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Effectiveness of the ARCS Model in Teaching Physics Competencies for Grade 10 Junior High School

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Abstract

Teaching physics requires effective approach since it deals with complex concepts and calculations. In this perspective, the study adopted ARCS model as instructional model in teaching physics which aimed to investigate its effectiveness in teaching physics competencies for Grade 10 under Basic Education Curriculum (BEC) and Special Science Curriculum (SSC). Pretest-posttest design and convenience-purposive sampling technique were employed in conducting the whole study. Researcher-made questionnaire was utilized in evaluating the effectiveness of the ARCS model. Data were subjected to statistical treatment such as mean, standard deviation, and Analysis of Variance (ANOVA). The result of the study showed that the post-test scores between the student-respondents in BEC and SSC significantly increase after employing ARCS model. The result also supported that at 0.05 level of significance, there is a significant difference in the scores between BEC and SSC in both pre-test and post-test assessment. As to the level of acceptability, based on the indicators the teacher-respondents both from BEC and SSC perceived ARCS model as excellently acceptable in their respective field of teaching. Hence, it is recommended to be employed in the classroom setting as intervention to address least-learned competencies in physics.

Key Words: *Effectiveness, ARCS Model, Physics Competencies, Grade 10*

Background Information

Physics is one of the important curricular subjects in the field of global education (UNESCO, 2013). This subject develops scientific inquiry skills, values, attitudes and total personality of the learner which is very useful weapon for his/her own personal development, future career, and life in general (SEI-DOST & UP NISMED, 2012). Thus, poor academic performance in science could possibly affect student's individual career in the future. In the Philippine setting, there are problems and issues encountered by several science teachers in the field of teaching physics. One of these is the teacher's hard time in getting students' interest despite socio-cultural differences. Lohrman (2013) claimed that students' interest and attitude toward science provide linkages to their retention of a concept and academic achievement gap. Several studies also have proven that among subjects in science, physics is considered as one of the most prevailing and problematic subjects by the students in the realm of science. Students perceived physics as a difficult subject because of its computational exigency in every problem sets (Guido, 2013). Hence, one of the challenges among physics teachers is to make the strategy motivating among students.

To answer this gap is to provide a reliable and valid method of sustaining learner's motivation. And one of these is by introducing motivational design in the classroom setting. ARCS model is one of the emerging motivational designs in teaching. According to Keller (2010), ARCS model is based on a synthesis of motivational concepts and characteristics into the four categories of Attention (A), Relevance (R), Confidence (C), and Satisfaction (S). These four categories represent sets of conditions that are necessary for a person to be fully motivated to learn. Since there were limited literature and studies that deals on instructional model; therefore, more studies needed that give focus on the effectiveness of ARCS model in improving the learning performance of the students in physics under Philippine setting. Having the belief that interest has a huge impact to the student's performance, this study finds it imperative to employ ARCS model in order to examine its effectivenessin teaching selected physics competencies for Grade 10. The result of this study could be used for benchmarking to enhance the learning outcome of the students.

Purposes of the Research

This study evaluated the effectiveness of the ARCS model in teaching physics competencies for Grade 10. Specifically, the study sought answers to the following questions:

1. What is the pre-test and post-test learning performance of the students in two curricula before and after employing ARCS model in teaching physics competencies for grade 10?
2. Is there a significant difference of the pre-test and post-test scores before and after using ARCS model in teaching physics competencies in two curricula?
3. What is the level of acceptability of the ARCS model in teaching physics competencies for grade 10?

Research Design and Method

This study utilizes the pretest-posttest design. In this study, four groups are pre-tested and exposed to the treatment, and then post-tested after the treatment was employed to the participants (Rasool, 2012). In addition, this study used the convenience-purposive sampling technique in selecting the participants of the study for the School Year 2017-2018. There were 143 student-participants with 8 science teacher-participants involved in the implementation of this study where Basic Education Curriculum has 81 students with 4 science teachers while Special Science Curriculum has 62 students with 4 science teachers. Each curriculum is composed of two (2) secondary school's participants and the participants were from identified sections in Grade 10 level enrolled at Jacinto P. Elpa National High School (JPENHS-BEC & SSC), San Miguel National Comprehensive High School (SMNCHS-BEC), and Tandag National Science High School (TNSHS-SSC).

