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Science proficiency and motivation in a web-based learning environment

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Abstract
Web based learning includes online course content which includes the use of the discussion forums via email, videoconferencing, and live lectures. The study assessed the science proficiency and motivation in Biology of Grade 12-STEM strand students in Valencia National High School for the academic year 2022-2023. It sought to determine the level of science proficiency in pre-test, post-test and retention test; assess the level of students' motivation when exposed to WBLE in relation to active learning strategies, science learning value, achievement goal and intrinsic value; ascertain any significant difference on the level of student's science proficiency in terms of: pretest, post-test, and retention test, and to find out any significant difference on the student's motivation between pre-survey and post survey.
The study used a quantitative method research design. Results showed that students' science proficiency in pretest is very low, however as they were exposed to WBLE, posttest and retention tests results yielded higher. WBLE has potentially increased students' science proficiency specifically in the retention test. Among the motivational factors, active learning strategies and science learning value had the increase in mean. It denotes that students' active learning strategies were improved and their achievement goal increased as exposed to WBLE. In the same way, the overall mean of students' motivation increased after the intervention and was recognized at the level of high motivation. There is no significant difference in the pretest and posttest however there is a significance obtained between posttest and retention test. WBLE significantly increased students' science proficiency from posttest to retention test. Results revealed that Grade-12 STEM strand students' science proficiency increased from low to high after being exposed to WBLE. WBLE has significantly increased students' motivation also towards learning Biology.

Keywords: science proficiency, motivation, web-based learning environment

Introduction

Years ago, up until now Covid-19 pandemic still existed and students were really struggling in science (Sparks, 2021), which significantly influenced the quality of learning and the emotional wellness of the students as seconded by Barrot *et al*. (2021) [6]. Most educational institutions were closed for face-to-face classes and resorted to their medium of instruction via online (Landicho, 2020) [22].

In the digital world these days, computer and information communication technology remain in the front row (Shanmugam, & Balakrishnan, 2019) [41]. Living these days, we all need laptops, cellular phones, iPads and personal computers specifically in science subjects. Research is very particular because it intertwines with technology.

In school year 2018-2019, the Department of Education recorded the NAT mean percentage score or MPS to be only 36.45 percent, which is comparatively lower than the 75% mark for the mean percentage score. The science MPS is only 45.74% which does not comply with the domestic MPS standard (NETRC, 2018). This implies that students have difficulty in learning science.

During the international assessments, the Philippines came in 58th spot out of 58 nations in the 2019 Trends in International Mathematics and Science Study (TIMSS). Likewise, PISA (2018), yielded nearly identical results, with the country ranking 78th out of 79 countries. Therefore, to address the problem, educators must use various effective strategies and technologies in teaching Science to enhance learners' understanding.

In order to have efficient and maximized learning, incorporating other strategies, Web-Based Teaching or Online Collaborative Learning (OCL) is a theory proposed by Harasim (2018) [19] that focuses on the facilities of the Internet to provide learning environments that foster collaboration and knowledge building. The Internet is very useful because it helps students and teachers add learnings or new discoveries through research. Siti *et al*. (2016) stated that web-based learning offers the potential to support the development of the struggle in the twenty-first century skills, which contributes to autonomous learning. These skills include communication, numeracy, ICT, critical thinking, and problem-solving. It further means that web-based learning leads the students to be independent and more initiative specially via online learning.

Today, traditional education is transformed into web-supported education, and enrichment of web-supported education is possible with certain applications (Birbir & Kanburoğlu, 2018) [12]. With technology integration into education, it can be said that a similar situation has been realized in science courses, and information and communication technologies have been integrated into science programs.

Science education in the Philippines aims to increase student's understanding of science, construction of knowledge and promote scientific literacy. It assumes that for every effect there is one or more causes.

Communication is one big way to increase science-related knowledge among children. These abilities are helpful in students' everyday living, personal growth, and potential career (SEI-DOST & UP NISMED, 2011).

The impact of motivation in science learning is construed as the pole-vaulting factor that hones their performances in

school science. Motivation in science learning, in this sense, includes extrinsic and intrinsic motivation, task value, control of learning beliefs, self-efficacy, and test anxiety (Bautista, 2012).

