviation.

The same table shows that the t-value of the analysis was 13.631 with a probability value of 0.000 ($p<.01$), this means that there is a significant difference between pretest and post-test scores. Hence, the null hypothesis that there is no significant difference between the academic performance in the pretest and post-test students was rejected. This data implies that the increase of means is statistically significant, students had better performance in their posttest than in the pretest. It also suggests that MCLE has contributed to this significant increase.

Students were able to familiarize the content even after class. This indicates that students had a favorable description of the different microlearning materials which can contribute to students' high post-test scores. Students shared insights about how they improved in terms of understanding the concepts. As shown in the interview responses below:

"I learned about sa heat, about sa everything, na familiarize naman nakong uban topic nya sa heat ko naglisod tas nibetter akong understanding sa heat nya ni clear akong pagsabot." (About the heat, about everything hehe, I was able to familiarize heat I was having a hard time on the topics of heat but I cope and I improved my understanding of heat, it was clear now.)

-Participant 5

In support of this claim, it was revealed that students improved their performance in physical science as they were exposed to gamification [67], and teaching techniques have a direct impact on the academic success [47]. He added that a significant difference existed when students were exposed to specific methods. Also, it was claimed that academic success was influenced by how students impose themselves while dealing with technology [68]. Academic achievement in an online setting is mostly driven by self-regulated and students have the most responsibility and capability in improving their performance [69-70].

The promising results can be attributed to active learning since MCLE promotes interactive class discussion based on the literature [71], which confirms that active learning was effective in increasing students' academic performance in Science, Engineering, and Mathematics. It was also noted that promotion of student-teacher engagement optimized students learning of course [72]. The use of information, communication, and technologies (ICTs) may contribute to the findings of this study. Edmodo was used as a platform for blended learning and students obtained high performance in Science [29]. Online simulations were found to enhance academic performance [73]. Also, similar results were found when researchers employed the "Newtons' Playground," a digital physics game created for eighth and ninth-grade students, to engage learners online for the attainment of learning competencies [74]. It demonstrated positive outcomes in the students' academic performance, with a significant pretest-posttest score and a rise in their posttest scores, proving that the developed digital game Newtons' Playground improves their academic performance. Researchers' Combined Project-based Learning and Web-based learning environment enriched student performance [75].

Moreover, the following literature supports the claim of the study that using the features of MCLE positively affects students' academic performance: the use of digital learning materials via augmented reality to engage learners online [76]; and the utilization of digital models and team-based learning in an online learning environment [77].

Table 10 presents the t-test between the pretest and retention test. A comparison of means was indicated: the pretests' mean was 39.21 and the retention test mean was 54.81. The difference of means suggests a general consistent increase in

scores with a significant p-value (.000**) after the analysis. Supported by the p-value (.000**), it can be recognized the effectiveness of exposing students to MCLE in enhancing students' retention in learning Physics concepts.

Table 10. Comparison of Students' Academic Performance between Pretest and Retention Test.

GROUP		N	MEAN	SD
Performance	Pretest	52	39.21	8.365
	Retention test	52	54.81	6.029

Pair 1	Mean	Std. Deviation	t-value	Sig.
Pretest-Retention test	15.596	7.285	15.438	.000**

*Note:** - highly significant at 0.01 level*

"I learned about sa heat, about sa everything hehe, na familiarize naman nakong uban topic nya sa heat ko naglisod tas nibetter akong understanding sa heat nya ni clear akong pagsabot." (About the heat, about everything hehe, I was able to familiarize heat I was having a hard time on the topics of heat but I cope and I improved my understanding of heat, it was clear now.)

-Participant 5

Students understanding of the physics concept was evident as the students understanding enhanced after the intervention. Corroborative to the results was that they found that students exposed to online advanced organizer concept teaching material significantly improved students' performance from pretest to retention test [78]. Also, a parallel result indicates that students' pretest and retention tests gained significant results on the use of blended learning [43]. Parallel to the results can also be observed from another study in which they investigated the impacts of active learning and discovered that student academic performance in science improved [71]. Likewise, the previous study supports the claim that students are exposed to learning by doing [42] (MCLE is anchored with that principle [21], their retention rate approaches to 90%. With the supporting literature, the comparison between the pretest and retention test validates that retention can be improved using MCLE.

3.4. Paired t-test of Students' Motivation in Physics

Table 11 displays the difference in the overall means before and after the assessment of motivational factors in MCLE. It has shown that significant results were drawn from intrinsic factors and personal relevance, and self –determination. The overall comparison of means has a significant difference before and after the intervention of MCLE.

