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Anchored Instruction in Teaching Business Mathematics

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ABSTRACT

This study aims to determine the effectiveness of Anchored Instruction in teaching Business Mathematics to the senior high school students of Simala National High School in Cebu, Philippines. Anchored Instruction is a teaching method in which the learners can generate problems, look for the relevant data, and find solutions from the situated problem-solving environment shown through videos. Its instructional design highlights three main features: generative stories, embedded data, and problem complexity. A quasi-experimental research method was utilized using pretest-posttest control and experimental group design. Both the control and experimental groups with 40 subjects each were not significantly different from each other as established in the match pairing of their profile. They were given a pretest, exposed to their respective interventions, and then were given a posttest. The control group was exposed to Conventional Instruction, while the experimental group was exposed to Anchored Instruction as the method in teaching Business Mathematics. Findings revealed that Anchored Instruction is a more effective method in teaching Business Mathematics than conventional instruction. The learner-centeredness of Anchored Instruction provided opportunities for the learners to be highly engaged in the learning process, as noted in the researcher's observation and interview with selected subjects. As a result, they could identify the useful knowledge and eventually overcome the inert knowledge problem. Hence, it is recommended to utilize this method in teaching Business Mathematics.

Keywords: Anchored instruction, business mathematics, Philippines, teaching method

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INTRODUCTION

Entrepreneurship is one of the core elements of the Philippines' K12 education curriculum. Senior high school graduates are expected to engage and succeed in worthwhile business endeavors. They are expected not just to settle on being employed but to generate job opportunities for themselves and others. The learners should be equipped with the skills essential in running a business to realize this curriculum exit. Deitz and Southam (2015) asserted that Mathematics is used in almost every phase of business; thus, mathematical skill is undeniably one of the essentials needed to succeed in business endeavors. This realization then leads to the emphasis on teaching business mathematics to all senior high school students.

Business mathematics skills are significant because of their practical applications. Hence, there is a need to teach these skills in methods that the learners can master the skills entirely and deeply. Teaching these skills should then be in a context where every concept and problem to be explored is relevant to real-life situations. In current Mathematics standards, memorizing computational facts has significantly shifted to applying problem-solving to real-life situations (Little, 2009). Introducing real-life problems in the classroom provides opportunities for the learners to understand what people experience in their day-to-day business engagements.

However, Morales (2008) stressed that problem-solving is a great challenge for most students because of its complex process, including reading the text, analyzing the ideas, identifying the unknown, and devising an approach to solve the problem successfully. Some students even exhibited negative attitudes towards problem-solving in Mathematics (Nicolaidou & Philippou, 2003). Furthermore, the concepts and problems presented in classes are usually given orally or in print which fails to deeply capture the attention and stimulate the interest of the learners. Thus, the students are not motivated to engage in mastering the desired skills because it is exhausting, complicated and the relevance to real life is not deepened. Therefore, it has been the challenge of the teachers on how to immerse the learners in a context with real-life problems that could lead them to become motivated, independent thinkers.

Anchored Instruction has been developed by The Cognition and Technology Group at Vanderbilt, headed by John D. Bransford, to address these concerns. It aims to conquer and solve the inert knowledge problem, which is the people's condition of easily remembering the relevant knowledge when explicitly asked but is naturally not used when it comes to problem-solving (The Cognition and Technology Group at Vanderbilt [CTGV], 1990).

Anchored instruction attempts to create a setting where the learners can explore and understand real-life problems. Its goal is for the learners to generate problems, look for the relevant data and find solutions from the realistic activities shown in the videos. Its instructional design highlights three main features: generative stories, embedded data, and problem complexity. Creating a situated problem-solving environment where the learners can explore the problem from different perspectives is one of its targets (Lee, 2002). Stories or macro-contexts shown in videos are used to situate the application of knowledge (Oliver & McLoughlin, 1999). As emphasized by

Crews et al. (1997), using videos, animation, graphics, and simulation addresses the problem of inert knowledge because they let the presentation of the learning material in realistic contexts while stimulating constructive and generative learning.

This interactive, realistic, and engaging nature of Anchored Instruction could be utilized in teaching the skills effectively in business mathematics. However, there is still less literature supporting the application of Anchored Instruction method in teaching Business Mathematics. Hence, this study would like to find out the effectiveness of Anchored Instruction in teaching Business Mathematics to the senior high school students of Simala National High School in Cebu, Philippines. The result of this study would determine if this method was effective in the mastery of such skills. The outcomes would eventually contribute to the successful attainment of the entrepreneurship curriculum.