Local studies in the Philippines like that of Miraña, (2019), found that the literacy level of students on Science Content Knowledge (SCK) along the concept domain and application domain was a "deficient mastery level". It is the moment when there is a surge in Covid-19, and online classes have begun for there were no face-to-face classes, schools have been closed and community and house quarantine have been implemented.

The study would provide teachers and students ease in time and a more motivated teaching and learning process, leading students to a non-overwhelming environment while developing mastery of a specific topic, especially Biology. Thus, this study hoped to examine Web-Based Learning Environment on how it assesses the science proficiency and motivation of Grade-12 STEM Strand students in Biology at Valencia National High School.

Materials and Methods

The study focused on examining Grade-12 STEM strand students' science (biology) proficiency using WBLE. It also examined the level of motivation as exposed to WBLE as well as the non-WBLE. The study participants were the two regular sections from the Grade-12 STEM strand biology classes. There are sixty students in the WBLE class and 58 on the non-WBLE. The study was conducted at Valencia National High School, Valencia City, Bukidnon during the First Quarter of school year 2022-2023. The study employed a quantitative method research design. The participants were the two (2) regular sections of Grade-12 STEM strand of Valencia National High School. One section was exposed to WBLE and the other section was exposed to non-WBLE. Pretest was conducted on proficiency and motivation on the two sections. The test was subjected to a reliability test through statistical software and got a Cronbach Alpha of 0.72. The test consisted of 50 multiple-choice items covering the lessons. After the pretest the students under the experimental group were exposed to WBLE and a posttest was administered after the intervention. Fourteen (14) days after, the retention test was then administered which was the same test prior to the intervention. For quantitative collection of data, analysis of Covariance (ANCOVA) was used. After the analysis, participants for the qualitative data collection were identified based on their scores in the pretest and posttest performance and motivation. Pre-test, post-test and retention test were conducted to ascertain a significant difference in the science proficiency and motivation of the students. Interviews were conducted and qualitative data gathered were used to explain further the quantitative findings of the study. The results of these tests determined the difference between the students' science proficiency and motivation exposed to WBLE and the NWBLE.

A group was randomly selected to be the participants, then a pretest was conducted on proficiency and motivation. After the pretest, the students were exposed to web-based learning environment (WBLE) and a posttest was administered after the intervention. Fourteen (14) days after, the retention test was then administered. Then, analysis of the qualitative data was made. After the analysis, participants for the qualitative data collection were identified based on their scores in the pretest and posttest proficiency and motivation.

The study implementation was divided into 5 major steps and these were the following

In step 1, the pre-survey form of Students' Science Learning Motivation Questionnaire and Pretest using ZIPGRADE was conducted.

Step 2 was the integration of the WBL materials: Wakelet, Padlet, Gmail and short videos. Twenty minutes of interactive discussion then followed, while a maximum of 5 minutes were allotted for the short videos.

Short Interactive Discussion: The teachers' task was to elaborate on the topic through the biology classroom, and PowerPoint. This lasted only for about 20 minutes per session because each class was given 50 minutes only for each subject. Due to the waiting time for the students to join the session the delay in response to each question and an intermittent internet connection, a minute was added to the time limit. WBLE lasted for about 6 weeks, WBL material was in the google classroom and a short interactive discussion per week.

For Step 3, after exposure to WBLE, post-survey for motivation was administered while the posttest was implemented on the schedule provided by VNHS. In Step 4, two (2) weeks after the post-test, the researcher administered the final test which was the retention test.

Finally, in Step 5, after all the tests, students were interviewed to gather qualitative support based on the results of their science proficiency and motivation. They were selected in accordance with the results of their students' motivation questionnaire survey and tests. The researchers selected 9 participants based on the mean difference (MD) in their test scores and motivation; three (3) highest MD, three (3) zero or close to zero MD, and three (3) lowest negative MD. The researcher conducted the study from September 2022 - October 2022.

Results and Discussions

This chapter presents the data gathered from the students' scores relevant for testing the hypothesis of the study, it was analyzed, interpreted and presented. Tables and other figures were used to provide a straightforward data analysis. The presentation was in the order of the objectives of the study.

