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# Development of Technology-Enhanced Lessons in Optics (TELO)

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## ABSTRACT

This study developed and validated Technology-Enhanced Lessons in Optics (TELO), particularly in teaching electromagnetic spectrum and light. It adopted the Research and Development (R&D) methodology, anchored on the Input-Process-Output (IPO) and Substitution, Augmentation, Modification and Redefinition (SAMR) models. A needs–assessment survey on selected topics in the electromagnetic spectrum and light that need technology enhancement was done first before the material was developed. A panel of evaluators who were chosen purposively evaluated the content validity of the TELO in terms of its objectives, content, activities, and assessment techniques using a content validation rating scale. The weighted mean was used to describe the content validity of the TELO. Results of the needs-assessment survey revealed that all topics in the electromagnetic spectrum and light are included in the development of the material. Results of the validation revealed that the TELO is highly valid in terms of objectives, content, activities, and assessment techniques. The TELO applies the principles that activities can be considered interesting and engaging if they are anchored on the theory of constructivism and the SAMR model as a support theory and stimulates many senses and allows learners opportunities to construct their own ideas by integrating existing knowledge with new one.

## INTRODUCTION

Science is of great importance because of its links to technology and industry that are areas with high priority for development. Science systematically develops students' scientific inquiry skills, values, and attitudes such as objectivity, curiosity, and honesty, as well as mental habits such as critical thinking. All of these are beneficial to the individual student's personal development, future career, and life in general. These abilities, values, attitudes, and personalities are also beneficial to the community to which a student belongs and the country in which he lives. Paris (2019) reported the Philippines was ranked 79th in reading in the 2019 Program for International Student Assessment (PISA), as indicated by its very low average of 340 compared to the international average of 487. In addition, Filipino learners scored poorly in Mathematics and Science, as indicated by the low averages of 353 and 357 points, respectively. For both areas, the score is significantly lower than the international average of 489. Furthermore, according to Albano Jr. (2021), the National Achievement Test (NAT) results for 2018 revealed that the national average mean percentage score (MPS) continued to decline, with the lowest performance in the history of the Department of Education's standardized examination.

Physics, as one of the components of the Science curriculum, is considered as the most problematic because it traditionally attracts fewer students than other fields of Science. Based on observations, students rarely participate in classroom discussions because Physics for them is a boring and complicated subject. Students are reluctant to understand Physics concepts because they believe the subject is difficult and uninteresting due to its high complexity and abstractness. As what Villa (2010) stated in her study that there are abstract concepts in Physics which students hardly understand because these need a lot of mental and physical exploration. The extra effort to comprehend its nature, principles and laws is needed. Also, Tumaneng (2010) revealed that students have difficulty in comprehending abstract concepts in Physics because of the prevailing teaching practices which consists mostly of lectures, confirmation level of inquiry – based activities and examinations of concepts toward lower – order cognitive skills.

The researchers have also observed that most of the students ignore or give less importance to Optics, a branch of Physics which deals with study of nature, propagation, and properties of light. Students have seen and used optical devices, but they do not understand the principles behind their operation and are not fully knowledgeable on how to properly manipulate them.

When students are allowed to envision their own learning and create a style that really works for them, they become lifelong learners. This implies that in order to equip students with the 21st century skills, there is a need for teachers to embrace the educational shifts and new trends in Physics education and upgrade competencies in terms of finding alternatives to teach students in the most efficient and transformative ways.

There has been learning materials provided by DepEd for Optics, but these need additional technology enhancement. Thus, with the advent of technologies

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permeating almost all aspects of life especially in the educational arena, the researchers were challenged to develop and validate Technology–Enhanced Lessons in Optics (TELO) for Grade 10 Science in order to harness the students' attention, increase their interest to participate in class discussions and improve their academic performance.

With the advent of technologies permeating almost all aspects of life especially in the educational arena, the researchers were challenged to develop and validate Technology–Enhanced Lessons in Optics (TELO) for Grade 10 Science to harness the students' attention, increase their interest to participate in class discussions and improve their academic performance. This study was anchored mainly on the Input – Process – Output (IPO) Model supported by the Substitution, Augmentation, Modification and Redefinition (SAMR) Model and Theory of Constructivism. This study aimed to determine the topics in optics that need technology enhancements. Moreover, the researchers focused on developing and validating the Technology–Enhanced Lessons in Optics (TELO) in terms of its objectives, content, activities, and assessment techniques.