Research Instruments
The following are the instruments used in conducting this study: Lesson Plan and Physics Assessment Questionnaire.

Lesson Plan
This was patterned from the K to 12 lesson plan (DepEd Order no. 42, s. 2016) and was integrated with ARCS model (Keller, 2010). Four least-learned competencies in Physics such as Electric Field, Magnetic Field, Electromagnetism, and Electromagnetic induction were being prepared and implemented to the selected secondary school participants. The lesson plan was integrated with the four elements of ARCS model (Attention, Relevance, Confidence, and Satisfaction). Before the conduct of the study, the researcher's made lesson plan undergoes content validation to the locally identified physics experts in Surigao del Sur and Tandag City Division, Philippines.

Physics Assessment Questionnaire
The physics assessment questionnaire was used as the pre-test and post-test which was self-constructed and some were adopted from the science 10 learner's material of the Department of Education, Philippines. Table of Specification (TOS) was served as a guide in formulating the thirty-item questions. To ensure the validity and reliability of the instrument, the questionnaire had undergone content validation to the three experts in physics. After the thorough validation, the questionnaire was subjected to pilot testing.

Researcher-Made Survey Questionnaire
This study utilized the researcher-made questionnaire patterned from the survey questionnaire of Manning et al. (2012) and Morales et al. (2016) to fit the present investigation. The said survey questionnaire was subjected to content validation by the pool of science experts in Surigao del Sur and Tandag City Division before the instrument was administered to the teacher-participants.

Data Collection
The conduct of the study started with the approval of the Schools Division Superintendent and School Principal prior to the implementation of the study. After the approval was granted, the researcher conducted an orientation on the implementation of the ARCS model in teaching physics. Afterward, K to 12 lesson plan (with ARCS model integration) was entrusted to them to be used for the implementation of the intervention. This procedure in anchored to the study of Ghbari (2016) with the recruited science teacher as the implementer of the instructional model.

Subsequently, pre-test assessment was conducted to the participants for one day, then the presentation of the lesson follows for the next day. After all chosen lessons were being undertaken for one month, the post-test assessment was conducted for the last day of the study. The post-test results were being recorded and compared with the results of pre-test to determine if there are gains in scores achieved by the grade 10 students in two curricula. Meanwhile, the survey questionnaire was administered to the teacher-participants to assess the acceptability of the ARCS model in teaching physics competencies for grade 10. The over-all gathered data were subjected to data analysis to answer the main objectives of the study.

Data Analysis
The study utilized the descriptive statistics in describing the test scores of the respondents. The mean and standard deviation were used to compare the pre-test and post-test measures while the weighted mean was used to quantify the level of acceptability. However, One-Way ANOVA was employed to determine the significant difference

between the pre-test and post-test scores of the grade 10 students in Basic Education and Special Science Curriculum.

Results and Discussions

Pre-test and post-test learning performance of the students in two curricula

As revealed in Table 1, the mean of the pre-test scores of the respondents from JPENHS (BEC) got a mean score of 12.358 out of 30 items (SD=3.229), which indicates that the scores were more scattered than the rests of the school participants. The mean scores in the pre-test of the four school participants showed that majority of the respondents were not able to get the correct answer to the questions.

Moreover, it can be inferred that the pre-test means scores of the two curricula were closely related to each other. Noted that JPENHS (SSC) got a high mean score of 14.034 (SD=3.053) which is close to the mean score and standard deviation of TNSHS (SSC) and SMNCHS (BEC). This only means that before the ARCS model was employed in teaching, the majority of the respondents has little knowledge of the lesson which indicates also that they have an almost same level of understanding.

Table 1: Mean and standard deviation of pre-test and post-test scores in two curricula

Curriculum Type	Name of School	N	Pre-test		Post-test	
			Mean	SD	Mean	SD
BEC	JPENHS	53	12.358	3.229	22.208	2.298
	SMNCHS	28	13.107	3.190	22.679	2.262
SSC	JPENHS	28	14.034	3.053	23.897	2.076
	TNSHS	34	13.235	3.153	23.294	2.195