The science proficiency of the students exposed to WBLE class and NWBLE class in terms of the pretest is presented in Table 1. As shown in the table, 100 or 100% of both classes did not meet expectation or nobody passed the pretest of General Biology 1 before exposure to WBLE.

Table 1: Students' Level of Science Proficiency in Biology in the Pretest

Percentage Grade	WBLE F (60) %		NWBLE F (58) %		Qualitative Interpretation
90-100	0	0	0	0	Outstanding (O)
85-89	0	0	0	0	Very Satisfactory (VS)
80-84	0	0	0	0	Satisfactory (S)
75-79	0	0	0	0	Fairly Satisfactory (FS)
Below 75	60	100	58	100	Did Not Meet Expectation (DNME)
Mean Score/MPS	21.25		20.38		Did Not Meet Expectation (DNME)

The group placed under the NWBLE has the result of 20.38 and did not meet expectation. This is lower compared to the WBLE group which gained 21.25 in a fairly satisfactory level. For both groups, no score reached an equivalent that can be interpreted as satisfactory, nor even higher than that. This is not a surprising result because the concepts/lessons on which the pretest was based have not yet been delivered in the class. In a classroom setting, a pretest or pre-assessment is administered in order to determine students' knowledge, skills, or disposition before instruction. This will help the teachers to determine where to begin instruction and provide them with baseline data from where students' learning starts. In this study, the pre-test will measure the difference of the level of students' science proficiency in both the control and treatment groups before the administration of the intervention. This result supports the study of Galarosa and Tan (2022) when they showed that the level of the academic performance of students before exposure to MCLE was also low.

The study by Fabito *et al*, (2020) revealed that one of the three barriers and challenges that students encountered in online learning was poor internet connection. Several studies showed some contrasting sentiments with regards to internet connectivity and the use of gadgets or devices for online learning for the local researches in the Philippines. There is one related concept from Casillano (2019) specified that only a minimum of the students has internet access thus impeding them to access the e-learning platform. Cleofas & Rocha, 2021 said in another study that poor students do not have gadgets and have limited internet connections.

Nevertheless, Jin and Sabio (2018) said that the use of mobile devices has the potential substitute and was of great help for learning. Estira, 2020 stated that there is another study presented that the greater number of devices owned by a student, the greater the level of learning readiness. Additionally, a study from another state university in the country evaluated the students' readiness for online classes. The study found out that the problem from computer and internet rentals in cafes exists (Yra *et al*., 2020). Therefore, the objective of this study is to assess the internet connection capability and learning devices availability of students for the possibility of a flexible or an online type of education.

Many problems and complaints arose, ranging from educators, students, elementary or tertiary and parents. With this, learning poverty increases to sixty-three percent (63%) from fifty-three percent (53%), a ten percent (10%) increase during pandemic (Joao, A. 2020).

The Philippines, was among the bottom five of poor performers in math and science. The country ranked 23rd out of 25 countries in grade four science and 42nd out of 45 countries in second year science in the 2003 TIMSS. While in 2019 TIMSS, the Philippines ranked last among the 58 countries in Grade 4 Math and Science. The scores in both mathematics and science were lower than how the country fared in 2003 (Mullis, *et al*, 2019).

Table 2: Students' Level of Science Proficiency in Biology in the Posttest

Percentage Grade	WBLE F (60) %		NWBLE F (58) %		Qualitative Interpretation
90-100	0	0	0	0	Outstanding (O)
85-89	0	0	0	0	Very satisfactory (VS)
80-84	0	0	0	0	Satisfactory (S)
75-79	0	0	0	0	Fairly satisfactory (FS)
Below 75	60	100	58	100	Did Not Meet expectation (DNME)
Mean Score/MPS	26.37		25.05		Did Not Meet Expectation (DNME)

The distribution of the students' science proficiency presented in Table 2 is the result of the posttest for both groups. Table 2 presents the science proficiency in genera biology 1 after exposure to WBLE. Results revealed that the mean of WBLE group increased 26.37 after the intervention and in the satisfactory level while the NWBLE increased from "did not meet expectation" to 25.05 which is the fairly satisfactory level.

