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RESEARCH ARTICLE

DEVELOPMENT, IMPLEMENTATION AND EVALUATION OF TECHNOLOGY REFLECTIVE INQUIRY BASED PHYSICS INSTRUCTIONAL MODEL: TOWARDS STUDENTS' LEARNING

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ABSTRACT

Innovative instructional models are essential in the promotion of quality Science education. Continuous efforts are made to improve the teaching learning process that is geared towards 21st century education. In the 21st century classroom, teachers are facilitators of student learning and creators of productive classroom environments in which students can develop their knowledge, skills and attitude they will need in their field. In the Philippines, Commission on Higher Education advocates for an outcomes-based education and promotes for a shift from teaching-centered approach to student-centered approach. Inquiry-Based Learning and Reflective Learning along with Technology Integration support student-centered approach. Because the focus is now on the students, there is also a need to observe and measure the knowledge, skills, and attitudes (KSA) that have been achieved. This study aimed to develop an Instructional model for Filipino learners that incorporated inquiry-based learning, reflective learning, technology integration as well as students' engagement and teacher's attitude in order to achieve students' learning in KSA. The developmental method of research was utilized in the study. A total of four stages were carried out that led to the development, validation and evaluation of a TRI-P6 Instructional Model. The results of the methods of the study contributed to the improvement in the working model. The inputs to the instructional model yielded a refined model that now includes the following constructs: 1) TRI-P6 (Technology Integration, Reflective Learning, Inquiry-Based Learning and P6 Steps), 2) Instructional Activities, 3) Students' Engagement 4) Teacher (Attitude and Teaching Methods), and 5) Students' Learning in KSA. The use of TRIP6 instructional model helps towards students' learning. Educators are therefore encouraged to consider instruction guided by the TRIP6 instructional model.

INTRODUCTION

Continuous efforts are made to improve the teaching learning process that is geared towards 21st century education. In the 21st Century classroom, teachers are facilitators of student learning and creators of productive classroom environments in which students can develop the skills they will need in the workplace. The Commission on Higher Education (CHED) of the Republic of the Philippines advocates for an outcomes-based education which promotes for a shift from teaching-centered approach to student-centered approach. In this paradigm shift, the teacher is not just an expert giving inputs, s/he a facilitator of learning, allowing the students to play their part in constructing knowledge through experience, discussions, reflections, and other processes that enhance learning.

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CHED defines outcomes-based education as an approach that focuses and organizes the educational system around what is essential for all learners to know, value, and be able to do. If the quality of education delivered to the society is to be improved, then the underlying educational practices involved in shaping our learners also need to improve. This research involves designing an instructional model for undergraduate physics towards students' learning which incorporated inputs from inquiry-based learning, reflective learning, technology integration, students' engagement and teacher's attitude.

Inquiry-based learning: The inquiry-based instruction is an activity of a teacher and a pupil that is focused on the development of the knowledge, skills and attitudes based on the active and relatively individual cognition of the reality by the pupil who learns on his/her own how to explore and explores (Dostál, 2015). Whitworth, Maeng & Bell (2013) mentioned that inquiry is an important pedagogical approach in teaching Science. Inquiry-based learning describes an environment in which learning is driven by a process of inquiry owned by the student.

Several studies have also reported significant effects in learning outcomes and Science achievement (Abdi, 2014; Smallhorn, Young, Hunter, & da Silva, 2015). Learning is more meaningful to the students because they are the one who came up with the premises of the learning outcome rather than be given the theory itself. Inquiry-based learning "allows students to progress from simply holding and finding factual informationto being able to apply new knowledge in novel and different ways" (Coffman, 2009).

