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Research Article

Utilization of ICT-Based Instructional Materials Among Public Secondary Schools in the Division of Batangas City

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ABSTRACT

The aim of this study was to evaluate the use of ICT-based instructional materials by public secondary teachers in Batangas City Division. This evaluation focused on the self-learning modules provided by DepEd during distance learning, with an aim to design additional ICT-based supplementary materials in Earth and Life Science for public senior high school students. The study used a quantitative survey to determine students' performance and utilization of ICT-based instructional materials during distance learning due to the COVID-19 pandemic. A simple random sampling technique was used to collect data from select teachers and student participants, and the data were collected using a 4-point Likert-type survey. Findings of the study revealed that students' performance in using ICT-based instructional materials was moderately evident, and the effectiveness of the ICT-based instructional materials used during distance education was moderate. The study also found a significant relationship between students' performance and the level of effectiveness of ICT-based instructional materials. The challenges cited by teachers included insufficient network connection speed and students' preference to learn from teachers rather than SLMs. Meanwhile, the challenges cited by students included learning without the direct assistance of teachers and slow network access. This study was limited to the design of additional ICT-based supplementary materials in Earth and Life Science intended for public senior high school students during the School Year 2020-2021 in the Division of Batangas City, and may require further studies.

INTRODUCTION

The alchemy of mixing technology and education is perceived to be a rising trend in the field of education that may outgrown the physical constraints of the classroom and acquired mobility. In the 21st century, technology has become the knowledge transfer highway in various disciplines. Nowadays, it has gone through innovations that somehow reshaped the way people think, work, and live. Technology also plays a role in forming 21st-century learners to deliver fast societal changes. With this, schools and educational institutions considered its integration in the curriculum.

Information and Communication Technology (ICT) plays a pivotal role in the teaching and learning process. As an institution of learning, the Department of Education (DepEd) recognizes that the quality of teaching greatly influences the quality of learning; thus, several programs and advocacies regarding ICT utilization were planned, and some were implemented to achieve such goal. The birth of the K to 12 Program highly promoted ICT in teaching in almost all

learning areas. ICT curriculum standards for K to 12 schools in the Philippines served as the framework for technology integration in various academic content area instructions. It also served as a guide for curriculum decisions by providing the students' performance expectations in knowledge, skills, and attitudes as examples of classroom activities and instructional strategies utilizing ICT (Jamieson-Procter et al., 2013).

With the paradigm shift in the education sector, especially during the advent of the COVID-19 pandemic, Information and Communication Technology (ICT) in teaching can be very useful for teachers and learners. The presence of ICT in education allowed for new ways of learning for students and teachers, especially during the pandemic, where face-to-face learning is prohibited. ICT utilization in education has changed how learners learn as well as the teaching pedagogies of teachers. The COVID-19 pandemic has allowed the education sector to adopt online learning to be abreast with the rapid emergence of new technologies, thus making online, blended, and remote learning necessary in teaching (Ali, 2020).

The COVID-19 pandemic, with its impact on the education sector, has made the academic performance of the students to become of greater concern since even before the pandemic, there is below average assessment of the performance of learners in learning areas such as in Science as reflected in the 2018 Program for International Student Assessment (PISA) results. Results of the assessment showed that Filipino learners ranked second to last in Science, which was below the 489-point average for the learning area (Philippine Information Agency, 2019).

It is in this note that enhancing student's learning and academic performance in the different learning areas at the middle of the pandemic were the challenges educators of today has been facing. The utilization of ICT-based instructional materials in teaching could potentially get along with distance learning.

In particular, this study sought to investigate using ICT-based instructional materials in public secondary schools in the Division of Batangas City. It will address the concerns regarding its use and design for additional ICT-based supplementary materials in Earth and Life Science to teach senior high school students and aid in the self-learning modules provided by DepEd for distance learning. The researcher believed that the output generated from this study would result in improved performance of senior high school students in Science, particularly in Earth and Life Science.

Research Questions

This study aimed to assess the utilization of ICT-based instructional materials that aided the self-learning modules provided by the Department of Education during distance learning modality in enhancing the academic performance of public secondary students with an end view of designing additional ICT-based supplementary materials in Earth and Life Science for senior high school students in select public secondary schools in the Division of Batangas City.

