DEVELOPING, VALIDATING AND EVALUATING A PHYSICS MECHANICS MODULE IN AN EMERGENCY REMOTE TEACHING ENVIRONMENT

Giselle Ann J. Alcoran-Alvarez
Physics and Geology Department, Negros Oriental State University
Capitol Area, Kagawasan Avenue, Dumaguete, 6200 Negros Oriental, Philippines
E-mail: giselleann.alvarez@norsu.edu.ph

ABSTRACT*:A state university's Horizontal Motion with Constant Acceleration Module was developed and validated as a result of this investigation. The effectiveness of the module was evaluated using a quasi-experimental design. It had a very high degree of validity according to experts. The kinesthetic learner received the highest posttest score, whereas the Visual Read/Write Kinesthetic (VRK) group received the lowest. By two-step cluster analysis, the Kinesthetic (K), Visual Kinesthetic (VK), and Aural Visual Kinesthetic (AVK) groups obtained excellent grades during the posttest from scores that needed improvement during the pretest. Furthermore, some of the multimodal Visual Aural Read/Write and Kinesthetic (VARK) learners obtained excellent scores in both pretest and posttest. Using variability of scores, twenty-eight module users garnered scores below the μ and above range. Moreover, most of the scores were within the μ = x < μ+1SD, but majority were below the mean and μ-1SD. Spearman's correlation showed no significant correlation between participants' collaboration and posttest scores. There was no significant correlation between internet connectivity and posttest scores.*

Keywords: Horizontal Motion, Module, Emergency Remote Teaching, Validation, Spearman's Rho, Pandemic

1. INTRODUCTION

CHED Commissioner Prospero de Vera III's declaration of flexible learning as the new norm due to COVID-19 [1] posed a significant challenge in the educational sector, as the shift from face-to-face to virtual teaching was adopted by all college and university educators nationwide. The challenge then and now is how to best teach with a combination of digital and non-digital technology and develop teaching tools fast to meet the needs of online learners struggling to adjust to this shift from traditional face-to-face classroom learning.

The nature of Emergency Remote Teaching must be clarified. Emergency Remote Teaching (ERT) is defined as "a temporary shift of instructional delivery to an alternate delivery model due to crisis circumstances." The use of ERT during emergencies highlights the significant difference between lengthy planned online teaching and ERT. The emphasis is for learners to have access to learning and support quickly in times of crisis, i.e., the pandemic. Once the problem is diminished, there could be a shift to face-to-face learning from the fully remote, blended, or hybrid mode of instruction known as ERT [2].

In March 2020, tertiary educators were first forced to fully meet the reality and challenges of Emergency Remote Teaching (ERT) during the first pandemic surge [3]. At that time, teachers struggled to adjust to the technological and pedagogical demands of online teaching in its entirety, often faced problems with internet connectivity and the apparent lack of appropriate teaching tools for such an online teaching-learning environment [2]. Although classes for SY 2020-2021 were successfully conducted remotely through an online or modular approach, there remains a need to know the effectiveness of emergency remote teaching [4]. This is critical for continuing quality teaching pedagogies with aptly constructed modules.

Meanwhile, higher education sectors in other countries responded to the COVID-19 challenge differently. Some universities shifted to design emergency remote teaching in Australia, e.g., Victoria, Macguire, and Monash Universities; others to face-to-face with protocols and enhanced online offerings, e.g., Queensland; still others progressed to online learning fast with complete offerings, e.g., Australian National and Tasmania Universities. Others have retained face-to-face instruction with policy changes for more extensive lectures and seminars, e.g., Adelaide and Melbourne Universities [5].

In China, universities shifted all classes to emergency remote teaching from February to March 2020, although some were reportedly incapable [6]. Attention then turned to the quality of learning and the impact of social isolation on educators [7].

In the Philippines, a qualitative study of an ERT, Eliademy web-based classroom at La Consolacion University Philippines determined the experiences of graduate school students for three consecutive trimesters during the pandemic. Results disclosed the strong agreement in the use of Eliademy as a tool for ERT due to its accessibility, time flexibility, and timely feedback features despite the need for solid internet connectivity. Among the many, the researchers suggested Moodle, iTunes, and Schoology as online teaching platform alternatives [8]. While this study used Eliademy, there was a need to investigate the effectiveness of ERT using free learning management systems such as Canvas. This study analyzed the efficacy of the free Canvas For Teachers learning management system in ERT.

In a course of instruction, a module is a nearly self-contained unit of work. Additionally, it is a method of instruction that emphasizes the acquisition of knowledge and skills in small, manageable chunks.[9, 10, 11]. A fluid mechanics module was developed and its objectives, contents, originality, clarity, and appeal were validated[12]. Thus, there is a need to further explore the validity and effectiveness of other physics modules, especially during the pandemic.

This study aimed to develop, validate, and determine the effectiveness of a Physics module in an Emergency Remote Teaching Environment (ERTE) using Canvas, Facebook Messenger, and Google Meet at Negros Oriental State University during the COVID-19 pandemic times.

Particularly, this study aimed to attain the following objectives [13]:

1. Based on Russell (1974), what validity result is established on the developed Horizontal Motion with Constant Acceleration(HMCA) module?
2. What validity result is established on the Research Instrument/Questionnaire for Students?