Reflective Learning: Reflective learning is understood as a process that leads to reflection on all sources of knowledge that may contribute to understanding a situation, including personal sources and experience (Colomer et al., 2013). Implementation of student-centered approach that put reflective practice at their heart responds to the challenges posed by the society. This demand is supported by one of the most important goals of higher education to develop students' ability to learn continuously, reflecting on one's experience, in order to develop prospective specialists' holistic competence (Jakubė & Juozaitis, 2012). To learn from experience, we need to examine and analyze the experience; this is what reflection means in this context. Reflection on practice is central to learning and development of knowledge. Reflective learning can serve as a useful and appropriate methodology for developing generic skills such as independent learning and adaptation to new professional situations, among others (Colomer et al., 2013).

Technology Integration: The technology provides opportunities to enhance students' involvement in their study, improve students' achievements, and enable more active and personalized learning (Naveh, 2015; Snytnikova, 2015). There is a growing body of evidence that technology integration positively affects student achievement and academic performance. Various use of modern technology in the field of education is being integrated by teachers and educators to facilitate learning using the technologies available (Adams et al., 2006). Use of technology can help to improve and enhance the acquisition of knowledge and skills, and learning with and about technology is essential for students to gain the competencies to function well in a 21st century society and workforce (Moeller & Reitzes, 2011).

Students' Engagement: The students' success in achieving learning in terms of knowledge skills and attitude may also be attributed to students' engagement in the classroom. It is a term used to describe student's meaningful involvement throughout the learning environment. It is a multidimensional construct which includes cognitive engagement, behavioral engagement, and affective engagement which are dynamically interrelated (Stone, 2006; Kong, Wong, & Lam, 2003). Cognitive engagement includes persistence, willingness, motivation and psychological investment to learn. Behavioral engagement includes participation in activities. Emotional engagement includes attitudes, interest, sense of belonging and identification (Fredricks et al., 2004).

Teacher's Attitude: Akinfe, Olofimiyi & Fashiky (2012) studied teacher characteristics as predictor of academic performance of students and findings reveal that students' academic performance correlate positively and significantly depending on teachers' attitude to teaching and learning in the classroom; knowledge of subject matter and teaching skills. A study conducted by Ekperi et al. (2019) shows a positive and significant relationship between teacher's attitude and student's academic performance. This finding agrees strongly with the assertion made by Akinfe et al. (2012) and Afolabi (2009) whose studies established a positive and significant relationship between the teacher's characteristics and academic performance. Hamre & Pianta (2006) reported that positive student-teacher relationships are a valuable resource for students because it allows students to be able to work on their own knowing they can count on their teacher if problems arise.

Purpose: There really is a complex set of probable factors that can effect change in education, particularly Science education. Incorporating the literatures about the inquiry-based learning, reflective learning and technology integration, as well as students engagement and teachers' attitude contributes to a responsive instructional model for Filipino learners in college physics. This serves as the main objective of this current study, the development, implementation and evaluation of a Technology Reflective Inquiry-Based Physics (TRI-P6) Instructional Model towards students' learning. Specific objectives of the study include: 1) develop and validate an instructional model in physics helps achieve students' learning; 2) develop learning plans based on the instructional model; 3) pilot the study; 4) determine students' learning in KSA; 5) determine the level of students' engagement; 6.) determine the teacher's attitude; 7) evaluate the developed instructional model.

METHODOLOGY

Research Design: The study utilized the developmental research design. Developmental researches typically involves the following phases: design, development, and evaluation (Richey & Klein, 2005). There are four stages in this study: Stage 1. Design and Development of the working model; Stage 2. Development of Curriculum materials; Stage 3. Implementation; and Stage 4. Model Evaluation.

Stage 1: Design and Development of the working instructional model

This stage of the study involves the utilization and review of existing literature about inquiry-based learning, reflective learning, technology integration, students' engagement and physics teacher's attitude in the development of an instructional model in physics that will improve the learnings of the students.

Stage 2. Development of Curriculum Materials

In this stage, the working model was used to develop learning plans and identify existing materials for the conduct of the study: 1) learning plans, 2) Physics Test, 3) Survey and Rubric for Skills Assessment, 4) Survey for Attitude Assessment, 5) Students' Engagement Survey, 6) Teacher Attitude Scale and 7) Evaluation Tools.

