Use of Physics Innovative Device for Improving Students' Motivation and Performance in Learning Selected Concepts in Physics

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Abstract *–This research was focused on the development and evaluation of physics innovative device in enhancing students' motivation and performance in learning selected concepts in physics. The Physics innovative device was developed based upon research on student difficulties in learning relevant concepts in physics and their attitudes toward the subject. Basic concepts in mechanics were also made as baselines in the development of the locally-produced Physics innovative learning device. Such learning devices are valuable resources when used either in lecture or demonstration classes. The developmental, descriptive and quasi-experimental research methods were utilized to determine the effectiveness, in terms of motivation and performance, of the innovative device in Physics. The instruments used for the data collection were the Instructional Materials Motivational Scale (IMMS) developed by Keller and the students' performance test. Pretest and posttest mean scores were measured to determine if there is a mean gain score difference between the experimental and control groups. The study revealed that the group taught with the Physics innovative device performed significantly better than those taught in the traditional method and also the use of Physics innovative device generally improved students' understanding of concepts and led to higher academic achievements. Analysis of the students' level of motivation showed that their interests were captured, the instructions they received were relevant to their personal goals and motives, their confidence to learn on their own were build-up, and learning for them was rewarding and important. In the four dimensions (ARCS) of IMMS students were found to be attentive, confident, and in agreement in using the fun-learning tool having realize its applicability and relevance in learning their Physics lessons. Results of the study disclosed students and teachers consider the novel device acceptable because it is useful in attaining the lessons' objectives, interesting, efficient, durable, accurate, and low-cost.*

Keywords *–Physics Innovative Device, Motivation, Performance, and IMMS*

INTRODUCTION

Over the past two decades, an increasing number of physics educators have been turning their research attention to the problems of physics and science education. One of their major concerns today is the inability or failure of students to appreciate, recognize and process the subject, especially in the discernment of the fundamentals. Science education is generally hierarchical and students who do not learn the basics find it more difficult to learn more advanced concepts. Two of the most common specific issues in physics education include: (i) students develop weak qualitative understanding of concepts; and (ii) students often encounter learning difficulties such as alternative conceptions that hinder understanding of targeted concepts [1]. Various reasons were cited by physics educators for these failures and such conditions must be addressed if the physics community would like to sustain an improved and developed physics education.

Performance in Physics is dependent on many variables. Many researches show that dismal results in physics performance can be attributedto faculty-student relationship. Obviously, much more of a concern is the teacher factor. The mismatch between student and faculty can lead even to a more disturbing result at another level-namely that of general beliefs about the nature of physics, how it is learned and used, and how physics knowledge is established. Thus, the outcome can be more alarming wherein students will have an 'impaired' structure of knowledge.

Likewise, Physics is also perceived to be a difficult course because of its abstract nature [2]. According to Akanbi[3] poor performance in Physics may be due to a number of fundamental reasons - shortage of science teachers in quality and quantity, inadequate laboratory equipment and facilities, shortage of suitable Physics textbooks and other factors.

Another reason is that, in some private institutions, instructions are completely based on memorization and there is negligible interaction towards experimental study among students. These young people sometimes are deferred from studying the subject because they find it difficult to relate without objects to stimulate their attention and physical apparatus to demonstrate several physical principles that would enhance their problem-solving techniques. Thus, interest and performance are going down with universities and colleges having empty laboratories [4].