## LITERATURE REVIEW

With the adoption of the new curriculum, the same old problems in the education sector were not addressed. Still, there are inadequacy on the number of classrooms, textbooks, seats, and toilets in public schools (Navarro, 2022). The excessive teaching loads of teachers (Esguerra, 2018), the difficulty in following the spiral progression approach in teaching (Dunton & Co, 2019), the scarcity of instructional materials (Soriano & Vargas, 2021), the presence of big class sizes (Esguera, 2018), and the inadequate training for teachers (David, Albert & Vizmanos, 2019), are still there. Many educators and graduate student researchers have identified several factors contributing to Filipino students' poor performance in Science. These include teacher quality, the teaching-learning process, the school curriculum, instructional materials, and administrative support (Combalicer, 2016 & Abragan, 2022). Integrating ICT in the teaching-learning process has become a great concern of many educators in K to 12 schools in the Philippines. In pursuing ICT in education, Republic Act 10844 prioritizes providing Wi-Fi access at no charge in selected public places including parks, plazas, public libraries, schools, government hospitals, train stations, airports, and seaports. This ICT-supported education will allow students to use learned skills in other academic content areas, motivate them to learn more, provide them opportunities to collaboratively learn with other learners, and help them develop various bits of intelligence (Bonifacio, 2013). In sum, the above citations imply that constant evaluation of teacher competence and high-quality instructional materials are required to ensure excellent delivery of instruction in the field. This assessment determines weaknesses and strengths in the system and identifies relevant challenges that can solve the ailing condition of a country's education system.

With the intense desire to address learning lags in Physics brought about by the appearance of the many issues and concerns, reforms are implemented to transform the present Science curriculum making it at par with the rest of world. The lack of qualified Physics teachers, lack of textbooks and Physics teaching equipment, and congested curriculum were addressed to bring out the best in Physics education. Sumandal (2023) reiterated the need to develop science- and technology-based teaching materials is vital to attain the government's goals of quality education for all Filipino learners.

Various instructional materials have been developed to address the problems of Physics teaching. Computer – Based Instructional Materials include that of Diculen's (2002) Computer – Assisted Instruction (CAI) modules on selected topics in Work, Power, Energy and Simple Machines, Ubina (2002) made the Validated Computer – Simulated Projectile Motion Experiments (C-SPEX), Francisco (2003) developed Web-Based Instruction on selected topics in Electromagnetism and Batuyong (2017) created the Physics Education Technology (PhET®) Interactive Simulations – Based Activities in Electromagnetism. Infographics in Guided Discovery Lessons were also developed by Medrano and Pacis (2022) in teaching science. Contextualized instructional materials were also made by Villa (2003), Ramos (2013), and Ramos (2016) wherein they developed Indigenous Game-Based Activities, *Komiks* and Mother Tongue Based – Multilingual Education (MTB – MLE) Strategic Intervention Materials for teaching Physics, respectively. All these materials were found to be effective in improving students' academic performance in Physics.

Research findings proved that an interactive teaching strategy stimulating students' interest can improve Physics teaching and learning. It was stressed that effective technology integration into K to 12 classrooms supports Science as inquiry teaching (Guzey & Roehrig, 2009).

The basis of effective teaching with technology requires three main components namely: understanding of how to use ICT tools in educational context, pedagogical approaches that use technologies to teach the content and appropriate technology that enables discovery of new content and representations of the content (Koehler & Mishra, 2008). Furthermore, technology makes students' thinking visible and promotes critical listening, evaluation, and argumentation in the class (Bransford, Brown & Cocking, 2000). Moreover, using ICT materials provides an enhanced learning experience, especially so when the material is presented with pedagogical underpinning, is easy to navigate, is reflective, and well-thought out to enhance student learning and promote the development of active learners rather than passive recipients (Lagura, 2022). In this research, technology – enhanced lessons in Optics (TELO) is made. This is a computer-based instructional material intended to provide proper directions and applications

of knowledge through actual situations that are relevant to the learners with the integration of ICT that assesses students' mastery of the Physics concepts, particularly Optics. Each lesson has the following parts: objectives, contents, activities and assessment techniques.

## MATERIALS AND METHODS

This study used the Research and Development (R & D) methodology in developing and validating the Technology – Enhanced Lessons in Optics for Grade 10.

