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INTERDISCIPLINARY CONTEXTUALIZATION (Icon) LESSONS IN TEACHING SENIOR HIGH SCHOOL MATHEMATICS

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Abstract

The study aimed to investigate the effects of Interdisciplinary Contextualization (Icon) lessons in teaching functions and their graphs. The study utilized mixed methods design to describe the features of interdisciplinary contextualization approach and to identify its effect to students' academic performance. The lessons were implemented to thirty-eight Grade 11 public school students in Albay, Philippines. The features identified are thematic, use of local context, problem-based learning, inquiry-based learning and collaborative learning. The features identified came from the teachers interviewed who uses the approach and the researcher's pertinent document analyses. The problems in the lessons used these features in synthesizing concepts that served as an axis of connection among disciplines. The results obtained from pretest and posttest scores of students revealed that there was a significant difference in favor of the implementation. Consequently, interdisciplinary contextualized lessons helped students to be real-life problem solvers, developed cultural awareness by citing relevant in-context problems and helped connect previously learned concepts from other disciplines. Educators must be aware that Mathematics is part of the students' personal life, community and cultural heritage. Thus,

interdisciplinary contextualization approach relate the teaching and learning process within specific communities and culture for meaningful learning experiences of the students. This approach that uses integrated lessons in Mathematics make the teaching and learning more accessible, relevant, and meaningful to every students that would further develop 21st century skills.

Keywords

Interdisciplinary, Contextualization, Approach, Lessons, Skills

1. Introduction

The trend of moving away from a knowledge-based, examination-driven system to a student-centered, performance-driven system is widely emphasized across cultures, although it may be at different stages in different contexts due to historical and cultural reasons (Hudson, 2009). Many educators highlighted different approaches which promote student-centered activities and teacher-facilitated instructions as it answer the needs of the learners. One of which is the use of interdisciplinary approach that allows learners to gather knowledge from various discipline and process this depending on his needs. Interdisciplinary teaching give importance in developing students' skills of inquiry, problem-solving, association, synthesis, and some sort of formulating conclusion on the subject being taught. This implies thorough planning and analysis of themes and concepts that will be used in an interdisciplinary structured lessons at the same time considering learners' setting in order to attain these skills.

The National Achievement Test (NAT) administered by the Department of Education to fourth year high school students during the years 2004-2005, 2005-2006 and 2011-2012 showed that Mathematics has mean percentage score of 50.70, 47.82, and 46.37 respectively. These statistical records prove that there is a continuous decline of mean percentage score of students' performance in Math in the achievement test. This poses a big task not only for the teachers but as well as the school administrators to address such problem in the educational landscape specifically in the area of Mathematics.

The recalibration of approaches in teaching and learning process is very timely considering the recent transition of the country to the K to 12 basic education program, therefore, urgently needing the training of STEM teachers who will be at the forefront of delivering quality education to our students. Given the nature of K to 12 Mathematics curriculum as learner-centered and inquiry-based, there is a need for teachers to focus on pedagogical approaches that would lead to a deeper understanding of

STEM concepts and its application to real-life situations in a local context and eventually elevate the country's performance in terms of mathematics and scientific literacy.

Interdisciplinary approaches in learning allows for synthesis of ideas from many disciplines that enhances students' holistic thinking skills (Hargreaves, Earl, Moore, & Manning, 2002); directing students to answer situated, socially-constructed, and culturally intervening experiences (Marshall, 2005); and offer learning experiences that can intellectually and emotionally cultivate their understanding of academic concepts from numerous perspectives.

Nikitina (2006) distinguishes three basic approaches to interdisciplinary work namely contextualizing, conceptualizing and problem centering. Contextualizing embed the facts and theories in the cultural, historical, or ideological fabric. If the scientific method guides and sets the standard for integration, conceptualizing work typically takes place. If the mode of inquiry is that of the applied sciences or creative product/policy development, the integrative process will take the form of problem-based investigation of urgent or tangible issues.