Taking into consideration the problems physics education posed above, there is evidence that traditional methods and approaches of teaching science subjects like physics are unable to bring the majority of students to understand the physical world. Thus, by way of response, researchers and curriculum developers have begun to consolidate the results of science education research and introduce new technological resources into more effective learning environment. Standards have been proposed by leading national science education organizations for the introduction of new strategies which may include adoption of new tools and equipment and the latest technology into science classrooms and for the preparation of science teachers. The saying that students see things in different ways poses the need for teachers to be very innovative in the delivery of concepts and in choosing learning tools that will motivate and stimulate students' enthusiasm for them to gain knowledge and skills in Physics. Accordingly, to improve the quality of teachers' thinking about teaching and learning physics as well as their behaviour, they should develop learning materials and methods[5]. In this study, the learning materials used, known as the innovative device, maybe described as an improvised material that improves students' performance [6] or a manipulative that enables students to be engaged in the learning process as active learners rather than passive learners [7]. Oladejo et al. [8] stressed that mastery of Physics concepts cannot be fully achieved without the use of learning materials. In this context, it is believed that the availability of science apparatus, even a locally-produced one, in the classroom must be highlighted. Both students and teachers' creativity to improvise these apparatuses may well serve the purpose.

In the development of the present study and to effect quality science teaching and learning, the Instructional Design Theory (IDT) was employed. Instructional Design is anchored in the learning theories of behaviourism, cognitism, and constructivism which provide structured foundations for planning and conducting instructional design activities [9]. Instruction is viewed as a systematic process in which the components: teachers; students; materials; and learning environment are crucial to successful learning [10]. In this perspective, emphasis is given in the relationships among instructional components and design of instruction, indicating how specific technique/strategies might best fit within a given context and with specific learners [11].

Of all the most important techniques/strategies that teacher uses to communicate in a classroom setting, the skills connected with motivation are the most significant in terms of encouraging and stimulating students to achieve objectives of lesson [12]. Wang, Haertel, and Walberg [13] found motivational tactics of teachers to be one of the most significant influences on student learning. Likewise, Good and Brophy [14] ascertained two major aspects of what makes learners enthusiastic and interested in learning: dynamics in presenting the materials, which they called intensity, and interest in the subject matter. Moreover, they described motivation as a means of maintaining students' attention and increasing achievement that can be obtained when teacher use varied instructional approaches.

The described theories above on science learning are in accordance with the ideas presented by Turlo, et al. [15] when he injected the use of the Dale's Cone of Experience. Physics educators advise the use of this strategy to address the impaired learning in physics and to avoid the common misconceptions developed on the minds of the learners. Innovations of learning tools are familiar strategies used by physics teachers to enhance and motivate learning of students. Instruction cannot be effective if it is not appealing to students. John Keller [16] of Florida State University practically generalized that effective learning begins with motivation. Hence, motivation among students is an affirmative prelude for learning to be effective, motivational tactics utilized in the classroom or in the laboratory may include innovations in teaching strategies such as the adoption of innovative devices to create interest among learners. Sometimes, innovative devices can be fun or even entertaining. In a classroom setting, as part of the teacher's management technique, the teacher can introduce fun activities as an extrinsic reward for achievement or effortful behavior[16]. The introduction of innovations in the form of fun-learning devices (toys) in physics teaching is common. They are not only very useful in lectures and demonstrations in order to motivate students but also very interesting from a scientific point of view. These fun-learning devices have great potentials for enhancing student learning and can help facilitate learning at all levels of education from high school to university [17]. Demonstrations with aids of toys will not only encourage learning for better performance but can really be fun or even entertaining. The utilizations of fun learning devices in lectures, demonstrations, and in the laboratory as well can make students think about concepts and relations. They are found to be motivating and very interesting from a scientific point of view. The construction of toys if can be done in the laboratory is a valuable occasion to learn hands on [18].Jeanne Omrod [19] postulated that teachers can motivate students by: (I) creating meaningful lessons; (II) providing authentic engagement; (III) encouraging students' success; (IV) promoting pleasure and enjoyment.These ideas have not skipped the researcher's mind that students in the classroom need to be motivated for them to enjoy learning. The researcher believes that innovative devices such as fun learning devices which are considered visuals and instructional materials would increase students' motivation and learning.

