SCIENCE-BASED DIGITIZED INSTRUCTIONAL MATERIAL IN SELECTED BIOLOGY TOPICS AND THE SELF-DIRECTED LEARNING SKILLS OF GRADE 10 SCIENCE, TECHNOLOGY, AND ENGINEERING (STE) STUDENTS

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ABSTRACT

The study dealt on the utilization of a science-based digitized instructional material (SBDIM) in tackling competencies in Grade 10 Biology. Specifically, the study determined the correlation between the perceived acceptability of SBDIM as to content quality, applicability, appeal to the target users, and originality in presentation with the self-directed learning skills of the Grade 10 STE students as to critical thinking and decision-making skills. Using descriptive correlational design, two sets of instruments that undergone reliability and validity were used. Mean percentage score was calculated to determine the mean performance of the students in Biology and to determine the perceived level of acceptability of the SBDIM, weighted mean and standard deviation were utilized. Moreover, to identify the relationship between variables, Pearson Product-Moment correlation coefficient was used. Results revealed that the students are 'moving towards mastery' in the assessed self-directed learning skills; the SBDIM is highly acceptable in terms of content quality, applicability, appeal to the target users, and originality in presentation. This implies that the SBDIM on selected Grade 10 Biology topics had achieved the criteria and standards for the acceptability of the instructional material in the teaching-learning process. Moreover, among the four criteria, originality in presentation was found to be significantly related to critical thinking and decision-making skill of the learners. The previous suggested that when the students were exposed to a novel instructional material such as SBDIM, they tend to think rationally in order to understand why they were learning biology. The results also suggest that when the students recognized a novel instructional material, they tend to consider it in choosing a good option and take them into account in making decisions. It can be assumed that it is imperative that novelty of digital instructional material should be taken as one aspect to be kept in mind during the development of digital instructional material.

Keywords: Self-directed learning skill, Critical thinking skill, Decision-making skill, Digital Instructional Material, Digital Education

INTRODUCTION

The primary purpose of teaching is to give learners proper and effective education, resulting in effective learning. A Science teacher is required to create and offer the necessary materials to implement scientific principles in the classroom. Republic Act No. 10533, section 5 (g), states that the Department of Education (DepEd) should adhere to a curriculum utilizing a spiral progression approach to ensure mastery of knowledge and skills after each grade level. Science education in the Philippines is currently based on a spiralling educational program that aims to improve students' scientific proficiency. Part of the K to 12 Science Curriculum students need to take is Biology. Moreover, DepEd issued memorandum no. 149 s. 2011 pointing out that various curricular programs

have been designed to enable students to understand their strengths, pursue their interests, and develop their multiple intelligences; and one among those curricular programs is the Special Program for Science, Technology, and Engineering (STE). Despite of the kinds of programs the learners are enrolled in, teachers rely on instructional materials in every aspect of the educative process.

Instructional materials are seen as means of communication, and must be provided in a way that is equally beneficial for students. According to Jocelyn Andaya, Director of the Department of Education's Bureau of Curriculum Development, the first step in improving education quality is to close technical gaps in Information and Communication Technology (ICT) in the Philippines (Education Summit, 2017). The Department of Education Secretary Leonor M. Briones affirmed in the National Department of Education Information and Communication Technology (DepEd ICT) summit that teachers are convinced to devise various teaching methods that infuse creativity and critical thinking among students through information and communication technology. The challenge to devise materials that can help to advance and support learners' performances is enormously dependent on teachers. Educators are encouraged to promote creativity in coming up with numerous materials that are ICT-based.

In public schools, online learning is a vital component of the curriculum. Since public school teachers are unfamiliar with this style of learning, they are currently developing instructional materials that incorporate modern technology. Selga (2013) identified that there is a deficiency in the availability and adequacy of the instructional materials in Science, Technology, and Society. In spite of the fact that efforts exist to assess the quality and guidelines of existing curriculum materials, there is little research on the norm alignment, quality, and effectiveness of digital materials (Sapers, 2015, as cited in Tosh, 2017). The aforementioned motivated the researcher in utilizing a digitized instructional material on selected biology topics that is suited to learners by means of bringing the concepts, principles and theories into digitized form, thereby addressing the interest of the students in the subject.