As shown in Figure 1, the steps in the R & D method in

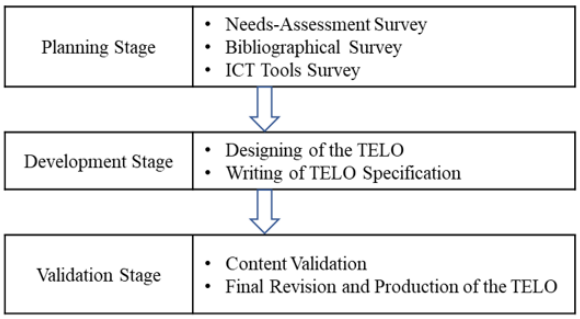


**Figure 1:** Schematic Diagram showing the steps in the Development of the TELO.

the development of the Technology – Enhanced Lessons in Optics are Planning Stage, Development Stage and Validation Stage.

### Planning Stage

Planning Stage included the conduct of needs-assessment survey, bibliographical research, and the ICT Tools survey.

Phase 1. Needs-assessment survey. This phase was the identification of the topics in Optics that need technology enhancement through questionnaire checklist.

Phase 2. Bibliographical research. In this phase, the researchers had extensive reading and analyzing possible sources of information on the legal bases of ICT integration in teaching and learning process such as the RA 10533 and RA 10844, the Science Curriculum Framework and the competencies in Optics stipulated in the K to 12 Science Curriculum and researching such as books, magazines, web pages, journals and other published and unpublished materials to help the researchers decide on the format, technical details and mode of presentation of the TELO.

Phase 3. ICT Tools Survey. In this phase, careful identification of the available and appropriate ICT tools was done. This includes downloaded videos, simulations through SWF, games, and quizzes from YouTube, PhET Colorado site and Footprints Science, Kahoot, and Quizziz.

### Development Stage

Development Stage included the designing of TELO specification and writing the TELO.

Phase 4. Designing of TELO Specification. In this phase, crucial processes were performed to meet the standard characteristics of the TELO. The K to 12 Curriculum Guide in Science, specifically, the Grade 10 learning competencies in the Physics Part were further examined. The topics that need technology enhancements included were based on the results of the needs–assessment survey. It was revealed that fifteen topics need technology enhancements. Downloaded video clips, simulations, interactive quizzes were included in the TELO.

Phase 5. Writing of TELO Specification. In the process of construction, the following steps were observed: 1) formulation of behavioral objectives, 2) determination of prerequisite concept and skills, 3) identification of the appropriate technologies for the lessons, 4) identification of innovative learning activities essential to the realization of the objectives, and 5) preparation of the evaluative items based on the content of the lesson. The layout design of the TELO was made using the software Microsoft PowerPoint 2010. The TELO was manipulated for several times since there are videos and simulations linked on it using VLC player and GOM Player, respectively.

### Validation Stage

Validation Stage included the validation of the TELO and the final revision and production of the TELO.

Phase 6. Validation of the TELO by a Panel of Evaluators. In this phase, the TELO was validated by a panel of Physics experts to establish internal validity in terms of its objectives, contents, activities, and assessment techniques.

Phase 7. Final revision and production of the TELO. The results of the validation were then used as bases for the final revision of the developed TELO. All revisions, corrections and remarks were incorporated in the final copy of the TELO.

There were two (2) groups of samples of the study. The first group was composed of ten (10) teachers who had been teaching Physics for at least five years. They served as needs–assessment survey teacher-respondents. The said teachers were requested to answer a survey questionnaire, the result of which became the basis of the researchers in developing the TELO. The second group was composed of the panel of evaluators which includes three (3) Physics experts and ten (10) field experts who served as validators of the TELO in terms of its objectives, content, activities and assessment techniques. The experts are Physics majors with exemplary performance in the field of Physics teaching.Two (2) instruments were used in this study to gather data, namely: 1) Needs -Assessment Survey questionnaire to determine the topics in Optics that need technology enhancement, and 2) Content Validation Rating Scale to assess the content validity of the TELO.