Results showed the improvement in their posttest scores as reflected by the mean scores and mean percentage scores. Students did not have comprehension of some of the topics, they remembered topics from elementary school days which were different in terms of the competency and level of difficulty in the high school days. The posttest results imply that students still remember some of the topics in biology, especially on the topics of cell, cell theory, cell types, modifications and functions, prokaryotes and eukaryotes as discussed by their teacher using WBLE.

The respective quantitative interpretations were noticeably different in the two groups, especially at the NWBLE classroom group; The mean MPS was 25.05 which corresponds to a fairly satisfactory level of students' science proficiency.

Freeman *et al*. (2014) studied the effects of active learning and found out that there was an increase in student academic performance in science, engineering, and mathematics. Accordingly, active learning engages students in the process of learning via discussion or activities in class that propose to enhance their skills rather than trying to assimilate unilaterally imparted information. Active learning interventions varied widely in intensity and implementation and also included approaches as diverse as occasional group problem solving, worksheets or tutorials completed during class, and workshop course designs.

The study of Nordheim *et al*. (2013), though the use of national science achievement test, explored whether students located at the lower quartile on the latent trait (scientific literacy) scale were likely to identify a health claim in a fictitious brief news report, and whether students located at or above the upper quartile were likely to additionally request information relevant for appraising that claim. The study found that only students with very high proficiency in science possessed that skill because upon interpreting the skill to request relevant information as expressing students' proficiency in critical appraisal of health claims, students with low proficiency does not possess the skill. Additionally, scientific literacy is assumed necessary for appraising the reliability of health claims. Therefore, there is a need for teachers, healthcare professionals and researchers to collaborate to create learning resources for developing these lifelong learning skills.

On the other hand, students amidst pandemic experienced anxiety and displayed less positive perception towards

online learning (Baloran, 2020). Owen, *et al*. (2019) also explored anxiety in students during the pandemic and revealed that rules in scholastic standing may contribute to anxiety. Such rules can be in a form of punishment like expulsion and suspension. This supports the results of this study as evident table 2 because students during the pandemic lack full attention due to precipitating factors caused by anxiety, fear and stress that leads them to perform poorly at school.

Table 3 presents the distribution of the student's science proficiency in biology in their retention test. The table shows the frequency and percentage of the 2 groups levels of science proficiency based on the revised transmutation table of VNHS.

Table 3: Students' Science Proficiency when Exposed to WBLE in the Retention Test

Percentage Grade	WBLE (F)%		NWBLE (F) %		Qualitative Interpretation
90-100	0	0	0	0	Outstanding (O)
85-89	0	0	0	0	Very satisfactory (VS)
80-84	0	0	0	0	Satisfactory (S)
75-79	1	1	2	2	Fairly Satisfactory (FS)
Below 75	60	100	56	56	Did Not Meet Expectation (DNME)
Mean Score/MPS	28.77		30.84		Did Not Meet Expectation (DNME)

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

Table 4: Comparison of the Level of Motivation in Biology Before and After Intervention under Active Learning Strategies and Scientific Learning Values

Indicators	WBLE			
	Before		After	
	Mean	QI	Mean	QI
1.When learning new science concepts, I attempt to understand them.	3.8	HM	3.6	HM
2. It is important to have the opportunity to satisfy my own curiosity when learning science.	3.5	MM	3.6	HM
3. When I do not understand a Science concept, I would discuss with the teacher or other students to clarify my understanding.	3.4	MM	3.6	HM
4.In science, I think it is important to participate in inquiry activities.	3.4	MM	3.6	HM
5.I think that learning science is important because it stimulates my thinking.	3.3	MM	3.8	HM
6.During the learning processes, I attempt to make connections between the concepts that I learn.	3.3	MM	3.6	HM
7.I believe science can be relate to other subjects which is easier to understand.	3.3	MM	3.6	HM
8.When I do not understand a science concept, I find relevant resources that will help me.	3.3	MM	3.7	HM
9.I think that learning science is important because I can use it in my daily life	3.2	MM	3.6	HM
10.When learning new science concepts, I connect them to my previous experiences.	3.2	MM	3.7	HM
Overall Mean	3.3	MM	3.7	HM

Legend

Scale	Level of Motivation	Descriptive Rating	Qualitative Interpretation
4	3.51 - 4.00	Strongly Agree	Highly Motivated
3	2.51- 3.50	Agree	Moderately Motivated
2	1.51- 2.50	Disagree	Poorly Motivated
1	1.00- 1.50	Strongly Disagree	Not Motivated