Stage 3. Implementation

The pilot implementation was done on identified 3 classes of students taking physics course. The subjects are part of an intact group in a catholic university in the capital of the country. Only participants with written consent were considered in the analysis of the study. The learning plans were implemented in a period of a half semester. Students'

Learnings in knowledge, skills and attitude (KSA) were analyzed before and after using the working instructional model. The survey questionnaires for students' engagement and teacher's attitude were also administered.

Stage 4. Model evaluation

In this stage, the evaluation of the model was done by content experts and science education specialists. Inputs of the experts became the basis for the development of a revised version of the proposed instructional model.

Research Instruments

***Learning Plans*:** The learning plans that were developed included the identified features of the TRI-P6 instructional model. In validating the learning plans, content experts looked into the details of the plan. They rated how the learning plans met the following general criteria: A) learning plan should include the following features 1) Inquiry-Based Learning; 2) Reflective Learning; 3) Technology Integration; 4) Students' Engagement; 5) Teacher's attitude; and B) General evaluation of learning plans.

Physics test: The Physics tests was developed by the researcher and given during the conduct of the study, and will serve as measures of students' learning in Physics in terms of knowledge. The item difficulty indices of the knowledge test scores were used to compute for reliability coefficient (KR-20) = 0.743 which is considered as an acceptable value for the study's aim.

Reflective Thinking Skills Questionnaire: This refers to the instrument adapted from the Reflective Thinking Questionnaire developed by De Leon (2019). The researcher reports a reliability coefficient Cronbach's alpha of 0.768 which tells that the items are internally consistent.

Metacognitive Skills Scale: This refers to the instrument adapted from the Metacognitive Skills Scale developed by De Leon (2019). The 15-item questionnaire describes the ability of a student to analyze how he thinks. The internal consistency coefficient Cronbach's alpha of the questionnaire is 0.865. *Student Engagement Survey*– this refers to the instrument adapted from the Student Engagement in Mathematics and Technology Scale (SEMTS) developed by De Leon (2019). The 16-item questionnaire aims to measure the level of participation of students in learning Physics and with technology. The internal consistency coefficient Cronbach's alpha of the questionnaire is 0.884.

Physics Attitude Scale: This refers to the instrument adapted from the Physics Attitude Scale Questionnaire developed by Kaur & Zhao (2017). The internal consistency analysis of the instrument as a whole and each of the dimensions revealed a significant value of Cronbach Alpha coefficient ranged between 0.75 and 0.89. The content validity of the Physics Attitude Scale was established by the close agreement of experts on the statements.

Evaluation Tool for the model: This instrument adapted from Torio (2018) is for the evaluation of the developed model. The results of the evaluation of this instrument revealed that all items in the instrument were able to help meet its objectives.

Data Analysis

The data collected were analyzed using statistical tools to find out how it relates to one another, and results were interpreted consequently. For the quantitative part, the following statistical tools were used and all computations were done through Microsoft Excel and Statistical Package for Social Sciences (SPSS) version 28.

Frequency, mean, and standard deviation: These measures were used to describe the data about the item analysis of the Physics Test, instrument evaluation, descriptive statistics of students' learning in terms of KSA and demographics of the evaluators and validators of the instruments developed in the study.

*KR-20.*This was used in checking the reliability of the physics test.

Paired Sample T test: This measure was used in determining the significant difference between the pre and post assessment of the students' learning in terms of knowledge, skills and attitude

Assumption Tests: Before proceeding to parametric data analysis, specifically the paired t-test, several assumptions need to be met by the sample data. The following are the appropriate statistical tests to determine whether the assumptions were met or not:

1.) Skewness and Kurtosis;
2.) Shapiro-Wilk; and
3.)Kolmogorov-Smirnov.

Thematic analysis: It is the process of identifying patterns or themes within qualitative data Braun & Clarke (2006).