OBJECTIVES OF THE STUDY

This study aimed to develop and evaluate a locally fabricated Physics innovative device for improving and enhancing students' motivation and performance in learning selected concepts in physics. It seeks to determine whether students exposed to the innovative fun-learning device perform better than those who are not in their posttest mean scores; know if students exposed to the innovative fun-learning device are more motivated than those who are not; ascertain if students who are motivated perform better than those who are not; and lastly, determine what is the level of acceptability of the innovative device as assessed by the students and teachers in terms of the; lesson's objectives, concept formation, operation process, aesthetic value, materials needed, as a device for the laboratory, as a device for demonstration lesson, as a fun learning device.

Conceptual Framework

In this study, the innovative device will be evaluated in terms of measuring its motivational effect and performance of the learners. The researcher hypothesized that the innovative device will enhanced and improve the students' motivation and performance. Several variables were examined in this study. The primary independent variable in the study is the use of innovative device in the activities given to the students during physics instruction. The dependent variables are the students' motivation as determined by the Instructional Materials Motivational Survey by Keller and the average student performance scores in Physics. The study looks also into the difference between motivation and performance of students.

The ARCS model of motivation: Attention(A), Relevance(R), Confidence(C), and Satisfaction(S) which provides guidance for analyzing the motivational characteristics of the group of learners and designing motivational strategies was used to measure the motivation to learn of the students. These four categories represent sets of conditions that are necessary for a person to be fully motivated, and each of these four categories has component parts, or subcategories that represent specific aspects of motivation [20].

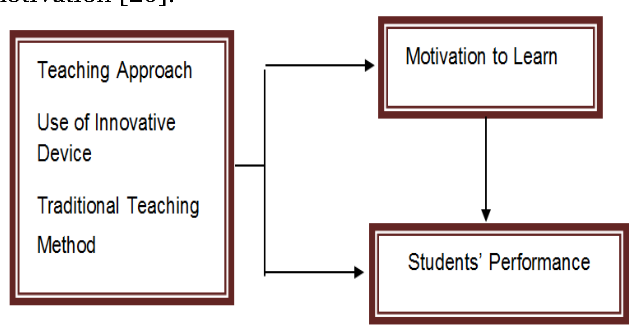

Figure1. Conceptual Framework

MATERIALS AND METHODS

The study made use of the developmental research method, descriptive through key informant interview, and the quasi-experimental design, specifically the pretest-posttest nonequivalent control group design. In this design, two (or more) treatment groups were pretested, administered with a treatment, and post-tested [21].

The researcher chose two comparable intact classes enrolled in Physics 1 lecture from the Department of Electronics and Communication Engineering of the College of Engineering and Industrial Technology, Rizal Technological University in the Philippines. These classes consisted of 24 first year students, all coming from the morning session. One class was assigned as the experimental group (X_1) and the other class as the control group (X_2). Since all the students enrolled in the two classes were tapped in the study (intact), purposive sampling scheme was used in orderto determine the composition of the experimental and control groups. The experimental group was exposed to the use of innovative device with supplementary worksheets as guide while the control group made use of the traditional teaching. The following factors were used as bases in comparing the experimental and control groups: same course, similar schedule of physics classes, same lessons, and one instructor. Ethical norms which serve as the aims or goals of this research were also taken into consideration. Ethical standards adopted in the conduct of the study include: Approval of the Institution to conduct the study; Optional participation in the study; consent of the selected participants to be part of the study; and confidentiality and security of data.

The experiential value of manipulative activities in science education has long been recognized as significant in engaging students. Hence, the researcher thought of designing an innovative device that could be considered as a fun-learning device that would give emphasis on the use of hands-on strategies in learning physics. The idea of designing and fabricating such device was conceptualized when the researcher saw a model being exhibited in a commercial establishment and combined it with readings done in numerous physics printed materials. These models were used as guides to enhanced final model that would respond to the needs of physics educators and learners as well, that is, putting innovations in physics at the forefront of science. Both the concept and post prototypes were designed and later fabricated, taking into consideration the following criteria: characteristics, portable, easy to use, functional, and precision among others.