3. What is the extent of effectiveness of the HMCA module based on the
3.1 Profile in terms of
i.) learning preference;
ii.) availability of gadgets for research?
3.2. Level of performance before and after exposure to the developed module as Revealed in their pretest and posttest results according to learning preference?;
3.3 Overall performance level before and after exposure to the developed HMCA module as revealed in their pretest and posttest results':
4.3.1 mean, standard deviation, and skewness?;
4.3.2 variability of scores?
3.4 Relationships between posttest scores and collaboration, posttest scores and connectivity, and connectivity and collaboration?
4. What is the level of effectiveness of the HCMA module as perceived by the module users?

2. METHODOLOGY

This research integrated the Isman Instructional Design Model (2011), ERTE model, and concepts of classical mechanics to develop and determine the effectiveness of a Physics module. Identifying the type of ERT is crucial in the first step of the learning process[14]. It specifically sought to a) develop a physics mechanics module on the topic Horizontal Motion with Constant Acceleration (HMCA), b) validate the module, and c) determine the module's effectiveness in an emergency remote teaching environment.

To elaborate the flow of the entire study, the 5-step planning of the Isman Instructional Design model was utilized, namely: input, process, output, feedback, and learning (see Figure 1). In the first step, the learning preferences of the student respondents were assessed using the VARK questionnaire ver. 8.01 [15]. Next, the contents, goals, objectives, and teaching strategies of the topic being considered were then identified. Lastly, the emergency remote teaching environment, i.e., Canvas, Facebook Messenger, and Google Meet, were identified. To process these inputs, the module was developed and, after experts' validation, was created in Canvas. Deployment and management of tests and activity were done utilizing Canvas, Google Meet, and Facebook Messenger. The pretest and posttest were automatically checked in Canvas in the third step. Assessment results were analyzed using statistical methods. Furthermore, students' feedback on the module and ERT were used to revise or maintain both. Finally, the four proposed processes offer lifelong learning to students in the selected physics mechanics topic.

Research Design

This study developed, validated, and evaluated the effectiveness a module through a quasi-experimental research design that was conducted in the Physics 1 Emergency Remote Teaching Environment (ERTE) at Negros Oriental State University, Main Campus 1, Dumaguete City, Negros Oriental from September 2021 to January 2022.

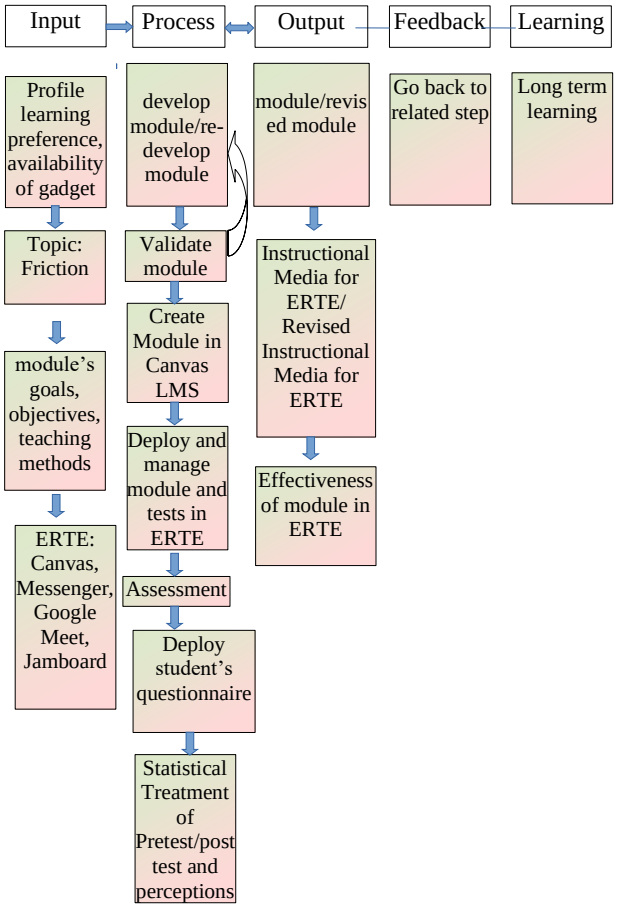

Figure 1. Flow of the Study

Respondents

The participants of the quasi-experimental study were college students taking up Physics 1(General Physics 1) handled by the researcher during the first semester of SY 2021-2022 at Negros Oriental State University, Main Campus 1 Dumaguete City. The survey fell under the census type category.

Instrument

This study utilized four research instruments. The first was a questionnaire based on Russell (1974) as cited in Arip (2013) which was used to validate the content of the Physics module [16]. The second questionnaire was a free module evaluation form for students adapted from Queen Margaret University (QMU) [17], which was used to determine the effectiveness of the module and ERT. Additional questions were added to this questionnaire to fit specific questions regarding the ERT as suggested by QMU. To validate the second questionnaire, a third questionnaire was adapted from Oducado (2020) [18]. The last questionnaire was an online VARK questionnaire version 8.01[15], which was utilized to assess the learning preferences of the student participants.

Data Analysis Plan

Microsoft Excel was utilized to collate and obtain the mean and percentage of the collected data. A five-point Likert scale [19] was used and described in the content validation as follows:

SCALE	VERBAL DESCRIPTION
5	To a very high extent
4	To a high extent
3	To a moderate extent
2	To a small extent
1	To an extremely small extent

Moreover, Microsoft Excel and SPSS 27 were both used to get the frequency, rate, mean, and standard deviation of the pretest and posttest scores according to learning preference and as a whole. Also, grouped scatter plots and variability of scores were generated for the module and non-module users' pretest and posttest scores to analyze the results further. In addition, Spearman's correlation coefficients were obtained to analyze the relationships among post-test scores, level of internet connectivity, and extent of collaboration.