Specifically, it sought answers to the following questions:

1. How do teachers assess the performance of the students in the use of ICT-based instructional materials?
2. What is the level of effectiveness of ICT-based instructional materials as assessed by the respondents?
3. Is there a significant relationship between students' performance and the effectiveness of ICT-based instructional materials?
4. What challenges do teachers and students encounter in using ICT-based instructional materials?
5. Based on the results, what additional ICT-based supplementary materials may be designed to enhance the performance of senior high school learners in Earth and Life Science?

Hypothesis

There is no significant relationship between the performance of the students and the level of effectiveness of ICT-based instructional materials.

MATERIALS AND METHODS

Research Design

This study utilized a descriptive research method. This method concerns the description of data and characteristics of a population. The goal is to acquire factual, accurate, and systematic data that can be used for averages, frequencies, and similar statistical calculations (Valdez, 2013).

Participants

The respondents of this study were randomly selected from the Division of Batangas City for School Year 2020-2021. The sample included 270 public secondary school teachers and 378 students who used blended learning and print/non-print modular teaching modality. The number of respondents was determined using the Raosoft formula.

Data Gathering Instrument Used

The data in this study were all sourced from a researcher-made survey questionnaire for 270 public secondary school teachers and 378 students. This served as the main data-gathering tool for the study to generate factual information on the utilized ICT-based instructional material among public secondary schools teachers. Two sets of questionnaires were prepared for the teacher respondents and the other for the student respondents.

The survey questionnaire for teachers has three parts. Part I covers the teachers' assessment of the students' performance in using ICT-based instructional materials. Part II deals with the effectiveness of ICT-based instructional materials as assessed by the teachers. Lastly, Part III deals with the teachers' challenges in using ICT-based instructional materials.

The survey questionnaire for the student-respondents was consist of only one part. It dealt with the challenges encountered by the students in the use of ICT-based instructional materials.

The first draft of the questionnaire was presented to the research adviser and other faculty members for

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comments, suggestions and validation. The draft was revised considering all corrections and suggestions given therein and was presented to some teachers who were not participants in this study for finalization.

Data Gathering Procedure

After the survey questionnaire was finalized, the researcher prepared the survey questionnaire using the Google forms. Permission to administer the questionnaire was sought from the Schools Division Superintendent and principals of the schools through a formal letter of request. The validated survey questionnaire prepared in a Google Form were distributed by sending the link through a private message using the Facebook messenger to school heads, teachers, and students. This was done to ensure the safety of the researcher and target respondents from the COVID-19. The responses were retrieved immediately in the Google Forms once the target respondents have submitted it after the given time allotment.

The results of the questionnaire were tallied, analyzed, and interpreted. The findings were used only to suit the purpose of the study.

RESULTS AND DISCUSSION

Performance of students in using ICT-based instructional materials

Information and Communication Technology can expand the learning environment for students beyond the regular classroom with more on-task activities by students. It played a vital role in the teaching-learning process, especially during the "new normal" in education, where distance learning was utilized, and students' performance was continuously monitored. Students' performance in using ICT-based instructional materials was assessed in Table 1, presented below.

Table 1. Distribution of the Respondents

Indicators Students are.....	WM	VI	Rank
1. Engaged with their lessons with the aid of ICT-based instructional materials	3.46	ME	1
2. Able to comprehend their lessons and easily follow instructions as stated in the materials	3.28	ME	10
3. Having increased level of comprehension and concentration	3.35	ME	4
4. Able to develop skills in recording and evaluating their findings and progress	3.38	ME	3
5. More self-directing and motivating	3.44	ME	2
6. Able to use, operate and comprehend with various multimedia materials used in the teaching-learning process	3.33	ME	7
7. More creative and imaginative and develop high order thinking skills	3.32	ME	9
8. Able to communicate and collaborate more with their classmates	3.33	ME	7
9. More confident towards learning and express their ideas and thoughts better	3.34	ME	6
10. Having improved ability in reading and writing	3.23	ME	11
11. Able to explore more detailed topics in which they are interested in	3.35	ME	4
Composite Mean	**3.35**	**ME**	

Legend:
WM – Weighted Mean *VI – Verbal Interpretation*
VE= Very Evident *SE= Slightly Evident*
ME= Moderately Evident *LE= Least Evident*