RESULTS AND DISCUSSION

Stage 1 Results: Design and Development of the Initial Model. In the development of the initial working instructional model, the researcher considered reviewing the literature. The salient features of the review include three important constructs: 1) Inquiry-Based Learning, 2) Reflective Learning, 3) Technology-Integration. It is complemented by students' engagement and teacher's attitude. The synthesis helped pave the way towards the development of theinitial instructional model shown in Figure 1.

Figure 1. TRIP6 Initial Instructional Model

Stage 2 Results: Development of Curriculum Materials

In order to translate the claims of the initial instructional model into a testable product, a design based on the developed initial model was developed.

The first component which is the laboratory inquiry skills of the 3 sections were described as "good". Table 2 presents the paired-sampled t-test of the second component which is the students' reflective thinking skills:

Table 1. T-test result of the Students' Pretest and Posttest

	Mean %	SD	MD	SD	t	df	p
SectionA-PreTest	34.868	8.341	26.97	15.845	10.494	37	0*
SectionA-PostTest	61.842	13.364					
SectionB-PreTest	29.375	7.128	17.27	7.864	12.42	31	0*
SectionB-PostTest	46.641	5.666					
SectionC-PreTest	30.345	8.575	18.79	13.687	7.394	28	0*
SectionC-PostTest	49.138	10.902					

Note. The following legends were used: SD – Standard Deviation; df – degrees of freedom; *p < 0.05; MD – Mean Difference

Table 2. T-test result of the pre- and post- assessment of Students' Reflective Thinking Skills

Reflective Thinking Skills	Pre-Assessment		Post-Assessment		Mean Difference	t	df	p
	Mean	SD	Mean	SD				
Section A	3.380	0.345	3.579	0.320	0.199	3.763	37	0*
Section B	3.290	0.316	3.500	0.367	0.210	3.267	31	0*
Section C	3.386	0.373	3.655	0.346	0.270	3.080	28	0*

Note. The following legends were used: N – Number of items; SD – Standard Deviation; df – degrees of freedom; *p < 0.05

Table 3. T-test result of the pre- and post- assessment of Students' Metacognitive Skills

	Pre-Survey		Post-Survey		Mean Difference	t	df	p
Metacognitive Skills	Mean	SD	Mean	SD				
Section A	3.174	0.317	3.355	0.355	0.181	3.804	37	0*
Section B	3.131	0.343	3.342	0.391	0.210	5.454	31	0*
Section C	3.037	0.369	3.435	0.403	0.398	4.728	28	0*

Note. The following legends were used: N – Number of items; SD – Standard Deviation; df – degrees of freedom; *p < 0.05

The design involves the inclusion of all identified features of the model, vis-à-vis, the 5 constructs. The following eight (8) lesson features were identified: 1) lesson topic, 2) Course Outcomes, 3) general plan of activities, 4) lesson outline, 5) integration of Bybee's 5E inquiry model and use of technology guided by SAMR model (Puentedura, 2010), 6) short quiz, 7) and 8) Guide to Gibbs reflection. These lesson features were used as reference in developing the learning plans. A multiple-choice type of Physics test was used as the format of the test which is a combination of conceptual questions and problem solving. The item difficulty indices of the knowledge test scores were used to compute for Kuder Richardson reliability coefficient (KR-20) = 0.743 which is considered as an acceptable value for the study's aim.

Stage 3 Results of Pilot Implementation

In the third stage, 3 classes of students taking physics course were used as a pilot group for the instructional model. Data about students' learnings in KSA, Students' engagement, Teachers' Attitude, how students improve their learning in Physics and their difficulties encountered in learning were taken from the results of the pilot. To determine the effect of using the TRIP6 Instructional model in the pilot, the researcher analyzed the students' learning in KSA. The results of the pretest and posttest in Physics Test as well as the paired sampled t-test result is shown in Table 1. In terms of knowledge, the students of Section A had a 26.97% gain, section B had a 17.27% and Section C had a 18.79% gain at the end of the intervention. These values were found to be significant. In terms of skills, 3 components were measured namely: laboratory inquiry skills, reflective thinking skills and met acognitive thinking skills.