3. RESULTS AND DISCUSSIONS

Experts' Validation

According to four experts, the overall validity of the HMCA module was 'to a very high extent'-accepted(see Table 1). This disclosed that the HMCA module can be used in the emergency remote teaching environment at Negros Oriental State University. Also, in terms of major indicators a) *module contents meet the target population*, b) *module contents* can be implemented successfully, c) *module contents* are appropriate for the planned duration, d) *module contents* can facilitate students' self-development, and e) *module contents* can help students to become more excellent, the composite mean of the module's appropriateness to planned duration was lowest at approximately 4.1. which implied that experts' views of timely accomplishment of self-test, pretest, posttest, and learning activity were minimal in the emergency remote teaching environment where students have no face-to-face supervision. This is in accordance with Chua's (2020) result on the Creative Thinking Skills module validation for engineering students [20].

Table 1. Content Validity of HMCA Module

Expert	Major Indicators for Module's Content Validity					Mean	Rounded to the Nearest Integer	Verbal Description	Decision
	a	b	c	d	e				
E1	5.0	5.0	5.0	5.0	5.0	5.0	5	To a very high extent	Accepted
E2	5.0	4.8	4.4	4.8	4.8	4.8	5	To a very high extent	Accepted
E3	4.7	4.4	3.6	4.8	4.7	4.4	4	To a high extent	Accepted
E4	5	4.4	3.2	4.9	4.8	4.5	5	To a very high extent	Accepted
Composite Mean	***4.9***	***4.7***	***4.1***	***4.9***	***4.8***	***4.7***	***5***	***To a very high extent***	***Accepted***

Overall Decision: Accepted

Validity of the Research Instruments for Students

The face and content validity of the research instruments for students was obtained using Oducado's (2020) validation rating scale with 1 for strongly disagree to 5 for strongly agree [18]. Three experts from Negros Oriental State University validated the research instrument.

The extent of Module's Effectiveness

The learning preference of each student was determined using the online VARK questionnaire [15]. The population was divided into two groups. Only those who successfully took and finished both the pretest and posttest for each module (accessible population) were considered in the evaluation of the modules' effectiveness. Fifty-four (54) students participated in the Horizontal Motion with Constant Acceleration (HMCA) modular approach in an emergency remote teaching environment (ERTE). These students completed the pretest, learning activity, self-test, and posttest of the HMCA module. Thus, the fifty-four (54) students (accessible population) comprised the module users for the HMCA module, and their pretest and posttest scores were evaluated to determine the extent of effectiveness of the module.

Table 2 shows the demographics in terms of learning preference and availability of gadgets. The table revealed that the majority of the participants, 22.22%, were Visual Aural Read/Write Kinesthetic (VARK) learners; 1.9% were Visual and Kinesthetic learners; and all owned gadgets for research. These suggest that the majority of the participants were multimodal VARK learners and were capable of doing research.

Table 2. Demographic Characteristics of HMCA Module Users

Categories	Frequency N=54	%
Learning Preference		
VARK	12	22.2
VA	3	5.6
AVK	4	7.4
RK	4	7.4
VK	5	9.3
VRK	2	3.7
ARK	3	5.6
VAR	3	5.6
KA	7	13.0
RV	2	3.7
V	1	1.9
A	2	3.7
R	5	9.3
K	1	1.9
Availability of Gadget		
Yes	54	100.00
No	0	0

Level of Performance of HMCA Module Users as Revealed in their Pretest and Posttest Results by Learning Preference

Table 3 presents the scores for the 10-item pretest and 10-item (parallel items) posttest of the horizontal motion with constant acceleration module users when grouped according to learning preference. The results showed an overall mean (M) of 2.57 (SD=1.90) was obtained during the pretest while an overall mean of 4.91 (SD=2.47) was obtained for the posttest. A positive, overall mean difference of 2.54 between the posttest and pretest suggests that the HMCA module users learned from the approach. Moreover, the groups that obtained the highest posttest mean were the Kinesthetic (K) learners (M=8.00), the Aural Visual Kinesthetic (AVK) learners (M=7.50), and the Visual Kinesthetic (VK) learners (M=6.40). On the other hand, the lowest posttest mean was obtained by the Virtual Read/Write Kinesthetic (VRK) learners (M=3.00). It should be noted that

Table 3. Performance Level of HMCA Module Users as Revealed in the Pretest and Posttest Scores by Learning Preference

Learning Preference	Pretest		Posttest	
	Mean	**± SD**	**Mean**	**± SD**
VARK	3.92	2.78	4.17	2.62
VA	2.00	1.00	5.67	3.79
AVK	2.25	2.22	7.50	1.73
RK	2.50	1.29	5.25	2.63
VK	2.20	1.92	6.40	3.21
VRK	2.50	0.71	3.00	0.00
ARK	3.00	1.00	4.00	1.73
VAR	0.67	1.15	4.33	0.58
KA	2.14	1.21	4.57	2.37
RV	1.00	1.41	4.50	2.12
V	1.00		5.00	
A	3.00	0.00	5.50	3.54
R	2.60	1.52	3.80	2.05
K	3.00		8.00	
Overall	**2.57**	**1.90**	**4.91**	**2.47**

there was no standard deviation for the posttest result of the kinesthetic learner since there was only one (1) kinesthetic module user. Further analysis was therefore needed to evaluate the effectiveness of the HMCA module.