The data presented revealed that the student's engagement with their lessons through the aid of ICT-based instructional materials earned the highest weighted mean of 3.46 for the assessed performance of students, with the verbal interpretation moderately evident. This finding conformed with the study of Ali et al. (2013), who emphasized that ICT-based materials facilitate dynamic learning towards collaborative learning among learners. It was also supported by the study of Nacario (2014), who described the characteristics of the students he referred to as digital learners. He regarded students nowadays as digital learners

who prefer activities where they can interact, express themselves, and get immediate feedback since they have been highly exposed to various media and technological tools. Thus, students became more engaged in learning with ICT-based teaching materials.

On the other hand, students' being more creative and imaginative, developing high-order thinking skills, lesson comprehension, ability to easily follow instructions stated in the materials, and having improved ability in reading and writing were the last three indicators for the performance of the students as assessed by the teacher-respondents. They had a weighted mean of 3.32, 3.28, and 3.23, respectively, but still regarded as moderately evident regarding the students' performance. These results were congruent with the study of Ghavifkr & Rosdy (2015), in which improved ability in reading and writing and students' being creative and imaginative were included in the last items ranked by teachers in assessing the effectiveness of ICT utilization on students' performance and learning.

The above results also corroborated with the study of Nacario (2014) indicating that the utilization of ICT-based instructional materials improved the performance of the students in terms of improving the skills in observing, classifying, inferring, predicting, measuring, and communicating after the lessons. With the above improved skills, students were able to record and evaluate their findings or learnings obtained from the learning materials provided by the teachers.

On the other hand, students' being more creative, imaginative, development of high-order thinking skills, lesson comprehension, ability to easily follow instructions stated in the materials and having improved ability in reading and writing were the last three indicators for the performance of the students as assessed by the teacher-respondents. They had a weighted mean of 3.32, 3.28 and 3.23, respectively but still regarded as moderately evident as to the performance of the students. These results were congruent with the study of Ghavifkr & Rosdy (2015) in which improved ability in reading and writing and students' being creative and imaginative were included in the last items ranked by teachers in assessing the effectiveness of ICT utilization on students' performance and learning.

Ghavifkr & Rosdy (2015) also related students' improved ability in language learning skills such as reading, writing, listening, and speaking to a lot of educational videos provided to students online. They also asserted that ICT enhanced students' thinking and enabled them to think out of the box enhancing their creativity and imagination.

Overall, teachers found the given indicators for the students' performance towards using ICT-based instructional materials to be moderately evident, especially during the "new normal" in education, which obtained a composite mean of 3.35. As regarded by Ghavifkr & Rosdy (2015) in their study, the use of ICT provided chances for students to become active and take more roles for their best learning experiences and performances. The students' performance towards using ICT was an influential instrument for providing educational opportunities both in the school set-up and in distance learning.

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The students' performances regarding the utilization of ICT-based instructional materials conformed with the statement of Hogarth et al. (2016), who stated that students' use of ICT simulations as part of ICT-based instructional materials helped them improve their understanding of Science ideas more effectively than the use of non-ICT teaching activities.

The result was also in conformity with the study of Santos (2014), who observed that students learn easier and faster by using audiovisual devices than by verbal explanation alone. He pointed out that ICT-based materials were useful in reinforcing the developed module to clarify lessons students learned from printed materials.

The above survey questionnaire results showed that ICT-based instructional materials enabled students to become more motivated and interested in learning. They also promoted high levels of student engagement, providing students with additional avenues to access other sources of knowledge.

Level of effectiveness of ICT-based instructional materials

Effective ICT utilization in education is a complex and multifaceted process. Its appropriate use expands access to education, strengthens its relevance to highly digital work environments, and raises educational quality. The level of effectiveness of utilizing ICT-based instructional materials as assessed by the teacher respondents is presented in Table II below.