The aim of education is the unification of knowledge existing from different outlets of learning and experiences. Therefore there is a close relationship among different disciplines that none of these subjects can be taught in isolation. Educators emphasized interdisciplinary approach because of its features that will keep paced in linking students' real - life experiences to be used in analyzing themes from different disciplines in attaining life skills needed by the society. Mathison and Freeman (1998); Thomas (2000); & Erickson (1995) define interdisciplinary teaching as integration of concepts from various disciplines. Reed and Bergman (1995) further defines integrated curriculum as an interdisciplinary concept as the integration of various disciplines around one single essence, especially an issue or problem. Interdisciplinary approach allow students to spot connections of differing disciplines and use this in processing loads of knowledge acquired from their experiences. In addition, it allows them to discover the connection across disciplines and link between disciplines and real-life situations; through this, critical thinking and creative problem-solving will be developed (cited in Duman and Aybek, 2003).

The experiences of the students with interdisciplinary contextualized lessons that goes beyond purely computations will help them reconcile past learning to other concepts integrated and eventually contribute to their holistic development that is needed as they function in the society (Dimaano, 2017). Specifically the objectives of the study were to identify the features of interdisciplinary contextualization approach and determine its effect to student's academic performance in Mathematics.

2. Methodology

2.1 Research Designs

The study used mixed methods design to identify the features of the interdisciplinary contextualization approach and to determine its effect to student's Mathematics academic performance. For the first objective of this study, guided by some interview questions, the researcher interviewed teachers from different schools who attended seminar on interdisciplinary contextualization approach in teaching to solicit information about the features and methodology of this approach. As the features of the approach is established and clearly defined, the researcher developed lessons with topics on functions and their graph of the subject General Mathematics. The student-respondents were given Mathematics achievement test before and after the implementation of the lessons. The results obtained from pre and post tests were further analyzed to determine the effect to Mathematics academic performance.

2.2 Respondents

The respondents in this study were teachers from Department of Education Albay Division who have the knowledge and expertise on using interdisciplinary contextualization approach and its features. The teachers were purposively selected since they attended the national training on Interdisciplinary Contextualization Approach for STEM Education and has the knowledge in using the approach to classroom instruction. All of the teachers interviewed were more than five years in the service with one teacher having 18 units in Ph.D. and the other two had a Complete Academic Requirement (CAR) in their corresponding Masters' degree. The teachers are in Teacher I, II and III positions in their respective school of assignment.

The researcher also purposively selected a school to achieve his goal of providing an instructional approach that suits the situation. One section from Grade 11 senior high school under General Academic Strand (GAS) in Albay, Philippines were also the respondents of this study. They were exposed to lessons and activities integrating the interdisciplinary contextualization approach. Secondary education was chosen because of students' interdisciplinary management skills develop during this stage. The selection of respondents was based on purposive sampling method. The main goal of using purposive sampling is to focus on particular characteristics that are of interest to the researcher, which will best enable to answer the research questions of the study. Thus, the researcher purposively selected students that are representation of the general public.

2.3 Research Instruments

The researcher utilized the following instruments for obtaining essential information for the study.

Interview Guide Questions for Teachers. This served as the guide of the researcher to keep track of what data he needed to gather. This covered ten questions asked by the researcher during the interview to Department of Education Albay teachers. This also served as one of the primary source of data to define interdisciplinary contextualization and give its key features in developing lessons.

Mathematics Achievement Test. This was administered to the students before and after the implementation of the study. These are pilot-tested and validated examinations that are in line with the competencies of the General Mathematics subject particularly under the content Functions and Their Graph. The construction of these tests started from making table of specification (TOS) using the taxonomy in evaluating educational objectives as provided by the Department of Education for K to 12 curriculum. The TOS also included the time allotment, number of items and the item placement. The prepared tests are 40-item test that contain the key concepts on the respective topics in line with the competencies that needs to be assessed to students. The pretest/posttest were validated by experienced teachers specializing in Mathematics and Science. A pilot study was performed and indicated a reliability coefficient of 0.71.