The performance test was a teacher-made test constructed by the researcher that covers five topics in Physics 1 (Work, Work-Energy Transformation, Potential and Kinetic Energy, Angular Motion and Rotational Energy). This performance test was formulated based on the Physics 1 course syllabus with focus on the objectives and the time allotted for the discussion of the topics. The test developed followed the item distribution in terms of the course objectives and content based on the Table of Specifications. This was analyzed qualitatively by a group of experts; two are PhD students in Physics and the other a PhD holder in Educational Technology. Qualitative analysis was determined in terms of clarity of options, significance of concepts, simplicity of the responses, appropriateness of vocabulary, and similarity of options. Quantitative analysis, on the other hand, assessed the quality of the test questions in terms of item difficulty, discrimination index, and distractor analysis. In appraising the reliability of the tests, the study used the Kuder-Richardson Formula 20. The said modified 30 items multiple choice tests was administered as the pre-test and post-test to both respondents in the experimental group and control group at the start and end of the lessons.

In this study, the Instructional Materials Motivational Scale (IMMS) developed by Keller [16] was used to measure students' perception on the motivational characteristics of the innovative fun-learning device. The IMMS included the four subscales or motivational components of attention, relevance, confidence, and satisfaction described in the above paragraph. Modifications were made on some numbers in the IMMS instrument to suit the needs of the study. The author of the IMMS reviewed the document and approval for its use was granted.

The Semantic Differential Scale was used in the study to measure the level of acceptability of the innovative device. The scale used adjective pairs with each adjective as an anchor in a single continuum. The adjective pairs involved categories in terms of the following criteria: lesson's objectives, operation process, aesthetic value, materials needed, as a device for the laboratory, as a device for demonstration lesson, as a fun learning device, and concept formation. Students were asked to rate the twenty-two adjectives pairs in the attitude inventory scale. The arithmetic means for the attitude inventory scale was computed on a five point rating described as follows: 4.21 – 5 Highly Favorable (HF), 3.41 – 4.2 Favorable (F), 2.61 – 3Neutral, 1.80 – 2.30Unfavorable (UF), 1.00 – 1.79Highly Unfavorable (HUF).

Quantitative research method made used of statistical tools to analyze the data gathered in the study: frequency distributions and percentage for the population and sampling scheme, weighted means for the results of pretest and posttest mean scores, T-test for independent sample means for the effects of use of innovative device to motivation and performance, and the F-test for the difference between motivation and performance.

RESULTS AND DISCUSSION

Steps in the Development of the Physics Innovative Device

Design. In this study, an improvised device intended to visualize concepts and principles of work, energy, rotational motion, and rotational energy was designed. The development of this apparatus was based on the principle of Instructional Design theory by Dick and Carey [10] which adapts the following sequential steps: identify goals expected to learn, know the skills to be developed, assess the existing skills, figure out specific objectives, construct tests, decide the materials to be covered, make learning materials available, and give formative and summative evaluation. Parameters considered in the construction include: locally-fabricated, aesthetic value, strength, accuracy, and others. Stages of the development are discussed in the succeeding paragraphs.

Concept Prototype. The concept prototype was made of iron, since it is very affordable. The same material was used for the rolling sphere, the diameter of which is 11.0mm. As have been in most cases, initial works were not always perfect. The concept prototype was presented to a group of experts in the discipline and various suggestions from them were incorporated towards the enhancement of the device.After consultation with physics experts and doing some readings and experimentation, the prototype was modified, paint was removed because it tend to make the movements of the sphere slower due to the greater force of attraction between the surface of the rolling ball and the surface track. The next model then was just painted on the external part of the surface track in order to improve its aesthetic value. This model was supported by four legs hooked to a wooden board with rug to prevent bouncing and further rolling of the sphere.