Table II. Level of Effectiveness of ICT-based instructional materials

Indicators ICT-based instructional materials integrated in teaching in the new normal of education aide in.....	WM	VI	Rank
1. Increasing students' interest in the subject matter	3.22	ME	2
2. Explaining complex instructions easily and ensured students' comprehension	3.22	ME	2
3. Making the lessons more enjoyable hence improving students' concentration.	3.11	ME	7
4. Developing students' creativity	3.11	ME	7
5. Promoting active and engaging lesson for students' best learning experience	3.22	ME	2
6. Enabling students to understand theories/concepts better and more effectively	3.11	ME	7
7. Developing students' skills in recording and evaluating their findings and progress.	3.19	ME	6
8. Making students on becoming more self-directing and motivating	3.11	ME	7
9. Making students to become more autonomous in their learning in which they can repeat exercises if needed	3.20	ME	5
10. Improving students' abilities specifically in reading and writing	3.04	ME	11
11. Encouraging the students to express their ideas and thoughts better.	3.29	ME	1
Composite Mean	**3.17**	**ME**	

Legend:

WM= Weighted Mean *VI= Verbal Interpretation*

VE= Very Effective *SE= Slightly Effective*

ME= Moderately Effective *LE= Least Effective*

As presented in Table II, ICT-based instructional materials were found to be moderately effective in encouraging students to express their ideas and thoughts better, with the highest weighted mean of 3.29. This result was supported by the study of Palagolla (2019), which showed that ICT positively influenced students' educational performance, motivation, attention, collaboration, communication, and process skills. It also increases student self-confidence and eagerness to learn; thus, students can easily express their ideas and thoughts in class.

ICT-based instructional materials were also moderately effective in promoting active and engaging lessons for students' best learning experience, increasing

students' interest in the subject matter, and explaining complex instructions easily, ensuring students' comprehension, each having a weighted mean of 3.22. The results were congruent with the study of Jamieson-Procter et al. (2013), who emphasized that ICT-based materials were designed to stimulate students' understanding of the subject. They also asserted that it helped teachers design their lesson plans in an effective, creative, and interesting approach to maximize the students' abilities in active learning. In addition, Lucido (2012) emphasized that learners became more interested and engaged in learning when teachers used something they were familiar with, in this case, ICT, with which the digital learners were very familiar.

Meanwhile, as assessed by the teacher-respondents, ICT-based instructional materials were also moderately effective in improving students' abilities, specifically in reading and writing, with the lowest weighted mean of 3.04. However, the indicator ranked last among the given indicators and obtained the same verbal interpretation as the above indicators. The result is backed by the study of Ghavifkr and Rosdy (2015), who related students' improved ability in language learning skills such as reading, writing, listening, and speaking to many educational videos provided online or offline to students.

Teachers generally found using ICT-based instructional materials to be moderately effective in teaching-learning in the "new normal" education, obtaining a composite mean of 3.17. In this regard, the effectiveness of ICT utilization in teaching-learning can engage the learners and foster students' learning.

The results above also conformed to the study of Hussain et al. (2017), who regarded ICT as an effective learning aid for teachers and learners in teaching-learning. He emphasized that ICT was an effective and influential instrument for providing educational opportunities in the school set-up and on distance learning.

The above survey questionnaire results showed that ICT-based instructional materials effectively enabled students to become more active learners. They also aided teachers in delivering their lessons and ensuring better class interactions, even with the advent of distance education.

Relationship between the students' academic performance and level of effectiveness of ICT-based instructional materials

ICT-based materials are part of the teacher's and students' daily lives. Several studies have shown the positive impact of ICT on students' learning capabilities and performances.

Table III. Pearson-r Test on Student Performance and Level of Effectiveness of ICT-based Instructional Materials

Variables	r	p-Value	Significance	Decision
Performances and Effectiveness of ICT-based instructional materials	0.803	0.000	Significant	Reject HO

**At 5% level of significance*

As shown in Table III, the r-value (correlation coefficient) of 0.803 between the performance of the students in the use of ICT-based instructional materials and the level of effectiveness of ICT-based in-

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structional materials showed a high correlation between these two variables. Also, the p-value of 0.000 indicated that the null hypothesis was rejected and concluded that the relationship was significant since the P-value is less than 5%. The findings entailed that the students' performance towards the use of ICT-based instructional materials affects the effectiveness of ICT-based instructional materials in the teaching-learning process.