The data revealed that there is a significant difference between the pre-assessment and post-assessment of the students' reflective thinking skills in the 3 sections. The pre-and post-assessment mean difference in Section A is 0.199, in Section B is 0.210, while in Section C is 0.270. The third component which is the metacognitive thinking skills of the students were described as "good" in the post assessment. Table 3 presents the paired-sampled t-test of the students' metacognitive skills before and after the use of the TRIP6. The data revealed that there is a significant difference between the pre-assessment and post-assessment of the students' metacognitive skills in the 3 sections. The pre-and post-assessment mean difference for Section A is 0.181, Section B is 0.210 and Section C is 0.398. In terms of attitude, students in general were described to have a 'positive attitude' in the 3 sections. The data revealed that there is a significant difference between the pre-assessment and post-assessment of the students' attitude for Section A and Section C while it was found out that there is no significant difference between the pre-assessment and post-assessment of the students' attitude for Section B. Further analysis of the 2 factors under attitude shows that even though in the overall result of the t-test, there is no significant difference of students' attitude of Section B, exploring the first factor under attitude revealed that there is a significant difference between the pre-assessment and post-assessment of the students' Enthusiasm towards Physics in the 3 sections. Students' engagement was described as 'engaged' in the 3 sections while students' views towards their Physics Teacher's attitude were described as 'positive' in the 3 sections. To look on how students improve their learning, data from students' reflections were analyzed. The students were asked to reflect about their learning experience. Gibb's reflection guide was used which

includes 6 stages: 1.) Description; 2.) Feeling; 3.) Evaluation; 4.) Analysis; 5.) Conclusion; and 6.) Action Plan. Thus, the reflection essays of the students covered a broad variety of topics in their learning experiences. The researcher used thematic analysis to explore on how students learned or improved learning through their reflection essays.
Braun & Clarke's six-phase framework for doing a thematic analysis was used as guide.

The 6 phases include: become familiar with the data, generate initial codes, search for themes, review themes, define themes, and write-up. First, the researcher read all the students' reflection essays become familiar with the data. All 99 student respondents in the research wrote reflection essays. Of these 99 students, 90 mentioned about what helped them improve their learnings. 241 reflection excerpts discussing what helped them improve their learnings were manually extracted by researcher who read the reflection essays. Second, the researcher performed thematic coding on 241 reflection excerpts manually extracted. These were coded independently and generated a total of 56 independent codes. For example, "laboratory experiment", "group collaboration", "first-hand experience" and "professor's way of teaching" are some initial codes. Third, codes were reviewed again and themes were extracted. The themes were not selected based on importance or the frequency with which they were being mentioned by students. Instead, they represent different factors which help students improve learning. After finalizing the categorization of the initial codes and themes, the researcher reviewed again the themes which is the fourth step. Three major themes emerged which include: 1) Instructional Activities; 2) Students' Engagement; 3 Teacher (Attitude and Teaching Methods). Fifth the researcher defined the themes and lastly made a write-up.

Instructional Activities: This theme refers to the different activities that students have done which helps them improve learning in Physics which include Laboratory Experiment, Group Report/Presentation, Discussion, Reflection, Use of technology, Group activities, Online Questionnaires, Seatwork and Group Discussion.

Students' Engagement: This theme refers to the involvement of students in the different activities which helps them improve learning in Physics which include: first-hand experience, brainstorming, doing trial and error, working with groupmates, delivering thoughts in front of class, figuring out own ideas, being a leader, communicating, going through the process of learning, showing interest to learn, cooperating, making mistakes, being focus, being patient, working as a team and others.

Teacher: This theme refers to the teacher related factors which helps students improve learning in Physics which includes 2 sub themes: Teacher's Attitude and Teaching Methods.

Difficulties encountered by some students from the analysis of reflections include: 1) Trouble in computations; 2) Too many formulas; 3) Weakness in numbers; and 4) Committing mistakes during experiment.