LITERATURE REVIEW

Enhanced Basic Education in the Philippines

Through the Republic Act 10533 (2013), formally named as Enhanced Basic Education Act of 2013, basic education in the Philippines was strengthened, resulting to the addition of two years. The additional years were intended for the Senior High School program in which four curriculum exits were projected for the graduates, namely employment, entrepreneurship, higher education, and middle-level skills development.

Section 5 of the Enhanced Basic Education Act of 2013 specifically states that the Department of Education shall follow the standards and principles of constructivism, reflective, collaborative, integrative, and inquiry-based pedagogical approaches in the curriculum implementation. Hence, with this provision, it is mandated that the teaching and learning approaches employed in the classrooms should uphold the features of a constructivist classroom, which are democratic, student-centered and that the focus of learning is on making connections among the facts gathered towards developing new understanding (Brooks & Brooks, 1999). The learners are the center of the process of education, and they should actively construct knowledge in their minds (Bada & Olusegun, 2015).

Entrepreneurship as a Curriculum Exit

Entrepreneurship as one of the K to 12 Basic Education Curriculum exits is one of the highlights of the senior high school program. Hence, senior high school graduates are expected to engage in business endeavors with high hopes of creating job opportunities for Filipinos and eventually contributing to the Philippine economy. Setting up more businesses can stimulate economic growth, which in turn provides benefits to society (Ahlstrom, 2010).

With entrepreneurship curriculum exit, curriculum planners embedded basic business mathematics as one of the General Mathematics core subject components. Kaur (2014) agreed that learning Mathematics is essential for it is a tool to fully understand business and finance, economics, or even medicine through the development and improvement of problem-solving skills and logical reasoning of a thinking individual. Since these essential entrepreneurship skills are embedded in a core subject, all senior high school students are mandated to learn the concepts. Particularly, the lessons that composed the basic business mathematics can be divided into four major concepts: Simple and Compound Interest, Annuities, Stocks and Bonds, and Loans.

Anchored Instruction

A group of researchers from various disciplines gathered at Vanderbilt University, specifically at the Learning Technology Center, Peabody College for Education which was eventually known as The Cognition and Technology Group at Vanderbilt (CTGV). A variety of technology-based programs that adhere to the theories of constructivism and generative learning in meaningful contexts was developed and tested by CTGV (Bransford, 1997). Hence, the team coined the term Anchored Instruction to describe a special situation for learning (Young & Kulikowich, 1992). This approach essentially targets to utilize context of meaningful problem-solving environments where the instruction is situated (Bransford, 1997; Lee, 2002; Zydney et al., 2014). CTGV experimented with programs of anchored instruction in various learning areas, including Mathematics.

CTGV (1997) outlined the governing principles of the anchored learning design. These include Generative Learning Format, Video-Based Presentation Format, Narrative Format, Problem Complexity, Embedded Data Design, Opportunities for Transfer, and Links across the Curriculum (Love, 2004). It was emphasized that the main features of the seven design principles of Anchored Instruction are mutually influencing each other. They operate as gestalt instead of functioning as a set of independent parts (CTGV, 1997).

Thus, Anchored Instruction situates learning in a context with enough complexity, which can provide realization of the meaning of the usefulness of the information (Young & Kulikowich, 1992). It utilizes constructivist theories as its main framework (Serafino & Cicchelli, 2003). It is somehow similar to case-based learning; however, the learners need to explore and discuss the stories presented rather than simply reading or watching them (CTGV, 1997; Oliver & McLoughlin, 1999). Oliver and McLoughlin (1999) further emphasized that Anchored Instruction exhibits similarity to problem-based learning (PBL). However, Anchored Instruction is not as open-ended as problem-based learning since all of the data required to unlock and eventually solve the problems are already embedded in the anchored module, making it more manageable in environments with limited time and resources.

In a study by Bottge et al. (2015), results revealed that students exposed to enhanced anchored instruction improved their performance on math skills included in many standards. In another study, problem scenarios patterned on anchored instruction principles were given to the pupils through web-stream video, results showed that the pupils' attitudes towards mathematics were generally favorable (Etheris & Tan, 2004). Mathematics is the learning area where Anchored Instruction is useful and effective. However, no research has been done yet to determine the effectiveness of this method, specifically in business mathematics concepts.