This result substantiates Ullah et al. (2019) and Hussain et al. (2017) that there was a significant relationship between ICT use and students' performance regarding the effectiveness of ICT utilization. Furthermore, their studies emphasized the positive effect of ICT utilization on student academic achievement and retention. Hence, the performance of the public secondary students in the Division of Batangas City towards integrating ICT-based instructional materials in teaching directly affects the effectiveness of the ICT-based materials in the teaching-learning process.

Challenges encountered by teachers and students in the utilization of ICT-based instructional materials

Although ICT in education has been encouraged to meet the needs of 21st-century learners and to cope with technology's demands even before the new normal in education came, considerable challenges and issues still exist. Tables IV and V below identify challenges the teachers and students faced in using ICT-based instructional materials.

Table IV. Challenges Encountered by Teachers in the Utilization of ICT-based Instructional Materials

Challenges	WM	VI	Rank
1. Students prefer to learn from teachers than learn through self-learning modules (SLMs), mobile phones, etc.alone	3.53	SA	2
2. Insufficient bandwidth or network connection speed	3.54	SA	1
3. Lack of experience in using ICT-based teaching materials	2.98	A	7
4. Unavailablity of ICT-based materials which are interactive	3.13	A	5
5. Insufficient trainings to practice the use of ICT in teaching especially during the new normal in education	3.14	A	4
6. Teaching time is not enough to use the ICT-based instructional materials	3.15	A	3
7. Inadequate skills on the use of ICT-based instructional materials	2.94	A	8
8. Insufficient pedagogical models on how to use the ICT for learning	3.00	A	6
9. Lack of interest towards the use of materials related with ICT in teaching	2.67	A	11
10. Difficulty in interacting/reaching with students who have queries on the subject matter handled	2.86	A	9
11. Difficulty in giving out instructions on the subject matter taught	2.81	A	10
Composite Mean	**3.07**	**A**	

Legend:
WM= Weighted Mean *VI= Verbal Interpretation*
SA= Strongly Agree *A= Agree*

The data gathered and presented clearly showed that insufficient bandwidth or network connection speed was on top of the challenges the teachers encountered in using ICT-based instructional materials. It obtained the highest weighted mean of 3.54.

This finding conformed with the study of Vien et al. (2019), who emphasized that the major challenges teachers face while using ICT include unstable internet connections. Nowadays, using the Internet in teaching is vital, and it has become an information highway for teachers and students (Mndzebele, 2013). Gebremendhin & Fenta (2015) mentioned that a stable Internet connection helped teachers use ICT

in their classrooms more easily. Still, it had to be admitted that though schools were expected to use the Internet, its availability was limited, especially in rural areas.

Students preferred to learn from teachers rather than learn through self-learning modules (SLMs), mobile phones, computers, etc. alone, and teaching time allotted to using the ICT-based instructional materials were revealed to be the teachers' second and third leading challenges. These challenges obtained a weighted mean of 3.53 and 3.15, respectively. These results were supported by the study of Hogarth et al. (2016), who asserted the gains in students' learning when using ICT.

On the other hand, teachers also agreed to some other challenges they faced. These include difficulty in interacting/reaching students who have queries on the subject matter handled, giving out instructions on the subject matter taught, and a lack of interest in using materials related to ICT in teaching. These three challenges were revealed at the bottom of the list with a weighted mean of 2. 86, 2.81, and 2.67, respectively.

The above results were supported by the study of Santos (2014) who cited the general lack of social interaction when using the Web as a limitation in using Web in teaching. The results were also backed by the studies of Asi (2014) and Yang & Wang (2012) emphasizing the effect of lack of technical support to assist teachers in the use of ICT assistance that may led to teachers' fear on the use of ICT, hence, caused them to become discouraged and uninterested to the use of ICT in teaching.

In addition, Nueva (2019) cited that social media networking through the Internet was used for instructional purposes. It promoted teacher-student and student-student interaction. However, due to the low-speed internet connectivity experienced by the teachers and the students, using the said social media networking sites in teaching affected the interaction of teachers and students.

Overall, results revealed that teachers agreed that they encountered several challenges in utilizing ICT-based instructional materials in teaching, especially during the implementation of distance learning under the new normal in education. However, the challenges cited in this study can be addressed if there is a strong will from the teachers and the support of the school administration.