Not assuming normality in variance, the two-step cluster analysis Scatter plot was employed to further analyze the performance of the students participating in the modular approach on the topic 'Horizontal Motion with Constant Acceleration' according to the learning preference. A focusing oval lens is placed on top of the scatter plot Figure 2 to highlight the learners who needed improvement during the posttest but excelled during the posttest. The focusing

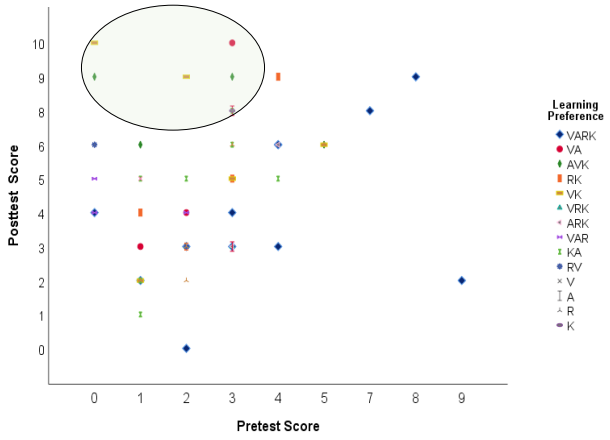

Figure 2. Frequency of Occurrence of Perceived Effectiveness of HMCA Module

The lens reveals that the groups that obtained the scores of 8 and above, interpreted as excellent, were Kinesthetic (K) learners(violet oblong icon), the Visual Kinesthetic (VK) learners(gold rectangular icon), and the Aural Visual Kinesthetic (AVK) learners(green diamond icon). Since these groups needed improvement during the pretest and obtained excellent scores during the posttest, then it can be said that the HMCA module was most effective for these groups. On the other hand, while a Visual Aural (VA) learner obtained a perfect posttest score, as represented by the red circle inside the oval, the remaining two VA learners obtained low pretest scores. Meanwhile, outside the lens, there are Visual Aural Read/Write Kinesthetic (VARK) learners, as represented by the blue diamond icon, who excelled in the posttest but also excelled during the pretest. Remarkably, other VARK learners needed improvement in the both pretest and posttest. These suggest that the module did not affect the VARK learners. Also, the poor performance of the Visual Read/Write and Kinesthetic learners, represented by the aqua blue triangle, can also be seen in the figure. Thus this grouped scatter analysis suggests and reinforces the results in Table 2.4.2 that the HCMA module was most effective for the Kinesthetic (K) and multimodal Visual Kinesthetic (VK) and Aural Visual Kinesthetic (AVK) groups and most ineffective for the multimodal Visual Read/Write and Kinesthetic (VRK) learners.

Overall Performance of HMCA Module Users as Revealed in Their Pretest and Posttest Results

The overall performance of the HMCA module users is presented in Table 4 The mean, standard deviation, and skewness of the pretest, and posttest scores of the Horizontal Motion with Constant Acceleration module users were determined using SPSS 27. The table revealed that while the post-test scores were normally distributed, the pretest scores were not. In addition, a skewness that is greater than 1 implies that the distribution is highly skewed to the right (Brown, 2011; Bulmer, 1979)[21, 22]. Because of this, we used the Euclidean distance measure in getting the two-step cluster analysis scatter plot in SPSS. Also, out of 42 students who needed improvement during the pretest, 22 or 40.74% attained scores of 4 and above or passedpost-testt scores. The number

of students who got scores of 9 or 10 increased to 7 or 12.96 percent, transmuted to 90% and above, interpreted as excellent. Moreover, the scores' mean had increased to 4.91 from 2.57. However, 20 or 37.04% obtained scores below 4, interpreted as 'needed improvement'. From these results, it can be inferred that although the overall performance of the HMCA module users had improved after using the module in an emergency remote teaching environment, improvement was needed to the module to cater to the learning needs of those who did not meet the minimum score to pass the posttest. This difficulty of tackling modules during remote teaching during the pandemic times is parallel with the results of Martin et al. (2020) [23]. Hence, as suggested also by Martin (2020) the HMCA module needed simplification or an expanded learning strategy could be applied to maximize its benefits to students in an emergency remote teaching environment.

To further analyze the scores of the HMCA module users,

Table 4. HMCA Module User's Performance Level as Revealed in their Pretest and Posttest Scores' Mean, Standard Deviation, and Skewness

Score	Grade (Percent)	Verbal Interpretation	Pretest		Posttest	
			f	%	f	%
9-10	90 and above	Excellent	1	1.85	7	12.96
7-8	85-89	Very Satisfactory	1	1.85	4	7.41
5-6	80 -84	Satisfactory	4	7.41	17	31.48
4	75-79	Moderately Satisfactory	6	11.11	6	11.11
0 - 3	below 75	Needs Improvement	42	77.78	20	37.04
Total			54	100.00	54	100.00
Highest Score			9		10	
Lowest Score			0		0	
Mean			2.57		4.91	
Mean Percentage Score			25.70%		49.10%	
Std. Deviation (SD)			1.90		2.47	
Skewness			1.23		0.42	

Table 4.3.2 and Table 4.3.3 present the pretest score and the posttest scores' variabilities. This method of getting the score variability was also used by Gabica (2020) in analyzing temperature variability among various towns and a city in Negros Oriental [24].

