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The Effect of Social Based-Trends Instruction to Students' Conceptual Understanding in Mathematics

Ezekiel Orozco Pelayo
College of Arts and Sciences, North Eastern Mindanao State University, Tandag City, Surigao del Sur, Philippines

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ABSTRACT

Purpose of the study: The study aimed to compare the effects of social trends-based instruction to conventional method of teaching on students' conceptual understanding in mathematics.

Methodology: The study employed a quasi-experimental research design using test questionnaire which was formulated by the researcher based on the National Council for Teachers in Mathematics (NCTM) principles and standards for teaching mathematics. Data were collected from two groups of First Year BS Hospitatily Management college students, analyzed using Statistical Package for Social Sciences and involved ethics review and informed consent.

Main Findings: The study revealed that both social trends-based instruction and traditional instruction methods led to improvements in students' conceptual understanding in mathematics. However, the social trends-based instruction group demonstrated higher scores on students' learning of the topic. Findings also revealed through the Analysis of Covariance that the type of instruction used in both groups had a significant impact on students' conceptual understanding.

Novelty/Originality of this study: To the best of the researcher's knowledge, no existing study has integrated social trends into mathematics teaching to the extent explored in this research. This study uniquely integrates Social Trends-Based Instruction in teaching mathematics to evaluate its influence on students' conceptual understanding. This study offers a new perspective for mathematics classroom and serves as an instructional model for mathematics educators to enhance mathematical learning of students. The findings of this study are expected to provide valuable insights for educators, policymakers, and curriculum developers seeking to modernize mathematics instruction.

Corresponding Author:
Ezekiel Orozco Pelayo
Department of Mathematics and Natural Sciences, College of Arts and Sciences, North Eastern Mindanao State University, National Highway, Rosario, Tandag City, Surigao del Sur, 8300, Philippines.
Email: eopelayo@nemsu.edu.ph

1. INTRODUCTION

Mathematics is a fundamental tool that empowers students throughout their lives. It equips students with essential skills for both the present and the future. These skills prepare students to stand out in different areas, whether in academia, professional careers, or everyday life. Fosters intellectual curiosity, analytical thinking, and problem-solving abilities that are essential for students to be successful in this present world. However, most students do not value mathematics because they do not see its importance and relevance beyond the range of the classroom. This causes them to have difficulty learning the subject area because their perception

of mathematics may affect their performance [1], [2]. In fact, recent local annd international assessments (PISA 2022, TIMSS 2019) and national tests (NAT 2022-2023) confirm Filipino students' consistently weak performance in math, reading, and science. This trend extends to higher education, where college students struggle with math, often displaying low grades, negative attitudes, and weaknesses in data analysis and problem-solving, despite mastering some basic skills [3], [4].

Many interrelated factors contribute to lower mathematics performance among these students. These difficulties of students face with mathematics are most often attributed to cognitive reasons [5]. Studies consistently show that students with weak foundational skills usually struggle with math skills and will continue falling behind in higher-level math. Students' struggles with problem-solving, which often leads to poor mathematics performance, suggest a lack of understanding of mathematical concepts and operations [6]. This lack of conceptual understanding limits students' ability to apply their knowledge to new and unfamiliar mathematical problems [7]. The success of good students' mathematics performance depends on their ability to solve problems and understand when and how to apply knowledge and ability [8], [9]. This implies that students' mathematical performance is linked to their ability to understand the concept effectively.

Students with continuously low performance in mathematics may eventually lose their interest and refuse to learn further [10]. One reason for this poor performance of students is the method of teaching [11], [12]. A key factor in effective teaching and learning of mathematics is the teaching method employed. Effective teaching methods are essential for creating a stimulating and supportive learning environment that empowers students to succeed in mathematics. However, the traditional teaching method that focus primarily on the transmission of content and procedural skills have been criticized for not effectively developing students' deeper understanding, problem-solving abilities, and appreciation for the subject [13], [14]. It only enables students to perform algorithmically and understand mathematics without reasoning [15]. It often lacks relevance to students' daily experiences and societal contexts [16]. As such, there is a pressing need to explore alternative instructional methods.

Recent studies in mathematics education have highlighted the potential of context-based instruction and social justice integration in the teaching of mathematics. Context-based instruction uses real-world and fictional scenarios to make mathematics more engaging and relevant [17]. Studies have shown that this method can improve problem-solving skills, increase student interest, and foster a stronger connection between mathematics and everyday life [18]-[21]. Further, social justice integration also aims to make mathematics education more fair and empowering for all students. Studies have also shown positive results from incorporating social justice into mathematics education. Students can develop a deeper understanding of mathematics and its role in addressing societal problems [22]. However, challenges such as time constraints, material limitations, assessment difficulties, teacher training and the development of resources can hinder the effective implementation of these methods [23], [24].

While there has been growing interest in integrating various methods into mathematics teaching, there remains a gap in employing social trends-based instruction into mathematics teaching. Despite its promise, research exploring the direct influence of social trends-based instruction on students' conceptual understanding remains limited. Most existing studies have focused on the general benefits of contextualized mathematics instruction without specifically addressing the role of social trends as instructional tools [25]. These social trends can influence various aspects of life, including cultural norms, economic practices, technological advancements, and social interactions. Social trends often emerge from shifts in demographics, technological innovations, cultural transformations, and economic developments [26].