2.4 Procedures

Guided by some interview questions, the researcher interviewed teachers from different schools who attended seminar on interdisciplinary contextualization approach in teaching to solicit information about the features and methodology of this approach. As the features of the approach is established and clearly defined, the researcher came up with lessons based from the topics identified by the teacher respondents that integrated other disciplines as theme with the use of local samples and materials that relate activities drawn from cultural background and daily experiences. The lesson plans developed utilizing interdisciplinary contextualization approach was evaluated by teachers in Mathematics and other field who are knowledgeable about interdisciplinary, contextualization, localization and other forms of instructions in the teaching and learning process. The researcher determined the effect of the ICon lessons to student's Mathematics academic performance using the teacher-made pretest and posttest.

2.5 Data Analysis

In the analysis and interpretation of the data collected, a content and response analysis was performed on the data obtained from the interview to teachers and lessons retrieved to identify the key features of the approach. Interview data from teachers were recorded by the researcher. Later these records were analyzed to check on commonalities of features identified. In order to determine whether or not there exists significant difference between the pre-test and post-test scores, t-test was used.

3. Results and Discussion

3.1 Features of Interdisciplinary Contextualization

Based on the interview conducted with teachers and in-depth document analyses conducted, the features of Interdisciplinary Contextualization can be mainly found from the two words, Interdisciplinary and Contextualization. Moreover, some features which are found evident in the sample lessons and pertinent documents are the following:

Thematic Approach. Integration of concepts from other disciplines depends upon the topic of concentration and the competencies underlying this topic. One of the questions asked to teachers was how do you make the lesson interdisciplinary, one said that “*whenever I find an opportunity to link disciplinary material, we tend to bring this in class and analyse the material in the perspective of mathematics and also I do research on what concepts from other disciplines might be embedded to the topic under study*”. Teachers use interdisciplinary contextualization approach moderately since there are lessons that they cannot integrate right away and eventually they went back to the usual algorithmic way of delivering their lessons. Topics say for instance, Linear Equation which are very much applicable for the approach let them maximize integration and contextualization of concepts. Maximizing interdisciplinarity means finding mathematical concepts with connection to real-life and other disciplines, teachers’ response to this through research on the use of that topic in other fields. Teachers give time and exert effort for essentializing interconnected concepts for integration. Thematic approach is similar to essentializing which is an integrative strategy that involves identifying core concepts that are central to two or more disciplines and establishing a rigorous quantifiable connection among them. Such core concepts such as linearity can effectively help them to tie together mathematics, physics and biology, and illuminate a hidden pattern of relationships among these disciplines (Nikitina, 2006).

Use of Local Context. One of the main features of the K to 12 is the delivery of the lessons through Contextualization and Localization. When the teachers asked on how they contextualized their lessons, one of the teachers responded, “*I contextualize interdisciplinary lessons by bringing concepts to the local context of the learners including their daily activities, parents’ livelihood and their interaction*

to the community. Also, integrated concepts was further contextualize by relating this to local scenarios that incorporates local products and situation depicting the people's activities in that locale". Teachers can present the lesson in a more meaningful and relevant context based on the learner's previous experiences and real-life situations. Both of which adhere in making the lesson flexible, fit, creative, relevant, meaningful, and adoptive to students' level of understanding and instructional needs. Moreover, the use of local context takes place in associating themes to the local scenes where learners encounter in their daily lives. Similarly, localization of interdisciplinary contextualized lessons takes place in finding the concepts under study in the realm of the locality. Using local context means bringing the lesson close to the experiences of the learners (Zakaria, E., & Syamaun, M., 2017). Teachers should be adaptive and creative in using localization and contextualization in teaching. Such principles were made and adapted in the academe to make the curriculum responds, conforms, reflects, and be flexible to the needs of the learners, especially the 21st century learners who need to be holistically and skillfully developed (Torres, 2015).