OBJECTIVES OF THE STUDY

The study aimed to utilize a science-based digitized instructional material in tackling competencies in selected Grade 10 Biology topics. Specifically, it sought to 1) describe the mean level of performance of the students in the achievement test in terms of the assessed self-directed learning skills as to critical thinking and decision-making skills; 2) identify the students' mean level of acceptability of the digitized instructional material in terms of: content quality, applicability, appeal to the target users, and originality in presentation; and 3) determine the correlation of the students' perceived acceptability of the science-based digitized instructional material with that of the assessed self-directed learning skills of Grade 10 students in Biology.

METHODOLOGY

This study utilized descriptive correlational design where a single group of 60 students were exposed to the utilization of science-based digitized instructional material (SBDIM). They were from the Grade 10 Special Program in Science, Technology and Engineering (STE) class 2020-2021 of Quezon National High School. The topics contained in the SBDIM were aligned to the learning competencies selected from the third quarter of the Grade 10 science K-12 curriculum, specifically it consisted of four modules: Coordinated Functions of the Nervous, Endocrine, and Reproductive System; Heredity: Inheritance and Variation; Biodiversity and Evolution; and Ecosystem: Biodiversity.

The actual teaching procedure started on March 01, 2021 and ended on April 30, 2021. The researcher provided the students with the prepared digitized instructional materials in selected Grade 10 biology topics as supplementary material through online platform. The achievement test that would measure the level of the critical thinking and decision-making skills of the students was administered at the end of the third quarter where

SBDIM has been utilized by the students. In order to determine the level of acceptability of the science-based digitized instructional material in increasing the level of achievement of students in Biology, a form of a survey questionnaire with close-ended statements was given to the respondents after the utilization of the SBDIM.

To describe the mean level of performance of the students in the achievement test, mean percentage score was calculated. Weighted mean and standard deviation were computed to perceive the level of acceptability of the Science-based digitized instructional material. Meanwhile, to investigate the correlation of the students' perceived acceptability of the science-based digitized instructional material with that of the assessed self-directed learning skills the Pearson Product-Moment Correlation was used at 0.05 level of significant.

RESULTS AND DISCUSSION

1. Performance level of the students in the achievement test as to critical thinking skill and decision-making skill

Table 1
Mean Percentage Score of the Students in the Achievement Test

Self-Directed Learning Skill	Highest Score	Lowest Score	Mean	Mean Percentage Score	Standard Deviation	Descriptive Equivalent
Critical Thinking Skill	18	5	14.50	**80.56**	2.69	Moving Towards Mastery
Decision-making Skill	17	4	13.35	**78.53**	2.89	Moving Towards Mastery

Table 1 presents the result of the achievement test accorded to 60 Grade 10 STE students. The students were moving towards mastery in the assessed self-directed learning skill as to critical thinking and decision-making skill. In the study, the students were introduced to different biological processes and principles that involved coordinated functions of nervous, endocrine and reproductive systems and protein synthesis. Thus, the results suggest that the students can analyze, evaluate and synthesize biological concepts as well as they can decide well in selecting the appropriate biological laws and principle applied to a certain biological process. This implies that the students have developed their critical thinking and decision-making skills.

2. Level of acceptability of the digitized instructional material

2.1. in terms of Content Quality

Table 2
Level of Acceptability of the Science-based Digitized Instructional Material on Selected Grade 10 Biology Topics in Terms of Content Quality

Statements	Frequency				WM	DR
	4	3	2	1		
Content Quality						
1. provides lectures suitable to the students in learning biology	42	18	0	0	3.70	HA
2. has a variety of biological concepts in learning biology which enhanced the learner's thinking skill	38	21	1	0	3.62	HA
3. is congruent to the competencies the subject requires	41	19	0	0	3.68	HA
4. is logically arranged to provide order of understanding	39	21	0	0	3.65	HA
5. is well-explained	41	19	0	0	3.68	HA
Overall Mean					**3.67**	**HA**