Revision of TRIP6 Instructional Model: Insights from the pilot contributed to the improvement of TRI-P6 Instructional Model. Improvement on how the TRI-P6 Instructional Model will be incorporated in learning plans to provide additional activities which would address the difficulties encountered by the students was added. This insight from the pilot contributed to an additional construct in the instructional model. This construct is called P6 (Plan, Prepare, Present, Process, Pose and Probe) which will represent the steps to incorporate the different constructs in developing learning plans.

Plan: The planning part answers the question: 1) What learning outcomes in knowledge, skills and attitude are expected to be developed after the instruction? and 2) what instructional materials and technology to be used? *Prepare* – The teacher prepares the learning plans which includes course outcomes, activities, experiments, assessment, technology and instructional materials needed based from what has been planned. *Present* – The teacher presents the topic and determines what the students know about it. The teacher presents the activities and experiments prepared in this stage which gears towards the achievement of learning outcomes. *Process* – This stage gives an opportunity for the students to process their learnings from the activities and experiments with their teacher. Teacher discusses about the topic relating it to the students' learning experience and corrects also misconceptions. Teacher can give examples where to apply what they have learned. *Pose* – The teacher challenges what the students have learned so far and poses questions or seat works which the students will answer as a practice. *Probe* – The teacher probes on the students' learnings and asks them to reflect. This is also where assessment takes place so the teacher can give appropriate feedback. The teacher probes on the learning experience from which improvement will be based From the analysis of students' reflections, 3 themes emerged which according to the students helped in their learning which includes: 1.) Instructional activities; 2.) Students' Engagement and 3.) Teacher which can be further sub-categorized into: teacher's attitude and teaching methods. Instructional activities which consider Inquiry-based learning, Reflective Learning and Technology Integration help provide an effective physics instruction in which complemented by students' engagement and teacher's attitude and teaching methods helps towards students' learning in KSA. From these results, revision was made in the TRIP6 Instructional model. The results of the implementation and personal insights of the proponent led to the following revised instructional model:

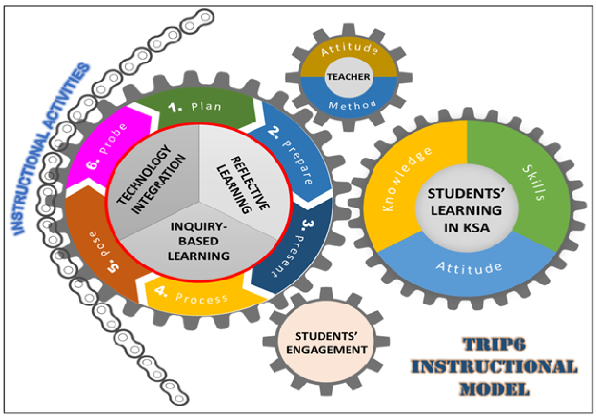

Figure 2. Revised TRIP6 Instructional Model after pilot

Stage 4 Results: Evaluation of the Model: A total of eight experts evaluated the model. The evaluators are all Science and Mathematics Education experts. The following figure shows the final TRI-P6 Instructional model after incorporating the suggestions of the evaluators:

Figure 3 shows the five important constructs of the TRIP6 Instructional Model: 1) TRIP6 (Technology Integration, Reflective Learning, Inquiry-Based Learning and P6 steps); 2) Instructional Activities; 3) Students' Engagement; 4) Teacher (Attitude and Teaching Methods); and 5) Students' Learning in KSA.