### Needs-Assessment Survey Questionnaire

This determined the topics in Optics that need technology enhancement. This questionnaire is composed of two parts: 1.) Personal Data Sheet; and 2) Topics in Optics that need technology enhancement checklist. Weighted

mean was used to determine the topics in Optics that need technology enhancement. The weighted means were interpreted using the following range of values with their corresponding descriptive interpretations.

| Ranges of Weighted Means | Descriptive Rating |
|---|---|
| 2.35 – 3.00 | Need Technology Enhancement (NTE) |
| 1.67 – 2.34 | Slightly Need Technology Enhancement (SNTE) |
| 1.00 – 1.66 | No Need to Enhance (NNTE) |

**Content Validation Rating Scale**

The content validation instrument has two parts. The first part required information on the evaluator's personal and professional background and the second part is composed of the criteria for evaluating the TELO's objectives, content, activities, and assessment technique. Each criterion had a set of items which was used as a guide for the evaluator's rating. Weighted mean was used to determine the content validity of the developed TELO and was interpreted using the following range of values with their corresponding descriptive interpretations:

| Ranges of Weighted Means | Descriptive Rating |
|---|---|
| 4.51 – 5.00 | Highly Valid (HV) |
| 3.51 – 4.50 | Valid (V) |
| 2.51 – 3.50 | Moderately Valid (MV) |
| 1.51 – 2.50 | Needs Improvement (NI) |
| 1.00 – 1.50 | Not Valid (NV) |

## RESULTS AND DISCUSSION

This portion presents a discussion of the salient findings and analyses of the gathered data.

**Topics in Optics that Need Technology Enhancement**

It is evident in Table 1 that all the topics under Electromagnetic Spectrum and Light for Grade 10 Science need technology enhancement as revealed by the overall mean rating of 2.56. Thus, it was necessary that all the topics in Optics need to be included in the making of TELO.

**Table 1:** Needs-Assessment Survey Result

| Topics in Optics | WM | DI |
|---|---|---|
| **A. Electromagnetic Spectrum** | | |
| 1. Development of the electromagnetic theory; | 2.50 | NTE |
| 2. Production and propagation of electromagnetic wave; | 2.90 | NTE |
| 3. Regions of the electromagnetic spectrum; | 2.60 | NTE |
| 4. Practical applications of the different regions of EM waves. | 2.60 | NTE |
| 5. Effects of electromagnetic radiation on living things and the environment. | 2.50 | NTE |
| **B. Light** | | |
| 6. The Nature of light; | 2.50 | NTE |
| 7. Properties of Light: A Review; | 2.50 | NTE |
| 8. Mirrors – Types and Uses; | 2.40 | NTE |
| 9. Reflection in Curved Mirrors; | 2.40 | NTE |
| 10. Graphical & Analytical Methods of Locating an Image in Mirrors; | 2.40 | NTE |
| 11. Lenses – Types and Uses; | 2.50 | NTE |
| 12. Refraction in Lenses; | 2.40 | NTE |
| 13. Graphical & Analytical Methods of Locating an Image in Lenses; | 2.40 | NTE |
| 14. The Eye and the Camera; | 2.80 | NTE |
| 15. Optical instruments | 2.70 | NTE |
| **Overall Mean** | **2.56** | **NTE** |

This finding coincides with the comments of the teachers that there is a dearth of technology-assisted materials in teaching Optics. In addition, teachers are unfamiliar with the different educators' apps that can be used in teaching Optics and other fields of Science. They further emphasized that technology-assisted instructional materials must be used in the classroom because most of the students are more motivated to learn when ICT is used, and this is to embrace the trend in shifting from the traditional to a technology-driven classroom.

**Content Validity of the Technology - Enhanced Lessons in Optics (TELO)**

This section presents the results of the validation by the panel of evaluators on the validity of the TELO as regards objectives, contents, activities, and assessment techniques.

**Objectives**

Table 2 below shows that the objectives of the TELO

were rated as highly valid by the panel of evaluators based on the overall composite mean of 4.93, which means that the objectives of the TELO are specific, measurable, attainable, realistic, time-bound and clearly stated.

**Table 2:** Results of the content validation of the TELO in terms of objectives. (n=13)

| Criteria | WM | DI |
|---|---|---|
| **The objectives of the TELO are…** | | |
| 1. specific | 5.00 | HV |
| 2. measurable | 5.00 | HV |
| 3. attainable | 4.78 | HV |
| 4. realistic | 4.95 | HV |
| 5. time-bound | 4.90 | HV |
| **Composite Mean** | **4.95** | **HV** |

This rating is notable because for any technology – enhanced lesson to be effective, it must be geared toward achieving its goals (Tumaneng, 2010).

The observations of the evaluators support this:

The lesson objectives really jibe with the learning competencies prescribed. – Expert 1

The objectives are SMART. – Expert 2

This finding conforms to that of Tumaneng (2010), which says that objectives are considered valid when all the criteria are present in the developed material. A valid instructional material should have objectives that are clearly stated, specific, measurable, attainable, realistic, time-bound and clearly stated.