As shown also above in table 1, after the students were being exposed to ARCS model, it obtained a higher mean compared to their pre-test result. On the other hand, the standard deviation in the post-test result of the two curricula indicates that there is a closer gap between each score, since, the standard deviation of JPENHS-BEC (SD=2.298) and SMNCHS-BEC (SD=2.262) manifest closed match with the post-test result of SSC from JPENHS (SD=2.076) and TNSHS (SD=2.195). This signifies that there is a high learning performance among participants which implies that ARCS model remarkably influenced the students' learning performance. This further indicates that students who are exposed to ARCS model have a conceptual understanding of the topics; thus, resulted to their high scores. The result confirms the study of (Ghbari, 2016; Reynolds, 2017; Malik 2014; & Faryadi, 2013) that ARCS model can help increase academic achievement. This only means that the ARCS model applied in this study could improve the learning performance of the participants.

Significant difference of the pre-test and post-test scores before and after using ARCS model

As reflected in table 2, the p-value in the pre-test scores of the two curricula gained 0.147 which is greater than 0.05 level of significance that lead to the rejection of the null hypothesis. Therefore, there is no significant difference between the pre-test scores of BEC and SSC. This implies that they have an almost same level of understanding before the ARCS model was utilized in teaching least-learned competency in physics.

Table 2: Significant difference of the pre-test and post-test scores using ARCS model in teachinggrade 10 Physics competencies in two curricula

Sources of Variation	Computed F	p-value	Decision	Conclusion
BEC Pre-test Vs SSC Pre-test	1.82	0.147	Failed to Reject Ho	Not Significant
BEC Post-test Vs SSC Post-test	4.1	0.008	Reject Ho	Significant
BEC Pre-test Vs BEC Post-test	165.61	0.000	Reject Ho	Significant
SSC Pre-test Vs SSC Post-test	147.24	0.000	Reject Ho	Significant

Note: *The level of significance (alpha) used is 0.05. If the p-value is less than or equal to 0.05, reject the null hypothesis. If the p-value is greater than 0.05, do not reject the null hypothesis.*

As revealed also in Table 2, the post-test scores between BEC and SSC showed a significant difference. This implies that after the intervention conducted, the knowledge of the respondents significantly increases after the application of the ARCS model (Montero, 2018). The significant difference between pre-test and post-test scores of BEC and SSC indicated also that before the intervention was conducted, the knowledge of the respondents is not similar after the ARCS model was applied in teaching. Hence, more learnings and understanding of the lessons were acquired when the ARCS model was used in teaching least-learned competency in physics. This result relates with the finding of the study of Ghbari (2016) that ARCS model and traditional approach in teaching shows a significant difference in the achievement post-test between the two groups of the study due to the method in favor of the ARCS group.

Level of acceptability of the ARCS model in teaching Physics competencies

Table 3 shows the level of acceptability of the ARCS model when used in teaching Physics to Grade 10 students. The overall result of the evaluation among all teacher-respondents manifested that ARCS model is “Excellently Acceptable” in teaching Science for Grade 10 students with an overall mean of 4.61. This finding indicates that most of them find ARCS model suitable to the teaching-learning process.

To give the comprehensive discussion of the overall result of the study, this portion provides further analysis and interpretation of the indicators that obtained the highest and lowest weighted mean in table 3. As observed on the result of this study, all of the teacher-respondents agreed that ARCS model could increase student motivation by promoting cooperation among the learners with a highest weighted mean of 5.0 which means "Excellently Acceptable”. This implies that teacher-respondents utilized group activity in their classes by introducing a manipulative activity that induces participation of the students.