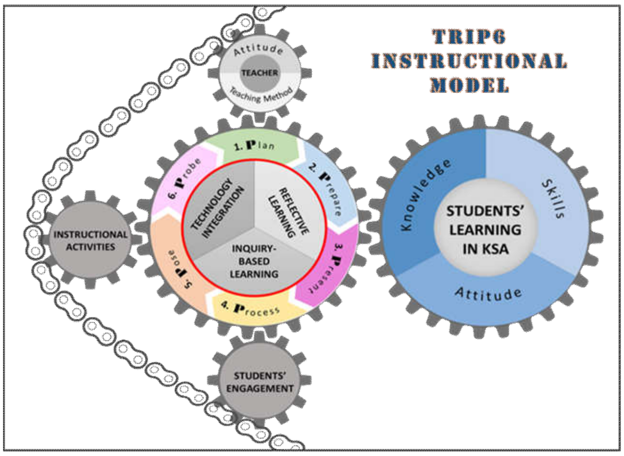

Figure 3. Final TRIP6 Instructional Model

Gears were used to represent the different constructs in the study. The movement of KSA gear which represents students' learning in KSA depends on the movement of the TRIP6 gear. The movement of TRI-P6 gear depends on the three gears which represent the constructs which were found to improve students' learning in Physics which include: Instructional activities, Students' Engagement and Teacher (Attitude & Teaching Methods). The rate at which: TRI-P6 is translated into instructional activities, how TRI-P6 help encourage students to engage in instructional activities and how TRIP6 is considered in teaching and implementation of the teacher determines the speed of the movement of the KSA gear which represents the student's learning in KSA. It is deemed that the more considerations of the TRI-P6 in Instructional activities, Students' engagement and Teacher's attitude & teaching methods, the more contributions that can help push students' learning in KSA.

Conclusion

Following a model for teaching is important for science educators. It is an even more significant feat for an educator to develop an instructional model that will embody his or her ideals as to how a subject area in general should be handled. The results of the study led to the development of instructional model which is proven to effect students' learnings in KSA. Students' Learning in KSA is an inevitable component of what should be considered in teaching and learning process. Learning should cover the KSA to develop the students in a holistic manner. TRI-P6 includes Technology Integration, Reflective Learning, Inquiry-Based Learning, and P6 Steps. The consideration of these constructs in the instructional activities, students' engagement and teacher helps in the achievement of students' learning in KSA. Instructional activities introduced by the teacher in class should be one of the major considerations in the teaching and learning process. In the study, instructional activities are one of the factors which helped students improve learning in Physics. Understanding the curriculum content and planning of activities that can best address the contents should ideally be one of the most important considerations of a teacher in making quality learning possible. As students experience hands on Physics activities, they learn to work independently and in groups. As students experience the different activities, they learn about knowledge, skills and attitude needed for life-long learning.

Students' Engagement is another factor to be considered in the teaching and learning experience of students. As students experience the many activities in class, what makes them push forward in what they aim to learn depends on how they are engaged in learning. Students who are highly engaged exerts effort directed toward learning knowledge, skills and attitude. Teacher which includes Teacher's Attitude and Teaching Methods is also a significant factor which was found to help students improve learning in Physics. Having a teacher who has a good attitude and teaching methods is a valuable resource for students because it allows students to be able to work on their own knowing they can count on their teacher if problems arise. It affects the teaching and the learning going on in a classroom. The conscious effort on the end of the teacher to improve attitude and teaching methods is a big contribution in the achievement of students' learning in KSA.

There still are a lot of space for improvement for the introduced idea of the study. Improvement in the incorporation of the model in the learning plans and activities to better address the difficulties encountered by the students which include 1) Trouble in computations; 2) Too many formulas; 3) Weakness in numbers; and 4) Committing mistakes during experiment. Other physics teacher educators can utilize TRI-P6 Instructional model in doing learning plans and activities. Though it's designed only for a physics course, the process in the utilization of the TRI-P6 may be extended to other fields of sciences or other disciplines. This study only measured the effect of TRI-P6 instructional model in the students' learnings in KSA. Similar researches can be done that will look into how it affects other student related factors. Future research may carry out the study in a larger scale and may conduct experimental studies as this study involved only three contact groups.

Conflict of interest statement

Authors declare that they have no conflict of interest.

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Glossary of Abbreviations

CHED - Commission on Higher Education
KSA - Knowledge, Skills and Attitude
SAMR - Substitution, Augmentation, Modification and Redefinition
TRIP6 – Technology Reflective Inquiry-Based Physics
5E's of Inquiry Model - Engagement, Explore, Explain, Elaborate and Evaluate

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