**Contents**

Table 3 below shows that the contents of the TELO have an overall composite mean of 4.82 which is interpreted as highly valid. This means that the panel of evaluators agree that the lessons are clear and easy to understand, jibe with objectives and activities presented and the information that are utilized are up to date.

In addition, the lessons are equipped with technology – driven activities such as videos, games, simulations, and interactive sites which the learners are interested in to. Hence, the contents of the TELO are valid.

**Table 3:** Results of the content validation of the TELO in terms of content. (n=13)

| Criteria | WM | DI |
|---|---|---|
| **The contents of the TELO…** | | |
| 1. are clear and easy to understand | 4.73 | HV |
| 2. jibe with the objectives and activities presented | 4.73 | HV |
| 3. utilize information that are up to date | 5.00 | HV |
| **Composite Mean** | **4.82** | **HV** |

The result above is supported by the findings of Tumamao (2017) that in developing learning materials, the content should be relevant to the skill which the teacher wants to develop and suited to the level of the learners.

The outcome is also backed up by the following comment of one of the experts:

The contents are easy to understand and stated in simple way or manner. The concepts were clearly explained. I like how technology was used in presenting the lesson, very informative and interactive. – Expert 3

**Activities**

Table 4 shows that based on the composite mean rating (4.82), the activities in the TELO are highly valid.

This means that the lessons are helpful in making concepts clearer because they represent real-life situations, are relevant to the prescribed curriculum which is technology-based and student centered, up–to–date information with the use of video clips and simulations, varied, thought-provoking, logically-arranged, provided with the use of appropriate multimedia materials that are

**Table 4:** Results of the content validation of the TELO in terms of activities. (n=13)

| Criteria | WM | DI |
|---|---|---|
| **The activities of the TELO…** | | |
| 1. represent real life situation | 4.47 | V |
| 2. are helpful in making lessons clear | 4.78 | HV |
| 3. develop topics/concepts relevant to the prescribed curriculum | 5.00 | HV |
| 4. provide up to date information | 5.00 | HV |
| 5. are varied and arranged in logical sequences | 4.73 | HV |
| 6. present varied and thought-provoking activities | 4.95 | HV |

| | | |
|---|---|---|
| 7. have enough activities that could develop needed skills and critical thinking ability | 4.63 | HV |
| 8. provide opportunities for the students to be actively involved | 5.00 | HV |
| 9. include activities which are interesting and challenging | 4.95 | HV |
| 10. use clear and logically arranged instructions/directions/steps | 4.95 | HV |
| 11. develop desired values | 4.37 | V |
| 12. use instructional media that clearly develop the concepts | 5.00 | HV |
| **Composite Mean** | **4.82** | **HV** |

aligned to the interest and skills of the students to better learn the concepts.

The following comments of the evaluators support this finding:

This is the need of our learners nowadays since they are fond of using technologies such as cellphones and computers. The TELO is indeed a response for the 21st century teaching and learning placing ICT as the key tool. Good job! – Expert 4

Without sacrificing the real essence of the lessons, the learners are entertained because of the visuals they see while learning how and why things behave as they are. – Expert 5

**Assessment Techniques**

Table 5 reveals that the experts rated the TELO assessment techniques as highly valid as shown in the overall mean rating (4.72). This means that the assessment exercises of the TELO highly match with the objectives of the lesson (4.78), measure mastery (4.73) and develop critical thinking skills of the students (4.63). The ratings also show that the assessment techniques seek to determine whether the objectives have been attained which is an important characteristic of an assessment tool.

**Table 5:** Results of the content validation of the TELO in terms of assessment techniques. (n=13)

| **Criteria** | **WM** | **DI** |
|---|---|---|
| **The assessment techniques employed in the TELO…** | | |
| 1. match with the objectives of the lesson | 4.78 | HV |
| 2. measure mastery of the lesson | 4.73 | HV |
| 3. develop critical thinking | 4.63 | HV |
| **Composite Mean** | 4.72 | HV |

This is supported by the following comments of the experts:

The assessment exercises of the TELO are more focused on the utilization of authentic assessment rather than the traditional assessment. -Expert 6

The assessment techniques include differentiated instruction and cater multiple intelligences. -Expert 7

**Summary of Evaluation**

Table 6 presents a summary of the evaluation of the panel of evaluators on the four aspects of the TELO, namely objectives, content, activities, and assessment techniques. The TELO was evaluated as highly valid on all the four aspects of evaluation with an overall mean rating (4.82) which is interpreted as highly valid.