Finally, after several trials on running the metal balls on the track, the idea of having the material made of stainless steel has been decided because such material does not corrode easily, looks very appealing, and lasting among others. Figure 2 shows the conceptualize model.

Specifications in the design of the improvised device is shown below.

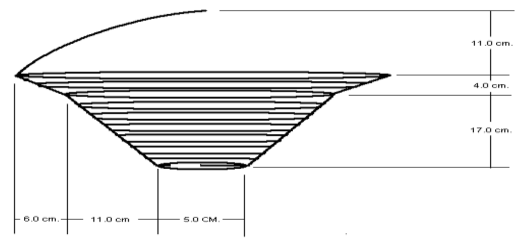

Figure 2. The Concept Prototype Model of the Innovative Device

Testing

After so many trials and errors on the fabrication, the post prototype made of stainless steel was constructed. See figures below for the evolution of the post prototype.

Figure 3. Innovative Device (Concept Prototype1)

Figure 4. Innovative Device (Concept Prototype II)

Figure 5. Improvised Device (Post Prototype)

Pilot Testing of the Innovative Device

After the conduct of the preliminary tests both on the concept and post prototypes, the researcher prepared the use of the post prototype improvised device in the classroom. Topics on work, energy, and rotational motion were chosen for the application of the said device in the lessons mentioned. The researcher constructed worksheets for the students in the experimental group and control group to serve as guide in developing and learning the concepts and principles presented in each lesson. The researcher tested informally the acceptability of the constructed low-cost improvised device in other physics classes. Selected faculty members were also requested to do the same evaluation of level of acceptability. This evaluation was anchored on certain indicators that include the following: usefulness, relevance, efficient, safe to use, low-cost, precise, and affordable among others.

Changes Made in the Design of the Innovative Materials

The following comments/suggestions of the group of experts are stated in verbatim:

Respondent 1: "Remove the paint because it slows down the motion of the metal balls due to the presence of friction." Students learn the concept of the attractive force present whenever two surfaces are in contact.
Respondent 2: "Change the base and make the device four legged." The idea would make the innovative device more stable with a wider base.
Respondent 3: "Please improve the appearance or the aesthetic value.""Millennia students are hard to please, they love to use something new. This material will help them to learn Physics better." Such remarks show the interest afforded to the use of the innovative device by the students because they realized there is fun in learning.
Respondent 4: "The program/design is interactive." The device is manipulative in nature, meaning students among themselves can interact among themselves. Learning is enhanced and reinforced when it is shared.
Respondent 5: "Improve the materials used in the production. Try using stainless steel". "This material when fully developed will be of great help in teaching Physics especially nowadays where students are fond of engaging themselves on hands-on related activities." The learning material has been found to be cost-effective because of its durability.

As suggested by the experts, the researcher made some modifications in the aesthetic value and material used in the development of the innovative device. In totality, the experts' comments and suggestions were adapted.

Performance on the Pretest Mean Scores of the Experimental and Control Groups

The comparison of the students' performance on the selected topics in physics was established using their pretest mean scores. Results of the analysis of the mean scores of the students' performance are presented in Table 1. The pretest mean scores of the two groups slightly differ. Data shows that pretest mean scores of the experimental group is higher than the control group by 0.06

Table 1. T-test of the Pretest Mean Scores of the Experimental and Control Groups

Test	Groups				Computed t-value	Critical t-value	Decision
	Experimental (N=24)		Control (N=24)				
	$\bar{X}$	SD	$\bar{X}$	SD			
Pre-test	11.96	2.37	11.88	2.11	0.03	1.96	Accept H_O

p>0.05, df=46

Calculation of the t-value using the t-test for independent sample means shows that the two groups were not significantly different in their performance in learning selected concepts in physics. The results could be due to the method used in controlling certain variables such as IQ, age and sex. The idea is supported by Fraenkel and Wallen[22] in their book that says in conducting an experimental study threats due to subject characteristics could be minimized or eliminated by controlling extraneous variables like age, gender, and IQ. Thus, they can be considered equivalent group for the study.