Table 4 and 5 exhibit the level of students' motivation in class groups before and after implementation of the WBLE. These tables include the weighted means and qualitative interpretations. The tables show the twenty (20) science motivation learning statements with weighted means arranged from highest to lowest. Table 4 and 5 show the mean score in the WBLE is 3.43 indicating a moderately motivated level, while for the NWBLE is 3.62 indicating a highly motivated level. The top 3 rated motivation statements for the WBLE were the following: "When learning new science concepts, I attempt to understand them"; "It is important to have the opportunity to satisfy my own curiosity when learning science; and "When I do not understand a Science concept, I would discuss with the teacher or other students to clarify my understanding." This is similar with the NWBLE statements. On the other hand, the 3 lowest scores statements were the following: "When I do not understand a science concept, I find another relevant resource that will help me, "I think learning science is important because I can use it in my daily life, and "When learning new concepts, I connect them to my previous experiences."

Table 5: Comparison of the Level of Motivation in Biology Before and After Intervention under Achievement Goal and Intrinsic Values

Indicators	WBLE			
	Before		After	
	Mean	QI	Mean	QI
1.During a science course, I feel most fulfilled when I am able to solve a difficult problem.	3.70	HM	3.90	HM
2.During a science course, I feel fulfilled when I attain a good score	3.70	HM	3.80	HM
3.During a science course, I feel most fulfilled when I attain a good score in a test	3.53	HM	3.82	HM

4.During a science course, I feel most fulfilled when I am able to solve a difficult problem.	3.58	HM	3.83	HM
5.During a science course, I feel fulfilled when the teacher accepts my ideas.	3.58	HM	3.87	HM
6.I feel most fulfilled when I feel confident about the content in a science course.	3.57	HM	3.88	HM
7.During a science course, I feel most fulfilled when other students accept my ideas.	3.57	HM	3.67	HM
8.During a science course, I feel fulfilled when other students accept my ideas.	3.52	HM	3.72	HM
9.During a science course, I feel most fulfilled when the teacher accepts my ideas.	3.50	MM	3.80	HM
10.I feel most fulfilled when I feel confident about the content in a science course	3.48	MM	3.67	HM
OVERALL MEAN	3.54	MM	3.81	HM

Legend:

Scale	Level of Motivation	Descriptive Rating	Qualitative Interpretation
4	3.51 - 4.00	Strongly Agree	Highly Motivated
3	2.51- 3.50	Agree	Moderately Motivated
2	1.51- 2.50	Disagree	Poorly Motivated
1	1.00- 1.50	Strongly Disagree	Not Motivated

The study of Edgar *et al* (2019) stated that the key dimension of motivation influencing student success in the transition into university was believing in one's self. Results identified the link between self-belief scores on entry and academic performance in the first year, including grade point average and performance in six of nine courses. There was no significant relationship in the courses that were identified in the curriculum areas where students may be less motivated.

Table 6: Comparison of the Students' Science Proficiency in Biology Before and After Intervention in the Pretest

Group	Standard Deviation	N	Mean
WBLE	1.10	60	26.37
NWBLE	1.10	58	25.05
Total	1.72	118	25.72

The science proficiency of the students exposed to WBLE and NWBLE is presented in Table 6. Student's science proficiency when exposed to WBLE recorded a mean of 26.37 out of a 50-item test, which obtained a percentage score of 80% - 84%, which was at a satisfactory level with a standard deviation of 1.10. On the other hand, students' science proficiency when exposed to the NWBLE classroom resulted in a mean of 25.05 out of a 50-item test, which had a percentage score of 75%-79% with a "fairly satisfactory" level and a standard deviation of 1.10

Table 7: Analysis of Covariance (ANCOVA) of Students' Posttest scores

GROUP	N	Mean	SD
WBLE	58	3.64	0.28
NWBLE	60	3.81	0.24
Total	118	36.29	6.92

Source	SS	D f	MS	F-value	Sig.
Corrected Model	52.38[a]	2	2.19	10.10	.000
Pre (Covariate)	1.39	1	1.39	.54	.464
Group	48.61	1	48.61		
Error	295.39	115	2.569		
Total	397.77	119			

As shown in the results of the analysis of covariance in table 7 above, the difference in proficiency between the two groups is not statistically significant. The computed p-value was 0.000 ($p>0.05$) which means that there was no significant difference, and thus, cannot be rejected.