METHODOLOGY

A quasi-experimental research method was utilized using pretest-posttest control and experimental group design. Both the control and experimental groups were given a pretest, exposed to their respective treatments, and given a posttest. The control group was exposed to the Conventional Instruction, which followed the learner's module prescribed in the K to 12 Basic Education Curriculum. In contrast, the experimental group was exposed to Anchored Instruction as the teaching approach. T-test of Paired Samples was utilized to test if there existed a significant mean gain on the pretest and posttest scores in the Business Mathematics achievement test of the students in the control group and experimental group while T-test of Two Independent Samples was used to test if there was a significant difference on the mean gain scores of the students between both groups at 5% level of significance.

The respondents in this study were Grade 11 senior high school students under the General Academic Strand of Simala National High School in Cebu, Philippines. They were in two class sections grouped heterogeneously at the beginning of classes. One class section had 40 students, which comprised the control group, while the other class section, which had 40 students, comprised the experimental group. A match pair design was established before conducting the experiment to ensure that the control group was not significantly different from the experimental group in terms of their profile. Age, gender, and grades in Math in the previous year were the profile considered for the match pairing.

The researcher administered pretest and posttest of the Business Mathematics Achievement Test, a 50-item multiple-choice type of test. It was designed to be answered in 60 minutes. This research tool is a teacher-made test in Business Mathematics in which the questions were focused on problem-solving. The concepts and skills included in the test were based on the competencies prescribed by the Department of Education for the General Mathematics curriculum. Experts examined it for content validity. After conducting a pilot test, Cronbach α was determined to test the reliability of the questionnaire. Results revealed a Cronbach α of 0.89, which signified high reliability.

Four videos were prepared for the intervention in the experimental group, one for each of the topics, namely "Simple and Compound Interest," "Annuities," "Basic Concepts of Stocks and Bonds," and "Basic Concepts of Loans." These videos were researcher-made involving students who were not part of the study. The videos were written and directed by the researcher strictly following the principles of Anchored Instruction. During the intervention, the anchored videos were shown using a large classroom television. The experimental group can go back to any point of the video whenever they need certain information.

Guided by the principles of anchored learning design, a problem generated from the researcher-made anchored video in the Simple and Compound Interest lesson is hereby presented as an example. In this scene, the characters Janice and Ericka talked about investing in a cooperative that offered an annual simple interest gain. The conversation between the characters provided clues to the problems that the learners needed to generate. One problem was asking for the maturity value given a different number of years, while there were also problems looking for the principal, the term, and the interest amount. Multiple data were strategically embedded throughout the anchored video in which the learners needed to determine its relevance. The complexity of these problems allowed the learners to be more attentive and think critically.

RESULTS AND DISCUSSION

The Pretest and Posttest Mean Gain Performance in the Business Mathematics Achievement Test of both the control and experimental groups are summarized in Table 1.

The mean gain performances between the pretest and post-test results of the control group in almost all the topics have significantly increased with P-values less than 0.05. In totality, a 5.37 mean gain had been achieved by the group with a P-Value of 0.000, which established a significant mean gain from the pretest results to the post-test results. Though the group still obtained below-average performances in

Table 1
Pretest and posttest mean gain performance in control and experimental groups

Topics	Test	RESPONDENTS							
		Control Group				Experimental Group			
		Mean	Mean Gain	T-Value	P-Value	Mean	Mean Gain	T-Value	P-Value
Simple and Compound Interest	pre	12.88	0.47	0.74 ns	0.466	13.03	2.07	3.66**	0.001
	post	13.35				15.10			
Annuities	pre	5.85	2.38	7.00**	0.000	5.78	3.00	6.69**	0.000
	post	8.23				8.78			
Stocks and Bonds	pre	3.60	1.95	6.42**	0.000	3.78	2.62	8.60**	0.000
	post	5.55				6.40			
Loans	pre	3.15	0.58	2.61**	0.013	3.08	1.22	5.38**	0.000
	post	3.73				4.30			
Totality	pre	25.48	5.37	5.50**	0.000	25.67	8.91	8.46**	0.000
	post	30.85				34.58			

Note: ** – significant when $\alpha \leq 0.05$ level of statistical significance; ns–not significant

"Annuities" and "Stocks and Bonds" lessons and maintained average performances in the lessons of "Simple and Compound Interest" and "Loans," in general, they were able to improve their overall performance from below average with a mean of 25.48 to an average performance with a mean of 30.85.