Problem – Based Learning. The lessons utilizing interdisciplinary contextualization approach uses a problem as an axis of connection among disciplines. As for the question how do they craft ICon lessons, one of the teachers said that, *"I start my lesson by posing questions, problems, or scenarios rather than simply presenting established facts and this problems are taken from real local setting, which are relatable, and relevant questions."*

Problems can also provide opportunities for working in groups, finding and evaluating research materials, and life-long learning (Duch et al, 2001). While the core problems vary among disciplines, there are some characteristics of problems that go beyond fields (Duch, Groh, and Allen, 2001) which are commonly applied by the teachers when constructing problems: some of the observable feature of the problems in each of the lessons of the teachers using the approach were (1) the problem must motivate students to seek out a deeper understanding of concepts, (2) the problem should require students to make reasoned decisions and to defend them (3) the problem should incorporate the content objectives in such a way as to connect it to previous courses/knowledge, (4) if used for a group project, the problem needs a level of complexity to ensure that the students must work together to solve it and (5) if used for a multistage project, the initial steps of the problem should be open-ended and engaging to draw students into the problem. This feature of problem-based learning, involves enlisting the knowledge and modes of thinking in several disciplines to address real-life problems that take more than one discipline to solve. The meaning of this feature in the area of Mathematics is posing local or in-context problems that require students to connect other disciplines in answering this problems.

Inquiry – Based Learning. Upon the review of the lessons developed by teachers knowledgeable on interdisciplinary contextualization and validated by the interview, it can be seen that teachers evidently used an inquiry-based learning feature whereas teachers used questions, problems and scenarios to help students learn through individual thought and provoke further investigation. As for one of the teachers, *“the activities I made will be given to small groups that is subject for discussion. I allow them to ask questions and evaluate situations. For example, I’ll be giving them topics in their Math subject and they are task to find its application from their surrounding and let them formulate their own problem about their identified application.”* Instead of simply presenting facts, the teacher encourages students to talk about a problem and draw on their intuition to investigate and seek an answer to it. The use of inquiry-based learning in an interdisciplinary contextualized lessons is understandable since it also focuses on letting students ask their own questions thus providing their own inquiry. Inquiry – Based Learning feature allow students to formulate their own questions following the teacher-guided inquiry. Instead of lecturing about learning goals, the teacher cultivates and hone a learning environment that let students explore it through questions and using some relevant experiences.

Collaborative Learning. Lessons using interdisciplinary contextualization approach include collaborative learning feature as shown in the lessons developed by the teachers. From the statement of the teachers, *“the interdisciplinary contextualized problems that we craft were answered through groups with close monitoring while the activity is in progress, this way the different abilities of the students are showcased in their group work and reporting”*, it revealed that problems were analyzed by students collaboratively. They also added that this is the best way to deliver instructions since they are limited with one hour per subject. With thorough analysis and investigation on the lesson, collaborative learning processes include posing of a question or problem during the development of the lesson and ask students to discuss their ideas with their groups. Most of the collaborative work takes place during the presentation of the new lesson. Problems used in the lessons require a group work to finish the task.

3.2 Effects to Academic Performance in Mathematics

The subject General Mathematics tackled different concepts that involve a lot of solving, analyzing and graphing different kinds of functions. This subject’s primary goal is to develop to students’ mathematical competence at the end of the course. Mathematical competence is a broad notion, and involves factual knowledge, skills, and understanding, as well as the ability to use mathematics in contexts and situations in which mathematics plays a role (Niss, 2003). Some manifestations of attaining this competence include thinking mathematically; posing and solving mathematical problems; modeling mathematically; and reasoning mathematically. To attain this goal,

conceptual understanding must be the primary basis of the teacher to assure that the students certainly grasp each concept prescribe by the guide regardless of approach incorporated to the lessons. To ensure that the learning competencies in the Department of Education’s Curriculum Guide was attained, the researcher administered a pre-test and post-test before and after the implementation respectively. The findings revealed that the null hypothesis is rejected. There is a mean difference between pretest and posttest scores in favor of the implementation of the approach.