As revealed in Table 5, only one (1.85%) got perfect (10 points) during the pretest which fell above μ + 3SD. Moreover, there were only 6 HMCA module users (11.11%) who belonged to the μ+1SD and above bracket with scores interpreted as satisfactory, very satisfactory, and excellent. Hence, eighty-eight and eighty-nine percent (88.89%) of the module users obtained moderately satisfactory scores or needed improvement during the pretest. Furthermore, there

Table 5. HMCA Module Users' Performance Level as Revealed through the Variability of Pretest Scores

μ = 2.57; SD =1.90

Pretest Score x	Frequency	Percentage %
x > μ + 3SD	1	1.85
μ + 2SD = x < μ + 3SD	2	3.70
μ+1SD = x < μ + 2SD	3	5.56
μ = x < μ+1SD	20	37.04
μ-1SD = x < μ	22	40.74
x < μ-1SD	6	11.11
	54	100.00

To help visualize the pretest scores and the variability of posttest scores, a scatter plot was created. As disclosed in Figure 3, although there were many posttest scores that belonged to the mean μ and above bracket (shown as red triangle icons above the green dashed line), there were also many scores below the mean μ. In fact, there were 28 HCMA module users (51.85%) whose scores fell under the μ and above range (see Table 6). Moreover, most of the scores (31.48%) were within the μ = x < μ+1SD bracket but the

Table 6. HMCA Module Users Performance Level as Revealed through the Variability of Posttest Scores

μ = 4.91; SD =2.47

Pretest Score x	Frequency	Percentage %
x > μ + 2SD	2	3.70
μ+1SD = x < μ + 2SD	9	16.67
μ = x < μ+1SD	17	31.48
μ-1SD = x < μ	18	33.33
x < μ-1SD	8	14.81
	54	100.00

were 3 who obtained extremely high scores or scores that fell above μ + 2SD. On the other hand, there were no extremely low scores since there were no scores that were below μ - 2SD. majority (33.33%)fell below the mean and μ-1SD. Furthermore, eight (14.81%) fell below the μ-1SD. In relation to Table 4.3.1, 17 out of 28 whose scores were below the mean needed improvement in the posttest. Lastly, there were 2 (3.70%) who obtained extremely high posttest scores or scores that fell above μ + 2SD but there was no extremely low posttest score. These results show the effectiveness of the module. However, since many did not pass the posttest as discussed earlier, then this implies that the HMCA module was not fully effective. Simplification of the module that would meet the minimum learning competencies must be done to increase the module's effectiveness (Martin, 2020) in an ERTE [23].

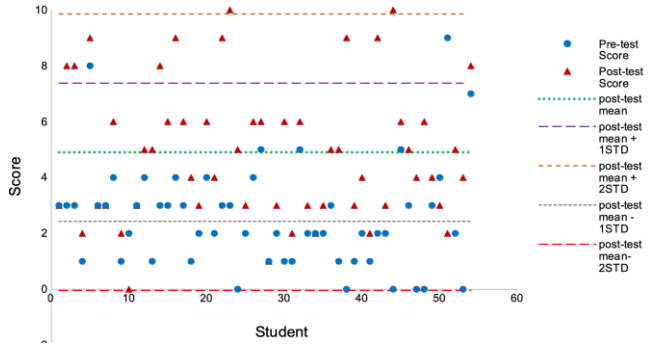

Figure 3. Pretest and Posttest Scores' Variability

Relationships between Collaboration and Posttest, Connectivity and Posttest, and Collaboration and Connectivity of the HMCA Module Users

The correlation between posttest scores and collaboration was investigated using Spearman's correlation. Spearman's correlation was used because it can measure the strength of relationships of qualitative data (Spearman, 1904)[25] such as the extent of collaboration and level of internet connectivity. In addition, it can also be used to analyze the correlation of variables of a population [26, 27, 28]

Based on the interpretation of Spearman's correlation coefficient by Dancey and Reidy (2007) as cited by Akoglu (2018) the ρs values in this study were interpreted as zero (0.1> ρs > -0.1), weak (0.1= ρs < 0.4 or -0.1= ρs >-0.4), moderate(0.4= ρs < 0.7 or -0.4= ρs >-0.7), strong(0.7= ρs < 0.9 or -0.7= ρs >-0.9) and perfect(ρs ≥0.9 or ρs ≤ -0.9. In addition, all the posttest scores were discrete hence these were translated to categorical ranked scores using the descriptions found in Table 4.3.1 such that scores from 0-3=needed improvement=1; 4=moderately satisfactory=2; 5&6=satisfactory=3; 7&8=very satisfactory=4; and 9&10=excellent=5 [29, 30].

Using SPSS 27, the correlation between the HMCA posttest scores and the extent of collaboration was determined by getting Spearman's correlation coefficient (Christiansen, 2018)[31]. Results showed that there was no significant correlation between participants' ratings of level of collaboration and posttest scores after using the HMCA module in ERTE ρs(52)= 0.157, p=0.258. Here, the correlation coefficient is positive but not significant at the 0.05 level. Also, the correlation between posttest scores and connectivity was determined. Results revealed that there was no significant correlation between participants' ratings of level of internet connectivity and posttest scores after using the HMCA module in ERTE $\rho_s(52)$= -0.038, p=0.785 at the 0.05 level of significance. Lastly, the correlation between the extent of collaboration and the level of connectivity of the HMCA module users was also determined using Spearman's correlation. Results disclosed that there was a significant positive weak correlation between participants' ratings of level of internet connectivity and extent of collaboration while using the HMCA module in ERTE ρ_s (52)= 0.273, p=0.046. This implies that as the level of internet connectivity increased, the extent of collaboration also increased. This result aligns with the findings of Sooryamoorthy & Shrum (2007) in which they obtained a positive correlation between internet connectivity and collaboration [32].