Table 11 shows significant results on the intrinsic motivation and personal relevance (.019) and self-determination (.018) before and after assessment of the motivational factors on the microlearning approach via cybergogy learning environment. No significant results were obtained from the following motivational factors: grade motivation; (.189) and self-efficacy and assessment anxiety; (0.526). The overall mean showed that there was a significant difference before and after exposure to MCLE.

Table 11. Difference between the Before and After Assessment on Motivational Factors in MCLE

MOTIVATIONAL FACTORS	Before		After		*t-value*	*p-value*
	Mean	Std. Dev	Mea	Std. Dev		
Intrinsic Motivation and Personal Relevance	4.01	0.42	3.91	0.3	-2.84	.019*
Grade Motivation	4.17	0.53	4.07	0.5	-1.58	.189^{ns}
Self-Efficacy and Assessment Anxiety	2.80	1.15	2.84	0.4	0.663	.526^{ns}
Self-Determination	4.40	0.05	4.17	0.1	-3.89	.018*
WEIGHTED MEAN	3.73	0.93	3.65	0.8	-2.52	0.018

*Note:** - significant at p>0.05 level*

The student indicated during the interview that before MCLE, his/her motivation was low. However, after MCLE, it became high. The student believed that Physics is important and relevant that's why she felt motivated (*Refer to the last statement of participant 5 in the discussion part of Table 5, page 41*.) The decrease in the overall mean score can be ascribed to the other external factors such as family support, low internet connectivity, and preference of students (presence of teacher).

This finding is similar to the study of [50] where they established that personal relevance had significant results on learning. Also, this is confirmed by the studies resulting in favorable outcomes when significant results in intrinsic motivation before and after interventions of their strategies in science and physics, respectively, were observed in their investigations [29, 45, 48]. However, the result contradicts the finding of the researcher when he concluded that students are not intrinsically motivated as they explore the virtual environment [25].

It can be concluded that students were "highly motivated" before and after exposure to MCLE in learning Physics concepts. Literature, such as claimed that motivated students conduct themselves more compared to less motivated students [79]. Also, other results stipulated that the exposure of students to a web-based technology platform, activities, and learning materials online develops students' sense of self-individualization, thus, contributing to the motivation of students [80, 81, 29]. Relative to this, mobile-based microlearning has potentially promoted learning and motivation wherein secondary students develop their autonomy, competence, and relatedness [66]. Studies revealed that microlearning and cybergogy learning environments with its underlying strategies motivate students [21, 20, 49].

4. CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of the study, the following conclusions are drawn:

Students' academic performance in the pretest is very low and as the students were exposed to MCLE, post-test and retention tests are high. MCLE has potentially increased students' academic performance.

Among the motivational factors, only self-efficacy and assessment anxiety had an increase in mean factors. It denotes that students' self-efficacy was improved and their assessment anxiety reduced as exposed to MCLE. However, motivational factors such as intrinsic motivation and personal relevance, grade motivation, and self-determination have declined in their mean, implying students' intrinsic motivation and personal relevance, grade motivation, and self-determination weren't improved as exposed to MCLE, but the interpretation remained at "highly motivated". In the same way, the overall mean of students' motivation slightly declined after the intervention but was recognized at the level of high motivation. There is a significant difference in the pretest-posttest and pretest-retention test. MCLE significantly increased students' academic performance from pretest to posttest and pretest to retention test. There is a significant difference in the overall motivation before and after the intervention of MCLE, it means that the intervention significantly affects the student's motivation.

Based on the summary of findings and conclusion of the study, the following recommendations are put forward:

To address different factors affecting the performance of students in Physics on the use of a microlearning approach via cybergogy learning environment, Science educators may investigate more the use of varied and appropriate strategies, especially the different platforms used that promote high engagement in learning online.

Teachers are encouraged to design, develop, and validation of more microlearning materials in Physics as well as use engaging online platforms to increase students' motivation toward Physics. Positive feedback was observed from the students on the use of inquiry via online platforms in support of their active engagement throughout the learning process. Nevertheless, the researcher may look into self-determination among students, especially since it has the utmost decrease in mean after the intervention.

Science educators are urged to explore also the factors affecting students' retention in physics on the use of this teaching approach. Science teachers are invigorated to utilize MCLE in teaching other science subjects besides physics to increase students' performance and retention.

More thorough studies on the effects of MCLE and other external factors on students' motivation is highly encouraged. A pure qualitative research investigation may be conducted to explore the self-determination of students.

ACKNOWLEDGMENT:

The researchers would like to extend their gratitude to Central Mindanao University headed by Dr. Jesus Antonio G. Derije, the University President, and the Department of Science and Technology – Science Education Institute (DOST-SEI) led by Dr. Josette T. Biyo, the Director, for the scholarship grant.

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