4. Conclusions and Recommendations

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

The science proficiency levels of the students in the WBLE classroom during the pre-test and post-test were very low but yielder high on the retention test. On the other hand, the science proficiency of the students in the NWBLE classroom was very low in the pre-test and post-test and high for the retention test.

The level of students' motivation in science in the following motivators; active learning strategies, scientific learning value in the WBLE group were "outstanding" while achievement goal and the intrinsic value is in the "satisfactory" level.

The difference in the science proficiency of the students on the posttest was not significant.

The difference in science proficiency between the two groups was found to be statistically insignificant.

The results and findings of the study led to some recommendations that could help for further research.

School administrators and curriculum developers may conduct workshops and training for the teachers on the basics of making computer simulations, which would help learners in their learning process and increase their motivation towards science.

Science teachers may also use web-based learning to interact during activities to acquire diverse perspectives from their peers. With that, there will be a gain in their learning outcomes.

In students' motivation, only four (4) subscales were considered; which are the alternative learning strategies, scientific learning values, achievement goal and the intrinsic value, perhaps future researchers may look for more scales to cater to the other variables that would help students be more motivated in the subject.

Parents may use this study as a helping hand for them to familiarize themselves with online platforms and may enhance their knowledge or widen their skills in teaching their students or children at home.

Web-based learning environment may be used specially in science education because research and technology involve a lot of online learning applications that might help students, teachers and future researchers.

Computer simulations may be utilized as a supplementary aid during discussions and/or activities since it has been observed that it allows the understanding of complex concepts in science subjects and improves science proficiency.