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Table 2 presents the level of acceptability of the SBDIM on selected Grade 10 biology topics as to content quality. This was evaluated by the respondents with an overall mean of 3.67 as highly acceptable. It can be gleaned on the table, that respondents perceived the SBDIM in terms of content quality all highly acceptable specifically on the statement which describes that the science-based digitized instructional material contains content that provides lectures suitable to the needs of learners learning biology. This was also explained by Urbandale Community School District (2019) that instructional materials should be suitable for the age, social and emotional growth, and skill level of the students for whom the materials are intended, and they should meet high standards and content quality requirements.

2.2. in terms of Applicability

Table 3
Level of Acceptability of the Science-based Digitized Instructional Material on Selected Grade 10 Biology Topics in terms of Applicability

Statements	Frequency				WM	DR
	4	3	2	1		
Applicability						
1. serves as a lesson's guide to enrich student learning about the biology concepts	45	13	2	0	3.72	HA
2. develops a strong interest in studying more about living things and their environment (biology)	30	27	3	0	3.45	HA
3. has animated visualizations that aid students' comprehension of the content	38	20	2	0	3.60	HA
4. has videos embedded which are appropriate to the lesson	45	12	3	0	3.70	HA
5. delivers information that makes the student engage in acquiring scientific concepts	37	23	0	0	3.62	HA
Overall Mean					**3.62**	**HA**

Table 3 presents the level of acceptability of the SBDIM on selected Grade 10 biology topics as to applicability. This was evaluated by the respondents with an overall mean value of 3.62 as highly acceptable. Based on the table, the respondents perceived the SBDIM in terms of its applicability all highly acceptable particularly on the statement which describes that the SBDIM serves as a lesson's guide to enrich student learning about the biology concepts.

2.3. in terms of Appeal to the Target User

Table 4
Level of Acceptability of the Science-based Digitized Instructional Material on Selected Grade 10 Biology Topics in Terms of Appeal to the Target User

Statements	Frequency				WM	DR
	4	3	2	1		
Appeal to the Target User						
1. captivates the learner's interest	31	27	2	0	3.48	HA
2. is adaptive to the needs of the learners enrolled in the Science, Technology and Engineering program	45	13	2	0	3.72	HA
3. stimulates the learner's engagement to perform scientific tasks	29	29	2	0	3.45	HA
4. sustains the curiosity of the learner by its order and presentation	34	23	3	0	3.52	HA
5. enables the learner to develop critical thinking with its information given	35	24	1	0	3.57	HA
Overall Mean					**3.55**	**HA**

Table 4 presents the level of acceptability of the SBDIM on selected Grade 10 biology topics as to appeal to the target user. This was evaluated by the respondents with an overall mean value of 3.55 descriptively rated as highly acceptable. The respondents perceived the science-based digitized instructional material in terms of appeal to the target user all highly acceptable specifically on the statement which described that the SBDIM is adaptive to the needs of the learners enrolled in the Science, Technology and Engineering program. This was also suggested by Khalil and Elkhider (2015) as being important that in designing instructional material the kind of learners is considered and that their interests are tapped during the design process.

2.4. in terms of Originality in Presentation

Table 5
Level of Acceptability of the Science-based Digitized Instructional Material on Selected Grade 10 Biology Topics in terms of Originality in Presentation

Statements	Frequency				WM	DR
	4	3	2	1		
Originality in Presentation						
1. The design and appearance of the material are exceptionally unique compared to the pre-existing material (e.g., Grade 10 Science learning module)	43	17	0	0	3.72	HA
2. The visual image contained in the digitized instructional material is one of a kind	34	24	2	0	3.53	HA
3. The content and ideas constituted in the digitized instructional material are presented in a unique and thought-provoking way	33	25	2	0	3.52	HA
4. The science-based digitized instructional material can be a new model of instruction in teaching K-12 science particularly Grade 10 Biology	30	28	2	0	3.47	HA
5. The science-based digitized instructional material contains features which other pre-existing material in science do not have	37	21	2	0	3.58	HA
Average Weighted Mean					3.56	HA