Level of Effectiveness of the HMCA Module as Perceived by Module Users

This study also determined the extent of effectiveness of the developed module at the undergraduate level during pandemic times as perceived by the module users. Data were gathered from the 13th -26th of November 2021 during the COVID-19 Alert levels 4 and 2 of the Negros Oriental Province. The questionnaire to evaluate the effectiveness of the module was adapted from Queen Margaret University (QMU) using the following scale, interval, and verbal descriptions:

Scale	Interval	Verbal Descriptions
5	4.21-5.00	Very Much
4	3.41-4.20	Much
3	2.61-3.40	Moderate
2	1.81-2.60	Less
1	1.00-1.80	Not at all

Table 7 presents the level of effectiveness of the HMCA module as perceived by the fifty-four (54) module users. The results reveal an overall mean of 3.89 (SD=0.67) interpreted as much. The means of the major indicators were as follows: module content (M=3.85, SD=0.51) and the module's ERTE (M=3.85, SD 0.71). The overall mean suggests that students felt that they had learned much from the HMCA module in an emergency remote teaching environment. Moreover, the 'helpfulness of the pre-recorded lecture/discussion' had the highest mean (M=4.39, SD=0.81), interpreted as very much and the easiness of the coursework had the lowest mean (M=3.30, SD=0.88), interpreted as moderate. These results emphasize the relevance of the preparation of the pre-recorded video as an aid to help students in an emergency remote teaching environment (Whittle, 2020) [3]. Moreover, the difficulty of the topic of horizontal motion with constant acceleration (HMCA) being a Physics mechanics subject coincides with Byun, Ha, and Lee's (2010) study wherein they had concluded that it was with the planning and step-by-step execution of problem-solving that challenged students most [33]. On the other hand, the discussion in the group chat and ease of accessing the pre-recorded lecture video on YouTube had the highest mean. This discloses the importance of student collaboration during emergency remote teaching as a strategy to help them adjust to the new learning environment which is supported by the study

Table 7. Level of Effectiveness of HMCA Module as Perceived by Module Users

Parameters	Mean	± SD	Verbal Description
Module Content			
learning objectives were achieved	3.52	0.84	Much
module was well-prepared and organized	4.13	0.83	Much
adequate help was available when needed	3.89	0.79	Much
module's pace was enough	3.80	0.90	Much
coursework was easy	3.30	0.88	Moderate
step-by-step solutions of sample problems were adequate and clear	3.98	0.92	Much
amount of course work was enough for a 5-unit/6 hours per week course	3.65	0.83	Much
feedback on progress was available in Canvas	3.94	0.88	Much
module was interesting	3.83	0.91	Much
teaching and learning were engaging and intellectually challenging	4.06	0.88	Much
LRC resources were easily accessible	3.69	0.86	Much
pre-recorded lecture videos were helpful	4.39	0.81	Very Much
pre-recorded learning activity video was helpful	4.35	0.85	Very Much
Self-test was helpful	4.15	0.88	Much
Mean and Standard Deviation	***3.90***	***0.69***	***Much***
ERTE			
internet connectivity was good	3.13	0.89	Moderate
module was easily accessed in Canvas	3.83	0.91	Much
discussion in FB messenger group chat was helpful	4.13	0.93	Much
accessing pretest through Quizizz was easy	3.89	1.02	Much
accessing posttest through Quizizz was easy	3.83	0.91	Much
feedback of inquiries/questions using email/inbox in Canvas was prompt	3.85	0.76	Much
accessing pre-recorded lecture videos on YouTube was easy	4.13	0.93	Much
accessing pre-recorded learning activities on YouTube was easy	4.09	0.96	Much
accessing self-test in Canvas was easy	3.78	0.88	Much
Mean and Standard Deviation	***3.85***	***0.71***	***Much***
Grand Mean and Standard Deviation	**3.89**	**0.67**	**Much**

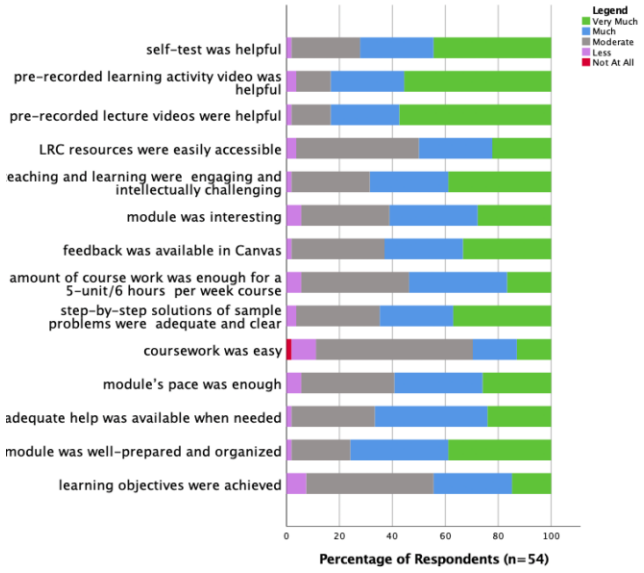

Figure 4. Frequency of Occurrence of Perceived Effectiveness of HMCA Module

conducted by Manca & Delfino [34]. Furthermore, the ease of accessing the lecture through pre-recorded videos using YouTube coincides with the study of Karisi, Pelenkahu, & Maru [35].