Performance in the Posttest Mean Scores of the Experimental and Control Groups

Table 2 presents a higher mean score of 21.25 for the experimental group over the control group mean score of 18.46. The computed t-value of 11.35 is very much higher than the critical t-value of 1.96 determined from 0.05 level of significance at 46 degrees of freedom.

Table 2. T-test of the Post Mean Scores of the Experimental and Control Groups

Test	Groups				Computed t-value	Decision
	Experimental (N=24)		Control (N=24)			
	$\overline{X}$	SD	$\overline{X}$	SD		
Post-test	21.25	2.74	18.46	3.11	11.35	Reject H_O

p>0.05, df=46; Critical t-value: 1.95

This reveals that the posttest mean scores of the experimental and control groups differ significantly. Better performance of the experimental group than the control group could be attributed to the positive effects of using the innovative fun-learning device. The findings were supported by Gerace and Beatty [23] who identified that knowledge can be best gained by the use of an innovative fun-learning device in learning. Likewise, Amir and Subramaniam [24] found out in their study that improved academic performance is attained if forms of instructional tools are utilized. The use of toys in his study has been proven to be effective in the teaching of physics and mathematics concepts. Other researchers said that learning could be reinforced on the basic science principles and concepts if provided with visuals or devices. Improved academic performance is made possible through the use of instructional materials that can be manipulated and played with [24]. Fun-learning devices like toys have been widely used as an effective and engaging way of teaching physics and mathematics concepts. They are tapped to promote better understanding of physics concepts and to retain students' enthusiasm and motivation to learn the principles involved.

Motivational Characteristics of the Experimental and Control Groups

Results of the analysis of the motivational characteristics of the experimental and control groups in learning selected topics in physics are shown in the table below.

Table 3. T-test of the Motivational Characteristics of the Experimental and Control Groups

Test	Groups				Computed t-value	Decision
	Experimental (N=24)		Control (N=24)			
	$\overline{X}$	SD	$\overline{X}$	SD		
Motivation Characteristics	3.46	0.433	3.43	3.46	0.483	Accept H_O

Critical t-value: 1.95

As shown in Table 3, the mean score of the experimental group slightly differ from the mean score of the control group. The mean score of the experimental group is higher than the mean score of the control group by 0.03. The t-test (t_v = 0.483< t_{cv}= 1.96) computation established that the two groups were not significantly different in their motivational characteristics.

A physics teacher comes across various motivational problems amongst his students. He may have some students who day dream in class, some who cannot answer his simple questions because they do not know what the question mean, some who cannot turn in their homework because they do not made an effort, etc. To tackle these problems, it is essential that the teacher should have a correct attitude towards the subject and effective method of teaching [25]. Supplement to traditional chalk-talk are sophisticated apparatuses or simply constructed ones would come in handy. But sometimes, it is even more effective in securing students' understanding of the concept for them to be motivated and learn.

It is practically generalized also that effective learning begins with motivation [16]. Hence, the reason why students from both groups have been motivated from the start of the lesson to its completion.

Difference in the Levels of Motivation (ARCS) and Performance

Table 4. Difference between Performance and Motivation of the Experimental Group

Tests of Between-Subjects Dependent Variable: POST_TEST					
Source	Df	Mean Square	Computed F-value	Tabular F-value	Sig
Attention	15	8.05	1.36	4.54	0.35
Relevance	13	6.66	0.79	4.67	0.66
Confidence	12	8.27	1.32	4.75	0.34
Satisfaction	11	7.37	1.00	4.84	0.74