Table 5 presents the level of acceptability of the SBDIM on selected Grade 10 biology topics as to originality in presentation. This was evaluated by the respondents with an overall mean value of 3.56 descriptively rated as highly acceptable. The respondents perceived the SBDIM as to originality in presentation all highly acceptable, specifically on the statement, which described that the design and appearance of the material were exceptionally unique compared to the pre-existing material. This was also suggested by Longman (2019) that originality is something that is entirely unique and unlike anything else that has been conceived of before. This implies that originality is a special feature of an instructional content that distinguished it from the others.

Table 6
Summary of Rating for the Level of Acceptability of the SBDIM on Selected Grade 10 Biology Topics in terms of Content Quality, Applicability, Appeal to the Target User, and Originality in Presentation

Criteria	Weighted Mean	Descriptive Rating
Content Quality	3.67	Highly Acceptable
Applicability	3.62	Highly Acceptable
Appeal to the Target User	3.55	Highly Acceptable
Originality in Presentation	3.56	Highly Acceptable
Overall Weighted Mean	3.60	Highly Acceptable

Table 6 shows all the criteria used in evaluating the acceptability of the SBDIM on selected Grade 10 biology topics. Results revealed that the overall level of acceptability of the science-based digitized instructional material on selected Grade 10 Biology topics as perceived by the respondents generated an overall weighted mean of 3.60 descriptively rated as highly acceptable. Thus, this implies that the SBDIM on selected Grade 10 Biology topics had achieved the criteria and standards for the acceptability of the instructional material in the teaching-learning process.

3. Correlation of the students' perceived acceptability of the science-based digitized instructional material with that of the assessed self-directed learning skills

Table 7

Correlation Coefficient of the Perceived Acceptability of SBDIM and the Assessed Self-Directed Learning Skills of Grade 10 STE Students

Variables	Mean	Standard Deviation	Critical Thinking Skill		Decision-making Skill	
			r - value	p value Sig. (2-tailed)	r - value	p value Sig. (2-tailed)
Content Quality	3.67	0.329	-0.138	0.293	-0.039	0.766
Applicability	3.62	0.359	-0.247	0.057	-0.267*	0.039
Appeal to the Target User	3.55	0.431	-0.123	0.350	-0.129	0.325
Originality in Presentation	3.56	0.378	-0.275*	0.034	-0.286*	0.027

*** p< 0.05 (2-tailed); N = 60**

Table 7 presents the computed r value between critical thinking skill and content quality, applicability, appeal to the target user, and originality in presentation (r= -0.138, p > 0.05), (r= -0.247, p > 0.05), (r= -0.123, p > 0.05), and (r= -0.275, p < 0.05) respectively. Results revealed that all of the variables were found to have very low negative correlation with critical thinking skill. Among the variables, only the originality in presentation was found to be significantly related to critical thinking skill. The result was also suggested by Nanda (2021) that originality is the foundation for developing something new through independent and critical thinking.

It can be inferred that when the students were exposed to a novel instructional material such as SBDIM, they tend to think rationally in order to understand why they were learning biology. They tend to consider novel concepts in analyzing and evaluating biological processes. However, content quality, applicability, and appeal to the target user though perceived as highly acceptable suggested that students could process and analyze information and facts without taking them into account.

Table 7 also shows the computed r value between decision-making skill and the content quality, applicability, appeal to the target user, and originality in presentation (r= -0.039, p > 0.05), (r= -0. 267, p < 0.05), (r= -0.129, p > 0.05), and (r= -0.286, p < 0.05) respectively. Among the variables, content quality was found to have markedly low and negligible negative correlation with decision-making skill, while applicability, appeal to the target user, and originality in presentation were found to have very low negative correlation with decision-making skill. Results also revealed that applicability and originality in presentation were found to be significantly correlated with decision-making skill.