Table V. Challenges encountered by the Students in the Utilization of ICT-based Instructional Materials

Challenges	Mean	VI	Rank
1. It is difficult to learn without the direct assistance of teacher and only use ICT-based learning materials like non-print modules installed in gadgets	3.19	A	1
2. The network access is slow or inadequate	3.11	A	2
3. Lack of orientation on how to use a gadget (tablet, android phone, laptop,etc.) and other ICT-based instructional materials for learning	2.53	A	5
4. Given time is not enough to use the ICT-based instructional materials provided	2.75	A	4
5. Limited hands-on activities and/or experiments to aide in learning	2.96	A	3
6. Lack of support from family members and/or relatives	2.51	A	6
7. Difficulty in reading and writing comprehensions	2.13	D	10
8. Difficulty in following self-directed instructions	2.48	D	8
9. Lack of interest towards the use and application of materials related with ICT in learning	2.43	D	9
10. Inability to receive direct feedback from the subject teachers whenever there are queries during the class schedule	2.49	D	7
Composite Mean	**2.66**	**A**	

Legend:
WM= Weighted Mean *VI= Verbal Interpretation*
A= Agree *D-Disagree*

The utilization of ICT in education facilitated both the instructional and learning process shifting the learning from teacher centered to student centered one. Despite of the positive response of students towards the use of ICT in learning, still, utilization especially in the context of distance learning approach posed some challenges to the students.

As presented in Table V, learning with the direct assistance of teachers and through ICT-based learning materials, such as the non-print modules installed in their gadgets alone, was the topmost challenge cited by the students on using ICT-based instructional materials. It obtained a weighted mean of 3.19. This result was supported by the study of Ghavifekr & Rosdy (2015), who emphasized that computers and technology are not replacement tools for quality teachers. Still, they were considered an add-on supplement needed for better teaching and learning even though students and teachers were physically far apart. This means that the teachers' guidance was an important factor in enhancing the use of ICT-based instructional materials.

Slow or inadequate network access and limited hands-on activities and/or experiments that may aid in learning were revealed to be the second and third challenges faced by the students. They obtained a weighted mean of 3.11 and 2.96, respectively. These results were supported by the study of Yang & Wang (2012), who emphasized that low connectivity sought to become a major problem and source of frustration for students causing interruptions in the teaching and learning process. In addition, the result of limited hands-on activities was supported by the study of Winthrop (2020), who cited that laboratory activities in Science and other subjects requiring performance would be limited to paper and pen tests in the context of distance learning.

On the other hand, students disagreed that they lacked interest in using and applying materials related to ICT in learning. They also categorically denied that they have difficulty following self-directed instructions. Difficulty in reading and writing comprehension was also not considered a challenge. These items ranked last on students' challenges in using ICT-based instructional materials. These results obtained a weighted mean of 2.48, 2.43, and 2.13, respectively.

The above results gained support from the study of Gebremedhin & Fenta (2015), who cited that digital learners nowadays are more frequently engaged in the meaningful use of computers. Hence, students showed interest in using and applying ICT in learning. In addition, the result was also supported by the study of Santos (2013), who regarded digital learners as active learners who were engaged in a self-guided, cooperative, independent, online, and open-learning environment.

In addition, this result aligned with Lucido's (2012) observation of digital learners. He observed that digital learners spend a lot of time talking with friends on their mobile phones, sending text messages, interacting through their social media accounts like Facebook, playing video or mobile games, and surfing the World Wide Web. This observation supported the students' disagreement on the difficulty in reading and writing comprehension since students or

digital learners practiced these skills in their everyday use of mobile phones, social media accounts, and Internet surfing.

Students agreed that they encountered several challenges in using ICT-based instructional materials, especially during the adoption of distance learning under the new normal in education. This result was congruent with the results obtained on the challenges encountered by the teachers. It was clear that teachers and students encountered such challenges in using ICT-based instructional materials in the teaching-learning process. However, despite the cited challenges, these can be addressed with the joint efforts of the different groups concerned, such as the teachers, students, school management, parents, and the government.

Designed additional ICT-based supplementary materials in Earth and Life Science

The designed additional ICT-based supplementary material was a learning material that can be used as an additional worksheet and instructional material in teaching Earth and Life Science. The additional ICT-based supplementary materials tackled some of the lessons in Earth and Life Science aligned with the Regional Memorandum No.306 series 2020 entitled "Guidelines of the Implementation of MELC Pivot 4A Budget of Work (BOW)" in all learning areas for key stages 1-4.