These findings indicated that conventional instruction helped improve the business mathematics performance of the students. Following the learner's module with mostly direct instruction as a way of teaching, the students still learned the concepts and skills in the business mathematics component under the General Mathematics core subject. Hence, discussion with well-prepared steps and procedures would still yield a better result on student achievement. Many students still profit from structured teacher-directed learning procedures (Harris & Pressley, 1991).

On the other hand, the mean gain performance of the experimental group between the pretest and posttest results revealed that there was a significant mean gain across all the four learning outcomes resulting in an overall mean gain of 8.91 with a P-Value of 0.000. Furthermore, it was also revealed that the group improved its performance in the "Stocks and Bonds" lesson, which was from below average to an average level. In addition. the average performance in "Loans" was raised to an above-average level. Finally, though they maintained an average performance in "Simple and Compound Interest" and obtained a below-average performance in "Annuities," in totality, the group performance improved from below average to an average level with a significant mean gain.

These findings showed that the learners understood the concepts well through Anchored Instruction as supported by their posttest results. This approach essentially targets to utilize context of meaningful problem-solving environments where the instruction is anchored (Bransford, 1997; Lee, 2002). Though the students had many struggles generating the problem embedded in the story shown in the videos, they eventually exhibited improvements in the problem formulation. Thus, they had engaged more with the learning process resulting in better test results.

The mean gain difference between the experimental and control groups is shown in Table 2.

A comparison of mean gain between the two groups revealed in totality a much higher mean gain of the experimental group than of the control group with a P-Value of 0.022. There were significant differences in the mean gain scores in two out of four topics, particularly in "Simple and Compound Interest" and "Loans." It signifies that Anchored Instruction is a more effective approach to these lessons than the conventional way of teaching. The comparable performance between the two groups in the lessons of "Stocks and Bonds" and "Annuities" could be because of the first-time exposure of the students. The students were still in the process of absorbing the unfamiliar terms included in "Stocks and Bonds." While in "Annuities,"

Table 2
Mean gain difference between the experimental and control groups

Topics	Group	Mean Gain	Mean Gain Difference	T-Value	P-Value
Simple and Compound Interest	Experimental	2.07	1.60	2.14	0.036**
	Control	0.47			
Annuities	Experimental	3.00	0.62	1.12	0.268 ns
	Control	2.38			
Stocks and Bonds	Experimental	2.62	0.67	1.79	0.077 ns
	Control	1.95			
Loans	Experimental	1.22	0.64	3.43	0.001**
	Control	0.58			
Totality	Experimental	8.91	3.54	2.34	0.022**
	Control	5.37			

Note: ** – significant when $\alpha \leq 0.05$ level of statistical significance; ns – not significant

the topic involved complex formulas with long computations.

In general, Anchored Instruction was a more effective approach in teaching business mathematics as it exposed the students to challenging and interesting problems. This method focused on processes that highlighted deep thinking rather than only on the contents of thought (Bransford et al., 2012). It also enhances learning through technology applications in the classroom (Kariuki & Duran, 2004; Shyu, 2000). Even students who normally are not good at math can still contribute to problem-solving. For example, they may be good at noticing information in the video that is relevant in solving the problem (CTGV, 1990). This approach lets the students define and pay attention to their perception and comprehension (Bransford et al., 1997).

Through the researcher's observation and interview with selected subjects, it was confirmed that learners felt that they were highly engaged in the learning process. They greatly appreciated the teaching method because they found the activities relevant and realistic. Furthermore, they felt involved throughout the learning experience, which is the essence of learner-centered teaching. Just like in the study of Duncan and Bamberry (2010), where anchored instruction was well received and can potentially improve learning in areas where learners have limited real-life experiences.

CONCLUSION AND RECOMMENDATIONS

Findings revealed that Anchored Instruction is a more effective method in teaching Business Mathematics than conventional instruction. The learner-centeredness of Anchored Instruction provided opportunities for the learners to be highly engaged in the learning process, as noted in the researcher's observation and interview with selected subjects. As a result, they were able to identify the useful knowledge and eventually overcome the inert knowledge problem. Hence, it is recommended to utilize this method in teaching Business Mathematics.

It is recommended to apply this method in other learning areas for comparison to further this study. Since the study was conducted only within six-week, the question of longitudinal effectiveness and sustainability of this approach over an academic year or more has yet to be established. Thus, a future study may be conducted spanning a longer period of intervention and covering more lessons in business mathematics.

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