It implies that, when the students recognized a novel instructional material, they tend to consider it in choosing a good option and take them into account in making decisions. When the students recognized a novel concept, they take it into account in making decision in choosing the appropriate biological laws and principle applied to

a certain biological process. Also, when they realized the usefulness of instructional material, they used such as the SBDIM, they tend to consider it in making decision such as selecting one best alternative. On the other hand, content quality and appeal to the target user despite perceived as highly acceptable implied that even without taking them in mind, students could make an informed decision and could choose the best alternative.

CONCLUSIONS

Based on the data gathered, it can be inferred that:

1. Grade 10 STE students are moving towards mastery in the development of self-directed learning skills and have achieved the prescribed 75% level of mastery by the Department of Education.
2. The science-based digitized instructional material on selected Grade 10 biology topics is highly acceptable as it provides lectures suitable to the student in learning biology, has served as a lesson's guide to enrich student learning about the biology concepts, adaptive to the needs of the learners enrolled in the Science, Technology and Engineering program, and is novel.
3. Since applicability and originality in presentation are correlated to the assessed self-directed learning skills, it is imperative that novelty of digital instructional material should be taken as one aspect to be kept in mind during the development of digital instructional material.

RECCOMENDATIONS

Based on the findings and conclusion of this study, the following recommendations are offered:

1. Development of science-based digitized instructional material in Earth Science, Physics, and Chemistry may be done.
2. Conduct further study to validate the effectiveness of the science-based digitized instructional material on selected Grade 10 biology topics.
3. Parallel study may be conducted in other curriculum program in which bigger population may be used to further validate the results of the study.

REFERENCES

Botha, M., & Zhou, D. (2008). The availability, suitability and use of instructional materials in integrated science classrooms in Zimbabwean schools. https://doi.org/10.1080

Cimer, A. (2012). What makes biology learning difficult and effective: Students' views *Educational Research and Reviews Vol. 7*(3), pp. 61-71 doi: 10.5897/ERR11.205

Colakkadioglu, O., & Celik, B. (2016). The effect of decision-making skill training programs on self-esteem and decision-making styles. *Eurasian Journal of Educational Research*, 65, 259-276 http://dx.doi.org/10.14689/ejer.2016.65.15

Department of Education, (2016), Adoption of basic education research agenda, https://www.deped.gov.ph/2016/06/10/do 39-s-2016-adoption-of-the-basic-education-research-agenda/

Khalil, M., & Elkhider, I.A. (2016). Applying learning theories and instructional design models for effective instruction. *Advances in physiology education*, *40*(2), 147-56. http://DOI:10.1152/advan.00138.2015

Lawless, K. A., & Brown, S. W. (2015). Developing scientific literacy skills through interdisciplinary, technology based global simulations: *GlobalEd 2. The Curriculum Journal, 26* (2), 268-289.

Lin, M., Chen, H., & Liu, K. (2107). A study of the effects of digital learning on learning motivation and learning outcome. *Eurasia Journal of Mathematics Science and Technology Education*, 13(7), 3553-3564. doi.10.12973/Eurasia.2017.00744a

Luistro, A. FSC (2012). DepEd Order No. 31, s, 2012. Enclosure No. 1 and Enclosure No. 2. Department of Education, Philippines

Nanda, N. (2021). The truth about originality. https://www.ouriginal.com/the-truth-about-originality/

Panworld Education (2017) Benefits of Digital Learning over Traditional Education Methods, http://www.panworldeducation.com/2017/03/23

Selga, Mary Corinne R. (2013). instructional materials development: A worktext in science, technology and society. *LCCB Development Education Journal of Multidisciplinary Research*. 2(1). https://www.scribd.com/document/446274748/Instructional-Materials-Development-A-Worktext-in-Science-Technology-and-Society-pdf

Tosh, K., Sy D., Ashley W., & Daniella H. (2020). Digital instructional materials: What are teachers using and what barriers exist? https://www.rand.org/pubs/research_reports/RR2575z17.html

Urbandale Community School District (2012). Instructional materials: Selection, inspection, and reconsideration. https://www.urbandaleschools.com/policy/article-600-educational-program/627-r1-instructional-materials-selection/

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