Table 3: Level of acceptability of the ARCS model

Indicators	Weighted Mean	Adjectival Rating
ATTENTION		
Present and administer tasks in a motivating way.	4.4	EA
Use an interesting opening activity to start the class.	4.7	EA
Draw students' attention to their strengths and abilities.	4.6	EA
Draw students' attention to the content of the task.	4.6	EA
Take the students' learning very seriously.	4.4	EA
Make learning stimulating and enjoyable for the learner by enlisting them as active task participant.	4.6	EA
Make learning stimulating and enjoyable for the learner by increasing the attractiveness of the tasks.	4.6	EA
Average Mean	4.56	EA
RELEVANCE		
Relate the importance of subject matter to the student's everyday experiences.	4.6	EA
Build the lesson plans based on students' needs.	4.7	EA
Allow students to imagine the future situations where they will need knowledge of science.	4.5	EA
Encourage students to share personal experiences and thought as part of the learning tasks.	4.8	EA
Promote the students' awareness of the instrumental values associated with the knowledge of the lesson.	4.4	EA
Make the curriculum and the teaching materials relevant to the students.	4.5	EA
Increase students' goal in particular tasks and in learning.	4.5	EA
Average Mean	4.57	EA
CONFIDENCE		
Build learners with regular experiences of success.	4.4	EA
Help diminish language anxiety by promoting students' participation.	4.5	EA
Build learners' confidence in their learning ability by teaching them with various learning strategies	4.7	EA
Increase the student's expectancy of success in particular learning tasks.	4.7	EA
Allow learners to maintain a positive image while engaged in the learning tasks.	4.8	EA
Increase student motivation by promoting cooperation among the learners.	5.0	EA
Increase student motivation by actively promoting learner autonomy.	4.7	EA
Average Mean	4.69	EA
SATISFACTION		
Provide students with positive information feedback.	4.7	EA
Increase learner satisfaction.	4.9	EA
Offer rewards in a motivational manner.	4.8	EA
Use grades/points in a motivating manner, reducing such as possible their demotivating impact.	4.1	VMA
Average Mean	4.63	EA
Over-all Mean	4.61	EA

Legend: *4.20 - 5.00 Excellently Acceptable (EA); 3.40 - 4.19 Very Much Acceptable (VMA); 2.60 - 3.39 Moderately Acceptable (MA); 1.80 - 2.59 Not Much Acceptable (NMA); 1.00 - 1.79 Not Evidently Acceptable (NEA)*

As cited by Chuang (2014) in the study of Srinivas (2014), cooperative learning approach can enhance learning satisfaction, promote positive attitudes toward subject matter, improve students' teamwork skills, encourage more in-class participation, promote greater in-class attention, create more in-class interaction and develop higher-order thinking. This result also relates with the finding of the study of (Feng & Tuan, 2005; Marshall & Mathew, 2013) which showed that using the ARCS model to teach science concepts could improve low motivated students' level of motivation. This only manifest that through using ARCS model could arouse motivation by introducing group activity among learners.

In this study, the teacher-respondents also employed the student-centered approach in conducting science lesson. In every good performance manifested, the teacher uses grades/points in a motivating manner to increase learner's positive feelings towards accomplishment which were responded by the most of the teacher-participants as "Very Much Acceptable" with the weighted mean of 4.1. The result of this study also indicated that reward system (under the element of satisfaction) is suitable as positive reinforcement to increase the likelihood of doing good.

However, it was noticed that the use of grades/points in reducing demotivating impact got the lowest weighted mean among all indicators. The result could be based on the observation of the teacher-respondents that students would become addicted to classroom rewards. This means that they will not study anymore without them. Howlin (2015) stated that reward system is very acceptable in the classroom setting, yet he suggested to limit the use of rewards for it could discourage intrinsic motivation of the learner. In the study of Kohn (2001) and Hufton, et al. (2003) as cited by Kelsey (2010) also suggested limiting the use of reward system instead teachers should ask specific questions to the learner to help them internalize what they enjoyed about the activity and what they felt they accomplished. In this way, teachers are helping the student to build their intrinsic motivation for learning. Thus, careful planning and preparation are deemed important to improve the efficient use of rewards system in teaching.

Conclusions and Recommendations

The study revealed that the post-test results are greater than the pre-test results before the ARCS model was employed. The mean and the standard deviation of the post-test results manifest that the teaching method applied in teaching least-learned competency in physics is effective to improve the learning performance of the grade 10 students in two curricula. The significant difference between pre-test and post-test scores of the Grade 10 students indicated that ARCS model helps promote better learning on least-learned competency in physics. However, most students in BEC need to be more strengthened with the use of ARCS model so that they could further compete with the academic performance of SSC in physics. Thus, intensifying its application to science teaching may result to higher academic performance.

For the students with less understanding of the lesson in science, science teachers may encourage themselves to integrate their lesson plans with ARCS model. For the teachers who have related problem on the least-learned competency in other subjects and with the problem on how to motivate their students to learn, he/she shall use ARCS model as an alternative intervention. Future study for the enhanced of the ARCS model is hereby recommended in order to develop and produce instructional materials such as module and worksheets in physics to be replicated.

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