Figure 4 presents the effectiveness of the developed module as perceived by the students. In relation to Table 7, it can be further gleaned that the figure is mostly dominated by the gray bars that represent the statements that occurred moderately. This is followed by the green bars that represent very much. It is in the easiness of the coursework and in achieving the learning objectives that the longest gray bars can be observed. These results reinforce the results in Table 7 that revealed the difficulty of tackling the HMCA module in an ERTE. Furthermore, the pre-recorded lecture and learning activity videos uploaded on YouTube were found to be most helpful by modular users.

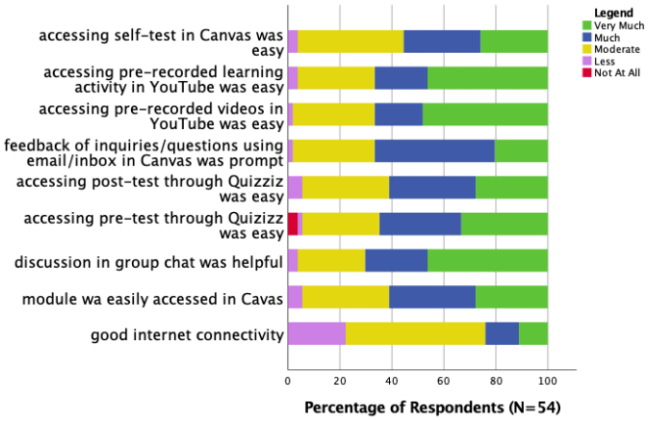

Figure 5. Frequency of Occurrence of Perceived Effectiveness of Emergency Remote Teaching Environment

Moreover, Figure 5 presents the frequency of occurrence of each of the emergency remote teaching environment conditions as perceived by the HMCA module users. In relation to Table 7, it can be further observed that the figure is mostly dominated by the yellow bars that represent the statement that occurred as moderate. This is followed by the green bars that represent very much. It is in the internet connectivity and accessing self-test using Canvas that the longest yellow bars can be observed. These reinforce the result of the challenge of obtaining good internet connectivity in Table 7. This is parallel to the internet connectivity issues encountered by the students in the study conducted by Shim & Lee [36]. Moreover, accessing the pre-recorded lecture and learning activity videos on YouTube was found easiest for the students.

4. CONCLUSIONS AND RECOMMENDATIONS

Results of the validity by experts, score evaluation, variability of scores, and module's effectiveness by users perceptions imply that the module can be used in an emergency remote teaching environment (ERTE) and would be more effective if further simplified or when expanded learning time is applied. Moreover, Spearman correlation results suggest that internet connectivity is essential to increase collaboration among students in an ERTE. Preparation of pre-recorded lecture videos is also proposed to increase student learning in a module-based ERTE. In creating a module, students' learning preferences and difficulty of the topic may be considered. It is

also recommended to develop modules for the rest of the Physics 1 Mechanics and Heat topics such as Free Body Diagram, Vectors, and Specific Heat based on Isman Instructional Model.

5. ACKNOWLEDGMENTS

The author expresses her deepest gratitude to the following: Gerardo C. Maxino, PhD, Founding President of Maxino College; Maria Milagros Velez, EdD, Graduate School Dean of St. Paul University Dumaguete; Maricar Flores, EdD, Dean of College of Arts and Sciences and Education of St. Paul University Dumaguete; Regidor Carale, EdD, of St Paul University, Dr. Ester V. Tan; Prof. Faith P. Villanueva,PhD Physics Education(Cand.), North Eastern Mindanao State University ; Prof. Michael P. Baldado Jr., PhD, CAS Dean of NORSU and Edwin Romano Jr., PhD, Director of NORSU RIDEO for the SPSS 27.

REFERENCES:

[1] Cruz, K. (May 24, 2021). *Flexible learning will be the norm – CHEd*. The Manila Times. https://www.manilatimes.net/2021/05/24/news/national/flexible-learning-will-be-the-norm-ched/1800408. Accessed on 25 August 2021.

[2] Hodges C, Moore S, Lockee B, Trust T, Bond A. (2020). *The difference between emergency remote teaching and online learning*. EDUCAUSE Rev. https ://er.educause.edu/articles/2020/3/ the-difference-between-emergency-remote e-teach ingan d-online-learning. Accessed 23 Mar 2020

[3] Whittle, C., Tiwari, S., Yan, S., & Williams, J. (2020). *Emergency remote teaching environment: a conceptual framework for responsive online teaching in crises.* Information and Learning Sciences.

[4] Palladino, R., Affinito, G., & Triassi, M. (2021). *The impact of COVID-19 on School of Medicine students' performance: an interrupted time series study*. European Journal of Public Health, 31(Supplement_3), ckab165-103.

[5] Crawford J et al. (2020). *COVID-19: 20 countries' higher education intra-period digital pedagogy responses.* J Appl Learn Teach 3(1):9–28

[6] Zhang W et al. (2020) Suspending classeswithout stopping learning: China's Education Emergency Management Policy in the COVID-19 Outbreak. Multidisciplinary Digital Publishing Institute

[7] Shin, M., & Hickey, K. (2020). *Needs a little TLC: Examining college students' emergency remote teaching and learning experiences during COVID-19.* Journal of Further and Higher Education, 1-14.

[8] Francisco, C. (2020). *Effectiveness of an online classroom for flexible learning.* International Journal of Academic Multidisciplinary Research (IJAMR), 4(8), 100-107.