Table 4 shows that for attention, the computed F-value of 1.36 is less than the tabular F-value of 4.54, for relevance, 0.79 is less than the tabular F-value of 4.67, 1.32 is lower compared to the tabular F-value of 4.75 for confidence, and 1.00 is also lower than the F-value of 4.84 for satisfaction at two-tailed test. These results indicate that there is parallelism between performance and motivation. Meaning if the student is motivated then he will perform better in class. In the study of Shakerin and Saviz [17], classroom demonstrations, through the employment of toys, add to students' interest and their understanding of the subject matter. Results also reveal that if the students found the subject relevant then the tendency is for them to perform better in class. The data also points to the idea that if the students have confidence in themselves to learn the lesson, then surely they will gain knowledge. Sustaining motivation to learn is dependent on the learners' confidence in their potential for learning [26]. And lastly, when students are satisfied with the way teachers apply strategies to develop the concepts presented in the lesson, then students can possibly perform better in class.

Difference in the Levels of Motivation (ARCS) and Performance of Control Group

Table 5. Difference between Performance and Motivation of the Control Group

Tests of Between-Subjects Dependent Variable:POST_TEST					
Source	Df	Mean Square	Computed F-value	Tabular F-value	Sig
Attention	14	6.72	0.70	4.60	0.74
Relevance	10	8.66	1.23	4.96	0.36
Confidence	12	7.32	0.88	4.75	0.59
Satisfaction	9	4.22	0.41	5.12	0.91

For attention, the computed F-value of 0.70 is lower compared to the tabular F-value of 4.60, 1.23 is less than 4.96 for relevance, 0.88 is lower than 4.75 for confidence, and 0.41 is very much lower than 5.12 for satisfaction. Hence, the data reveal that there is no significant difference between performance and motivation in terms of attention, relevance, confidence, and satisfaction. Meaning, the level of motivation is in consonance with the performance of the students. Students who are highly motivated are expected to perform better also in their academics. As postulated by Keller [16], effective learning begins with motivation. Motivation among students is an affirmative prelude for learning.

A total of fourteen physics faculty members were given the opportunity to evaluate the acceptability of the innovative device. The innovative device could be described as follows: (1) in the attainment of the objectives of the lesson, the apparatuses are useful and relevant. (2) It is very easy to operate, safe and simple. (3) Less effort is needed in its construction since the designs is very simple. (4) In constructing the device, the materials are affordable. (5) The values obtained when use for demonstration or in the laboratory are precise, suitable, and accurate. (6) As a fun-learning device it has been found to be stimulating, interesting, and enjoyable. (7) In the development of the concept, students become more interactive, investigative, and inquisitive.

CONCLUSION AND RECOMMENDATION

The use of the innovative device is considered as an effective strategy for improving student performance. Access of students to appropriate learning devices encourages self-discovery of knowledge and self-monitoring behavior needed to complete the tasks assign to them and set new goals as they interact with others in their environment, thus resulting in their enhanced performance. Likewise, student motivation is also improve through the use of the innovative device. It allows them for more social interaction, can sustain interest, and provides fun while learning. When students are provided with novel learning tools, their creativity and critical-thinking skills are developed, and they gain a sense of responsibility for their own learning. Students' confidence are enhanced when they establish a positive expectation for personal success. Moreover, motivation is characterize as a means of maintaining students' attention and increasing achievement that can be obtained when the teacher uses varied innovative instructional approaches. As such, it is necessary that science classes be provided with the essential instructional devices that would motivate students to learn and enhance their performance. Teachers maybe encourage to innovate by using hand-made folk toys in their lessons. It is a method of bringing the ideas and concepts of physics into the classroom as well as providing learning with fun. More sets of apparatus maybe be constructed and use in class and invite other physics faculty from other institutions to become familiar with the applications of the innovative fun-learning device. Teachers may make investments of time and effort to reproduce the novel learning tool to supplement the resources of the University. There is also a need to do further research on the accuracy of the locally fabricated innovative device so it can be used in the laboratory classes. Researchers of future studies may be able to utilize the results from this study to further their knowledge on the use and effects of novel and locally-produced learning materials in their classes.

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