Furthermore, Table 1 shows the comparison between the performance levels of the students in the pre-test and post-test. It includes the computation of the mean scores, weighted mean, standard deviation and p-value, also, the descriptive equivalence of the mastery level and significant level was included in each of the nine lessons developed.

Table 1: *Results of the Pre-test and Post-test of the Students*

	Test	Mean	Proficiency Level	Standard Deviation	p-value
Pre-experimental Group	Pre	10.00	Low Mastery	6.08	<0.00001
	Post	15.58	Average Mastery	3.19	

It is shown in table 1 that it demonstrated positive changes in the performance level of the students in which the descriptive equivalence from low mastery level become average mastery level. In addition, the total mean score of the post-test, 15.58, is greater than the pre-test, 10.00. Moreover, it implies that there is a highly significant difference between the test due to the p-value is equal to <0.00001. Furthermore, the computed standard deviation tells a more consistent data in the post-test scores rather than the pre-test scores. Demirel and Coskun (2010) in their study, claimed that the use of interdisciplinary teaching approaches developed holistic learning enabling the students to understand a problem statement in displaying scientific and reasoning abilities. This also implied that the use of interdisciplinary contextualization in teaching General Mathematics help the students to understand the concepts with the aide of the integrated concepts from Biology, Chemistry, Physics, Business Finance and Economics which was further enhanced its impact to the students as it was related to real-life. In addition, the learning of the students was maximized as they tackled some discipline in a single subject. Furthermore, the eagerness of the students to learn were heightened because they saw connections from what they are learning in the class.

Subsequently, the observation of teachers validated the positive result of the academic performance from the focus group discussion with the students. The student mentioned that she has improved problem-solving skill. When ask how, she said in verbatim *“aku sir nag improve ako sa pag solve ning problems, umaasa lang ako dati sir, feeling ko ngayon kayo ko na magsolve ng problems with confidence”*. (I have improved in solving problems, I rely on my classmates before, I feel that I can solve problems with confidence now). Another student said *“ako man sir nag improve saku decision making kina reasoning pag naga report. Dati kaya sir dawa aram ko su simbag nasupog ako ishare sa munan, naga disisyon ako kung isishare ko o kung idi. Wana kaya ko nang ishare saynda na di nagalangan”*. (I have improved my decision making and reasoning especially when reporting. Before, even I know the answer I was hesitant to share in front, I am deciding if I’m going to share this or not. Now I can share to them my ideas without hesitation). With this, interdisciplinary contextualization approach help students offer an on point inferences to the situation and problems given and at the same time it help them with an improved performance and positive outlook in Mathematics.

4. Conclusions and Recommendations

In conclusion, the Interdisciplinary Contextualized (ICon) lessons with the topic from the content functions and their graphs in the General Mathematics help the learners developed skills that are vital to function in our society in this new era. As observed on the trend of education, many educators emphasizes student-centered approaches that integrates the experiences of the learners in real-life From the results, the researcher therefore concludes that in Interdisciplinary Contextualization Approach in teaching there are five features which are thematic, use of local context, problem-based, inquiry-based and collaborative learning. All of these features work together to form a learner-centered classroom environment that hones the students’ knowledge in academics and develop necessary skills needed as they progress in their lives. Moreover, during the implementation of the lessons, students not only work on academic assignments but they also learned in the context of their culture. Being able to accustom the different features of interdisciplinary contextualization, the students engaged and involved themselves more actively in the learning process. It gives them a chance to learn their strengths and weaknesses as they work in groups and interact more with their peers, actively participate in discussion and eventually acquire new ways of handling problems (Mustfa & Hilmi, 2014). The lessons also helped developed skills for the 21st century. These skills include presentation skills which allow students to express their ideas with confidence; mathematical competence, critical thinking skills that help them deal with problems with accurate and precise analysis, synthesis and evaluation of ideas; social skills that would

help them appreciate the uniqueness of each individual and bringing the culture and the environment to the classroom raised students' awareness and appreciation of their culture and identity.