[9] Yoseph, G., & Mekuwanint, T. (2015). *The suitability of the modular curriculum to offer/learn skill in EFL undergraduate classes*. International Journal of Current Research, 7(4), 14686–14696.

[10] Malik, S. (2012). *Effects of modular and traditional approaches on students' general comprehension.* Elixir Social Studies 42, 6228-6231.

[11] Guido, R. (2014). *Evaluation of a Modular Teaching Approach in Materials Science and Engineering*. American Journal of Educational Research, 2(11):1126-1130. DOI: 10.12691/education-2-11-20

[12] Pantaleon-Villanueva, F. (2022). *DEVELOPMENT AND VALIDATION OF A MODULE IN FLUID MECHANICS FOR PRE-SERVICE SCIENCE TEACHERS.* Science International(Lahore), 34(5),459-463.

[13] Alcoran-Alvarez, Giselle Ann J. (2022). *Developing, Validating, and Evaluating Physics Modules in an Emergency Remote Teaching Environment.* (Unpublished doctoral dissertation). St. Paul University Dumaguete, Philippines.

[14] Isman, A. (2011, January). *Instructional Design in Education: New Model*. TOJET: The Turkish Online Journal of Educational Technology, 10(1)

[15] © Copyright Version 8.01 (2019) held by VARK Learn Limited, Christchurch, New Zealand.). http://www.vark-learn.com. Accessed on 25 August 2021

[16] Arip, M. A. S. M., Bakar, R. B. A., Ahmad, A. B., &Jais, S. M. (2013). *The development of a group guidance module for student self-development based on gestalt theory*. Procedia-Social and Behavioral Sciences, 84, 1310-1316.

[17] Queen Margaret University, Edinburg. N.D. https://www.qmu.ac.uk/about-the-university/quality/forms-and-guidance/other-forms/ (Accessed on 28 August 2021)

[18] Oducado, R. M. (2020). Survey instrument validation rating scale. Available at SSRN 3789575.

[19] Mahmud, M. I., Noah, S. M., Ahmad, J., Jaafar, W. M. W., Amat, S., & Bakar, A. Y. A. (2019). Initial development and validation of the career readiness cognitive information processing module among university students. International Journal of Innovation, Creativity and Change, 7(6), 360-374.

[20] Chua, Y. L., Balakrishnan, B., Chai, V. C., & Koh, Y. Y. (2020). Assessing the validity and reliability of creative thinking skills module in a pilot study on engineering undergraduate in Malaysia. Asian Journal of Assessment in Teaching and Learning, 10(1), 77-85

[21] Brown, S. (2011). Measures of Shape: Skewness and Kurtosis. https://web.ipac.caltech.edu/staff/fmasci/home/astro_refs/SkewStatSignif.pdf

[22] Bulmer, M. G. (1979). Principles of statistics. Courier Corporation.

[23] Martin Jr, N. A., Morales, M. M., & Ventayen, R. J. M. (2020). Reap What You Sow: Lived Experiences of Modular Learners in The New Norm. Available at SSRN 3909822.

[24] Gabica, D. T. (2020). *Temperature and Rainfall Patterns of Sitio Ulayan, Maloh, Siaton as Compared to those of PAGASA-Sibulan Siatong and Bagacay, Dumaguete City, Negros Oriental.* Philippine Physics Journal Vol. 42 (2020): pp. 48-77.

[25] Spearman C.E. (1904). *The proof and measurement of association between two things.* American Journal of

Psychology 15: 72–101

[26] Hauke, J., & Kossowski, T. (2011). *Comparison of values of Pearson's and Spearman's correlation coefficients on the same sets of data.* Quaestiones geographicae, 30(2), 87-93

[27] Hindle, I., Downer, M. C., & Speight, P. M. (2000). *The association between intra-oral cancer and surrogate markers of smoking and alcohol consumption.* Community dental health, 17(2), 107-113.

[28] Mielke, H. W., Dugas, D., Mielke Jr, P. W., Smith, K. S., & Gonzales, C. R. (1997). *Associations between soil lead and childhood blood lead in urban New Orleans and rural Lafourche Parish of Louisiana.* Environmental Health Perspectives, 105(9), 950-954.

[29] Dancey, C. P., & Reidy, J. (2007). *Statistics without maths for psychology. Pearson education.*

[30] Akoglu, H. (2018). *User's guide to correlation coefficients.* Turkish journal of emergency medicine, 18(3), 91-93.

[31] Christiansen, P. (2018, October 31). *Spearman's Correlation in SPSS* [Video]. https://www.YouTube.com/watch?v=fOWa3IsYiTY

[32] Sooryamoorthy, R., & Shrum, W. (2007*). Does the internet promote collaboration and productivity? Evidence from the scientific community in South Africa.* Journal of Computer-Mediated Communication, 12(2), 733-751.

[33] Byun, T., Ha, S., & Lee, G. (2010). *Toward understanding student difficulty in upper-level mechanics problem-solving.* SNU Journal of Education Research, 19.

[34] Manca, S., & Delfino, M. (2021). *Adapting educational practices in emergency remote education: Continuity and change from a student perspective.* British Journal of Educational Technology.

[35] Karisi, Y., Pelenkahu, N., & Maru, M. G. (2021*). STUDENTS'PERCEPTION OF THE USE OF YOUTUBE IN TRANSLATION CLASS*. SoCul: International Journal of Research in Social Cultural Issues, 1(2), 126-138.

[36] Shim, T. E., & Lee, S. Y. (2020*). College students' experience of emergency remote teaching due to COVID-19.* Children and youth services review, 119, 105578.