References

1. Adonis M. Students overwhelmed by tasks under the "new normal" way of learning. Philippine Daily Inquirer, 2020.
2. Avila EC, Genio AMGJ. Motivation and Learning Strategies of Education Students in Online Learning during Pandemic. Psychology and Education,2020:57(9):1608–1614.
3. Badeo J, Ong K, Bee C. Use of Comic-Based Learning Modules in Physics in Enhancing Students' Achievement and Motivation. Science Education International,2021:32(2):131-136
4. Baloran E. Knowledge, Attitudes, Anxiety, and Coping Strategies of Students during COVID-19 Pandemic, Journal of Loss and Trauma,2020:25:(8):635-642. DOI: 10.1080/15325024.2020.1769300
5. Barbera J, Vanden Plas JR. All Assessment Materials Are NotCreated Equal: The Myths about Instrument Development, Validity, and Reliability, Investigating Classroom Myths through Research on Teaching and Learning, American Chemical Society,2011:1074:177–193.
6. Barrot JS. Social media as a language learning environment: A systematic review of the literature, 2021, (2008–2019). Computer Assisted Language Learning. https://doi.org/10.1080/09588221.2021.1883673.
7. Bautista RG. The convergence of mastery learning approach and self-regulated learning strategy in teaching biology. Journal of Education and Practice,2012:3(10):25-32.
8. Bayo ang RB, *et al*. Grade 11 Earth and Life Science for Senior High School, Educational Researches Corporation, Cubao, Quezon City, Philippines, 2016.
9. Bergmann J, Sams A. Flip your classroom: Reach every student in every class every day. Industrial Society for Technology in Education and ASCD; 2012.
10. Bernard MB, Borokhovski E, Schmid RF, Tamim RM, Abrami PhC. A meta-analysis of blended learning and technology use in higher education: from the general to the applied. Journal of Computing in Higher Education,2014:26(1):87-122.
11. Bloom BS. Taxonomy of educational objectives, handbook 1: Cognitive domain. New York: Longmans Green. Brown, J. S & Adler R. P. (2008). Open Education, the Long Tail, and Learning 2.0. Retrieved 24 July 2010, 1956. from http://net.educause.edu/ir/library/pdf/ERM0811.pdf4
12. Birbir, Kanburoğlu. A web aided education model that can be used in power electronics course. Karabuk University. Publishing services by Elsevier B.V. Retrieved on 17, 2018. This is an open access article under the CCBY-NC-ND license (http://creativecommons.org/licenses/by- nc-nd/4.0/.
13. Calfoforo AV. Multiple Representation Based Instruction: Effects on the Performance and Attitudes of Students in High School Algebra. Unpublished Master's Thesis. Central Mindanao University (Graduate School), 2013.
14. Daugelaite, *et al*. An Overview of Multiple Sequence Alignments and Cloud Computing in Bioinformatics. Retrieved on January 2013 ISRN Biomathematics, 2013, (6). Retrieved from DOI:10.1155/2013/615630.
15. Edgar S, Carr SE, Connaughton J, *et al*. Student motivation to learn: is self-belief the key to transition and first year performance in an undergraduate health professions program? BMC Med Educ,2019:111:19. https://doi.org/10.1186/s12909-019-1539-5
16. Fortus D, Touitou I. Changes to students' motivation to learn science. *DiscipIInterdscipScIEducRes* **3**,1(2021).https://doi.org/10.1186/s43031- 020-00029-0
17. Galarosa K, Tan D. Sci. Int. (Lahore),2021:34(2),157-170, 2022 ISSN 1013-5316; Coden: Sinte 8 157, Students' Academic Performance and Motivation in Physics using a Microlearning Approach Via Cybergogy Learning Environment March-April 2021
18. González-Gómez D, Jeong JS, Rodríguez DA, nd Cañada-Cañada F. Performance and Perception in the Flipped Learning Model: An Initial Approach to Evaluate the Effectiveness of a New Teaching Methodology in a General Science Classroom. Journal of Science and Education Technology,2016:25(3):450-459.
19. Harasim L. Learning about Learning Online: The Methodology of Discourse Analytics. In B. Khan, J.R. Corbeil, and M.E. Corbeil (Eds.) Responsible Analytics and Data Mining in Education. Routledge (Taylor & Francis Group), 2018. Retrieved from https://www.lindaharasim.com/about-linda/curriculum-vitae/
20. Hartnett M. The importance of motivation in online learning. Motivation in Online Learning, 2016. ResearchGate. DOI: 10.1007/978-981-10-0700-2_2
21. Kamburoglo K. Effectiveness of Using a Mobile App to Improve Dental Students' Ability to Identify Endodontic Complications from Periapical Radiographs. Retrieved: 2019-2018:83(9):1092-1099. doi: 10.21815/JDE.019.099. Epub 2019 Apr 22.
22. Landicho CJB. Research attitudes, motivations, and challenges of STEM education researchers. International Journal of Technology in Education (IJTE),2020:3(1):49-61.
23. Learning Theories. Online Collaborative Learning Theory (Harasim), 2017. Retrieved from https://learning-theories.com/online- collaborative-learning-theory-harasim.html
24. Leatherman JL, Cleveland LM. Student exam performance in flipped classroom sections is similar to that in active learning sections, and satisfaction with the flipped classroom hinges on attitudes toward learning from videos. Journal of Biological Education,2020:54(3):328 - 344.
25. Licuanan PB, *et al*. Commission on Higher Education K to 12 Transition Program Management Unit, Commission on Higher Education, C.P. Garcia Ave., Diliman, Quezon City, Philippines. Lim, K. H. and I. Benbasat, "An empirical study of computer system learning: Comparison of co-discovery and self-discovery methods", *Inf. Syst. Res.*, 2016:8(3):254-272, Sept. 1997.
26. Liu WC, Wang CK. Academic Self-concept: A cross-sectional study of grade and gender difference in a Singaporean secondary school. Asia Pacific Education Review,2017:6(1):20-27, 2005.
27. Macalisang R, Calo B. Students' Struggles and Their Coping Mechanism in the New Normal, 2021. Retrieved from:

https://www.researchgate.net/publication/350443379, Retrieved on March 2021
28. Marrs KA, Novak G. Just-in-Time Teaching in Biology: Creating an Active Learner Classroom Using the Internet. Cell Biology Education,2004:3:49-61.
29. Migalang. Blended Learning Approach: Effect on Students' Academic Achievement and Practical Skills in Science Laboratories. Retrieved from: International Journal of Scientific & Technology Research Volume 7, Issue 11, Retrieved on, 2018.
30. Miñao R. Multiple Intelligence-based Instruction: Effects on Students' Performance and Attitudes in Intermediate Algebra. Unpublished Master's Thesis. Central Mindanao University (Graduate School), 2013.
31. Mirana V. Attitude towards Science and Process Skills of Junior High School Students (May 16, 2019). Available at SSRN: https://ssrn.com/abstract=3389072 or http://dx.doi.org/10.2139/ssrn.3389072
32. National Achievement Test (NAT) 2012. National Education Training and Research Institute (NETRC).
33. Nikou SA, Economides AA. Mobile- based assessment: A literature review of publications in major referred journals from 2009 to 2018. Computers & Education,2018:125:101–119. https://doi.org/10.1016/j.compedu.2018.06.006
34. National Research Council, (2012), Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering, in Singer S. R., Nielsen N. R. and Schweingruber H. A. (ed.), Committee on the Status, Contributions, and Future Direction of
35. Discipline-Based Education Research. Board on Science Education, Division of Behavioral and Social Sciences and Education, Washington, D.C.
36. Nordheim LV, Pettersen KS, Espehaug B, *et al*. Lower secondary school students' scientific literacy and their proficiency in identifying and appraising health claims in news media: a secondary analysis using large-scale survey data BMJ Open,2019:9:e028781. doi: 10.1136/bmjopen-2018-028781
37. Park, Yun. Muwonge, 2019 Studies provide that practical support to motivational needs further promote their use of cognitive learning strategies in online distance education programs in higher education, 2017.
38. Petra SF. The role of web-based learning in supporting students to become autonomous learners. International Journal of Information and Learning Technology, 2016, Emerald Retrieved from: DOI: 10.1108/ijilt-05-2016-0017
39. Pintrich PR. A motivational science perspective on the role of student motivation in learning and teaching contexts, J. Educ. Psychol.,2003:95(4):667–686. Retrieved from https://pubs.rsc.org/en/content/articlelanding/2015/rp/c4rp00152d
40. Rubin M. Do gender and ethnicity make the difference? Linguistic evaluation bias in primary school. Journal of Language and Social Psychology,2017:36(4):415437. https://doi.org/10.1177/0261927X17694980
41. Shanmugam K, Balakrishnan B. Motivation in Information Communication and Technology – Based Science Learning in Tamil Schools, 2019. Retrieved from DOI: 10.15294/jpii.v8i1.16564 on 28, March 2019
42. SEI-DOST & UO NISMED. (2011). Framework for Philippine science teacher education. Manila: SEI-DOST & UP NISMED
43. Shereka F. Newson Walden University The Effect of Interactive Notebooks on the Science Proficiency of Biology, 2019, 1. Students retrieved from:https://scholarworks.waldenu.edu/cgi/viewcontent.cgi?article=8129&context=dissertations
44. Steinmayr R, Weidinger AF, Schwinger M, Spinath B, 2019. The Importance of Students' Motivation for Their Academic Achievement – Replicating and Extending Previous Findings. *Front. Psychol*. 10:1730. doi: 10.3389/fpsyg.2019.01730
45. Taylaran R. Participatory Teaching Methods: Effects on Students' Anxiety Level and Performance in Mathematics. Master's Thesis. Central Mindanao University, 2015.
46. TIMSS R. Philippine Report Volume 1: Science Department of Education Culture and Sports: DOST, Science Education Institute & UP National Institute for Science and Mathematics Education development, 2000.
47. Uyulgan A, Akkuzu N, Alpat S. Assessing students'understanding related to molecular geometry by using a Two-Tier Diagnostic Test. Journal of Baltic Science Education,2014:13(6):839-855.
48. Vygotsky L. Mind in Society. Fikiran dalam Masyarakat. London: Harvard University Press. London: Harvard University Press. Waltonen-Moore, S., Stuart, D., Newton, E., Oswald, R., & Varonis, E. (2006). From virtual stranger to cohesive online community. Journal of Technology and Teacher Education,1978:14(2):287.
49. Zajda J. Motivation in the classroom: Creating effective learning environments. Educational Practice and Theory,2018:40(2):85–103. https://doi.org/10.7459/ept/40.2.06