Overall, these skills develop among students would help them hone their ability to apply their knowledge particularly in Mathematics to real-world setting as they can solve the range of small and large problems that arise in order to function efficiently as a person. However, the extent on what other subjects might use this approach and non-academic skills that might be developed on using this approach is an issue of further research.

References

- Chrysostomou, S. (2004). Interdisciplinary Approaches in the New Curriculum in Greece: *A Focus on Music Education*. *Arts Education Policy Review*. 105(5), 23–30.
<https://doi.org/10.3200/AEPR.105.5.23-30>
- De Diso, A. C. (2013). The National Achievement Test of the Philippines. Retrieved June 5, 2017 from www.philippinesbasiceducation.us
- Demirel M. and Coskun Y. D. (2010). Case Study on Interdisciplinary Teaching Approach Supported by Project Based Learning. Educational Research Association. *The International Journal of Research in Teacher Education* 2010, 2(3): 28-53.
- Department of Education. DepEd Memorandum No. 160 s. 2012 – National Education testing and Research Center: Mastery Level Descriptive Equivalence. Retrieved from <https://www.deped.gov.ph/>
- Dimaano, J. R. (2017). Effects of Interdisciplinary Approach Through Localized Activities on Students' Academic Performance in Science 7. 10.13140/RG.2.2.18022.11849.
- Duch, B., Groh, S. E., and Allen, D. E. (Eds.), (2001). *The Power of Problem-Based Learning: A Practical “How-to” for Teaching Undergraduate Courses in Any Discipline*. Sterling, Va.: Stylus.
- Duman, B. & Aybek, B. (2003). A comparison of the approaches of process-based and interdisciplinary instruction, Mugla University, *Journal of Social Sciences Institute*, 11, 1-12.
- Hargreaves, A., Earl, L., Moore, S., & Manning, S. (2002). *Learning to change: Teaching beyond subjects and standards*. San Francisco, CA: Jossey-Bass.
- Hudson JP. (2009). *Pathways between Eastern and Western education*. Charlotte, NC, USA. Information Age Publishing Inc.
- Marshall, J. (2005). Connecting art, learning, and creativity: A case for curriculum integration. *Studies in Art Education*, 46(3), 227-241. <https://doi.org/10.1080/00393541.2005.11650076>

- Mathison, S. & Freeman M. (1998). The logic of interdisciplinary studies. Retrieved September 13, 2009 from <http://cela.albany.edu/reports/mathisonlogic12004.pdf>
- Nikitina, S. (2006). Three strategies for interdisciplinary teaching: contextualizing, conceptualizing, and problem- centering, *Journal of Curriculum Studies*, 38:3, 251-271, <https://doi.org/10.1080/00220270500422632>
- Niss, M. (2003). Mathematical competencies: A research framework. Retrieved from <http://www.math.chalmers.se/Math/Grundutb/CTH/mve375/1112/docs/KOMkompetenser.pdf>
- Sağdıç, Mustafa & Demirkaya, Hilmi. (2014). Evaluation of Interdisciplinary Teaching Approach in Geography Education. *Elektronik Sosyal Bilimler Dergisi*. 49. <https://doi.org/10.17755/esosder.30182>
- Thomas, J.W. (2000) A Review of Research on Project Based Learning. Retrieved from http://www.bobpearlman.org/BestPractices/PBL_Research.pdf
- Torres, R. Z. (2015). Localization and Contextualization: Bringing Relevant Concepts in the Classroom. Retrieved from <https://www.pressreader.com/>
- Zakaria, E., & Syamaun, M. (2017). The Effect of Realistic Mathematics Education Approach on Students Achievement And Attitudes Towards Mathematics. *Mathematics Education Trends and Research*, 2017(1), 32–40. <https://doi.org/10.5899/2017/metr-00093>