**Table 6:** Summary of the results of content validations of the panel of evaluators. (n=13)

| **Criteria** | **WM** | **DI** |
|---|---|---|
| 1. Objectives | 4.93 | HV |
| 2. Contents | 4.82 | HV |
| 3. Activities | 4.82 | HV |
| 4. Assessment Techniques | 4.72 | HV |
| **Overall Mean** | **4.82** | **HV** |

The TELO is valid. Therefore, the different parts of each lesson – the objectives, content, activities, and assessment techniques – are aligned with each other.

This is supported by the following observations of the experts:

The TELO is very much useful in teaching complex topics in Physics such as Electromagnetic Waves and Optics. In this way, the learners could learn and understand the lessons at their own pace. – Expert 8

Your design of the material is highly interactive, congratulations. It is obvious that there is conscious effort to challenge students to learn on their own. Good work! This is what the students need, ICT integration in the class. They will love it and they will become more active and participative in class. – Expert 9

This is what the students need, ICT integration in the class. They will love it and they will become more active and participative in class. – Expert 10

**Feedbacks from the Evaluators**

The validators gave written suggestions and comments which the researchers implemented to improve the validity of the TELO. These are as follows:

Include the skills and attitudes domains in the objectives. 2) Make sure the contents and activities were stated as objectives. 3) Use contrasting colors and make words readable. – Expert 11

1) Think of the time to accomplish assigned work for the students. 2) Always make your assessment HOTS – based. – Expert 12

As suggested by the validators, the researchers used contrasting colors in the TELO. Furthermore, the objectives were revised so that they are stated in a behavioral manner; the questions in the assessment were improved and edited. The time frames were revised as to the level of difficulty of the work.

Based on the content validation, the TELO is a vital tool in improving instruction particularly in teaching Optics. The researchers, along with the validators, believe that the TELO could help teachers attain goals and objectives in developing students' critical thinking skills. This material is also a response to the implementation of the ICT – based instruction as pursuant to the mandate of the K to 12 curriculum.

Moreover, the TELO features one of the most effective ways to teach optics is through the use of simulations and visualizations. There are many software programs available that allow students to simulate the behavior of light in various optical systems, such as lenses, mirrors, and prisms. This helps students understand complex concepts and visualize how light behaves in different situations. In addition to simulations, virtual experiments can also be used to teach optics. Students can perform experiments in a virtual environment, allowing them to explore the properties of light and optical systems without needing expensive equipment. Virtual experiments can also be used to introduce students to more advanced concepts that are difficult to demonstrate in a traditional laboratory setting. Many online resources are available for teaching optics, including videos, tutorials, and interactive demonstrations. These resources can be accessed from anywhere with an internet connection, making it easier for students to learn at their own pace and from the comfort of their own homes.

## CONCLUSION

The following conclusions and recommendations were drawn based on the study's findings. The teachers perceived that all the topics under Electromagnetic Spectrum and Light for Grade 10 Science need technology enhancement as indicated by the overall mean rating of 2.56. The Technology-Enhanced Lessons in Optics (TELO) is a very good instructional material in teaching Physics for it is valid in improving the performance of Grade 10 students.

The developed TELO is highly valid regarding its objectives, contents, activities, and assessment techniques making them appropriate and relevant for the development of Physics concepts.

The TELO applies the principles that activities can be considered interesting and engaging if they are anchored on the theory of constructivism and the SAMR model. TELO stimulates many senses and allow the learners' opportunities construct their own ideas by integrating existing knowledge with new one.

## RECOMMENDATIONS

The researchers highly recommend that teachers should use the TELO in classroom teaching to enhance students' performance. The TELO is also highly recommended to be employed for classroom instruction on other areas of Physics.

ICT experts should design more computer-based tools that can be used for classroom instruction. Also, ICT developers should seek feedback from users to further improve interactive software that they will use in making more interactive simulations and other computer-based tools for teaching and learning.

Seminars and workshops should be conducted in constructing materials such as the TELO to equip teachers with essential knowledge and skills on using technology especially ICT in the teaching and learning process. Administrators should encourage and provide necessary support to their faculty to produce instructional materials and update existing materials.

Finally, similar, or related studies should be done to investigate empirically the use of TELO in other topics in Physics or other Sciences.

Overall, technology can be an effective tool in teaching optics, providing students with a more interactive and engaging learning experience. However, it is important to ensure that technology is used in a way that complements traditional teaching methods and that it is accessible to all students, regardless of their socioeconomic status or access to technology.

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