The topics covered by the additional supplementary materials designed were Earth's Subsystem, Minerals, Rocks and Rock Cycle, Geologic Processes and Hazards, Marine and Coastal Processes and Their Effects, and Plant and Animal Cells. The ICT-based supplementary materials are designed and composed of video clips, online and offline mobile and computer applications, use devices, and animations.

For the topic of Earth's subsystems, video clips through the given links may enhance students' understanding of the four subsystems of the Earth and their interaction with each other. Multimedia presentations, as well as the videos prepared by DepEd from other regional offices, were applied for further discussion on minerals, while an online website was utilized for the discussion of rock types and rock cycles. The online website was interactive for the students in which discussions were used, and interactive quizzes and animations were adopted.

Meanwhile, documentary videos and offline mobile applications such as photo collage, Earth's Core, and an interactive PowerPoint presentation were utilized for Earth's internal heat, geologic processes and hazards, and marine and coastal processes and mitigation practices. Social media platforms were also used to communicate and present outputs between the teachers and the students.

The rising trend of Augmented Reality was also adopted in the supplementary material. An augmented reality application was downloaded to create a 3D visualization of a concept in Life Science, particularly the plant and animal cells. The application, once downloaded, was available offline. It may enhance the traditional school content by making it more engaging and fun for the students.

The additional ICT-based supplementary materials for Earth and Life Science aligned with RTI International's (2015) definition of supplementary materials. They considered multimedia and digital materials supplementary instructional materials because they are a growing source of knowledge for teachers and learners. These supplemental materials can be a powerful tool for motivating and encouraging students to stay current in their subject matter, which in this study was Earth and Life Science for senior high school students.

CONCLUSION AND RECOMMENDATIONS

The study's findings revealed that the students' performance using ICT-based instructional materials was moderately evident as learners nowadays are active and take more roles in their best learning experiences and performances. The students' performance using ICT-based instructional materials was an influential instrument for providing educational opportunities both in the school set-up and on distance learning. Moreover, the level of effectiveness of ICT-based instructional materials in the teaching-learning process was found to be moderately effective in terms of motivating and engaging the learners, enabling them to embrace the student-centered approach to learning during the new normal in education, which also made them become more active learners expressing more of themselves and ideas. It was also revealed that there was a significant relationship between the student's performance in using ICT-based instructional materials and the effectiveness of ICT-based instructional materials in the teaching-

Meanwhile, teachers agreed with the challenges they encountered in using ICT-based instructional materials, such as insufficient bandwidth or network. Students also agreed that the challenges they encountered in using ICT-based instructional materials were the difficulty of self-learning and insufficient assistance from their teachers. The use of the internet, online and offline applications, video presentations, and YouTube, as the ICT-based instructional materials utilized in teaching-learning, plays a crucial role in education in the 21st century. Its use, speed, and different platforms aided in implementing distance learning modality.

In light of the findings and conclusions drawn from the study, it was recommended that schools conduct a pre-assessment of what the school, teachers, and students need and have regarding ICT integration before its full implementation. A specific ICT-based material only fits some schools because there were several challenges cited in this study about ICT integration, such as the internet connection. With this, a specific ICT-based material that uses the internet best fits one school rather than the other. ICT integration in teaching subjects such as Science can be further strengthened in school through additional ICT development and training programs such as through the School Learning Action Cell (SLAC), both for the basic and pedagogical skills which may provide teachers more updated and appropriate ICT-based instructional materials to be used in teaching. This also provides them with enhanced pedagogical and technical skills using ICT-based materials. With this, the effectiveness of ICT-based materials in the teaching-learning process can be further enhanced. A webinar for students on the "know-how" of using gadgets and different offline

and online computer and mobile applications is also recommended to utilize ICT-based instructional materials better. Parents' financial and emotional support is also encouraged to make using ICT-based materials more effective. Further and more profound research studies may be conducted on integrating ICT-based instructional materials, including the level of integration in different subject areas, the level of actual and evident use of ICT in classrooms, and learners' perceived effectiveness of ICT towards their learning.

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