The researcher believes that employing social trends-based instruction in mathematics teaching will be a promising one and by leveraging the benefits of integrating social trends in the teaching and learning of mathematics, this can create a more engaging, relevant, and impactful learning experience for students. As Iwamoto and Chun [27] stressed, employing social trends will relate to and impact learners' understanding of their lives. This will not only make mathematics more interesting but also help students develop critical skills and awareness that are essential in today's world.

This study addresses the research gap by examining the influence of social trends-based instruction on students' conceptual understanding. By exploring the interplay between mathematics instruction and social realities, this study aims to demonstrate how a socially contextualized approach can enrich the teaching and learning process in mathematics. Specifically, this study investigates how students' mathematical competencies toward the subject are shaped when mathematics is presented as a tool for analyzing and addressing real-world issues. The findings of this study are expected to provide valuable insights for educators, policymakers, and curriculum developers seeking to modernize mathematics instruction.

2. RESEARCH METHOD

2.1. Type of Research

A quasi-experimental design was employed in this study due to practical constraints associated with school schedules and logistical considerations [28]. This design aimed to establish a causal relationship between the intervention (social trends-based instruction) and the outcome measures (conceptual understanding in mathematics) while controlling for pre-existing differences between groups. Here, a pre-test was initiated to measure students' conceptual understanding in mathematics. The design chart can be seen in the figure below:

Figure 1. Chart for Pre-test/Post-test Desigm

Groups	Pre-test	Treatment	Post-test
Experimental	√	√	√
Control	√	-	√

Where:
√: With treatment of social trends-based instruction
- : Without treatment of social trends-based instruction

2.2. Research Subject

The study was conducted at Northeastern Mindanao State University, Philippines. Participants were randomly selected from two intact classes of First Year Bachelor of Science in Hospitality Management college students of the first semester School Year 2024-2025. Random assignment was used to divide the participants into experimental and control groups. The experimental group is composed of 40 participants with 11 males, and 29 females, while the control group will consist of 40 participants with 9 males, and 31 females.

2.3. Research Instrument

To measure the students' conceptual understanding, a researcher-developed test was utilized. The tests include topics; simple interest, compound interest, annuity, credit cards, stocks and bonds, and mutual funds under the topic of mathematics of finance. The test was formulated based on the National Council for Teachers in Mathematics [29] principles and standards to assess students' conceptual understanding in mathematics. These principles include defining concepts verbally and in writing, making examples and non-examples, changing the form of representation to various forms, and interpreting concepts.

The researcher had tested the validity of the test items for conceptual understanding test. Three mathematics professors and experts in the field were able to lend their time in validating and were able to provide feedback. After thorough validation, the test questionnaire was refined, and items were reduced. The researcher then pilot tested all the test questionnaires on a different population than the target population to see if the questions were appropriate. After pilot testing, the researcher performed item analysis based on the answers of the students to examine and evaluate the test items with its quality, effectiveness, and ability to measure specific knowledge or skills. Moreover, several questions were deleted as they needed to be rejected based on the results of the item analysis and were reduced. The researcher then proceeded with the computation of the reliability index for conceptual understanding test result, which resulted in Cronbach's Alpha of .80.

2.4. Data Gathering Procedure

The researcher carefully followed the ethical procedures in the conduct of the study. A request letter was sent to the office of the Dean of the College of Business and Management of North Eastern Mindanao State University-Tandag City, Philippines to ask permission to conduct the study. A random selection was employed as to which class was assigned as the experimental group and control group. The researcher did not inform the students that they were subject to an experiment to avoid the Hawthorne effect. During the pre-test administration, the experimental and control groups were given the pre-test at different times to ensure fairness. The researcher ensured conducive testing conditions by providing a quiet environment, sufficient time to answer the test, and clear instructions for the test.

In the intervention phase, each class session, for both groups, began with preliminary activities: a prayer, checking of attendance, review of previous lessons, and a warm-up activity. Students in the experimental group were exposed to mathematics of finance lessons that were directly connected to current events and social trends. To reinforce these concepts, students were given activities that required them to apply their knowledge to real-world scenarios. They were encouraged to participate in activities that explored the societal implications of mathematical principles. On the other hand, students in the control group received instruction through traditional methods. While they were given the same activities as the experimental group, the focus was solely on the mathematical concepts themselves, without any reference to current events or social trends.

The experiment lasted for several meetings that covered all the lessons under the topic of mathematics of finance, and after the experiment, a post-test was administered to both groups. During the post-test administration, the researcher administered the same test questionnaires to both groups to measure their learning gains.

2.5. Data Analysis

The researcher tabulated the collected data and proceeded with data analysis. Statistical tests were employed to compare the mean scores of the experimental and control groups on the pre-test and post-test. To compare the performance of the two groups, analysis of covariance (ANCOVA) was used, controlling for pre-test scores. Before conducting the ANCOVA, assumptions of normality and homogeneity of variance were verified. As emphasized by Karpen [30], ANCOVA is a valuable statistical tool for comparing group means while accounting for the influence of continuous variables. It allows for more precise and accurate analyses, particularly in situations where confounding variables might affect the results.

3. RESULTS AND DISCUSSION

3.1. Pre-tests and Post-tests Performance of Students on Cconceptual Understanding Test.

Table 1 presents a comparison of pre-test and post-test scores for the control and experimental groups on a conceptual understanding test, broken down by specific indicators. The conceptual understanding indicators section of the table presents specific areas within the concept of mathematical understanding, such as defining concepts, making examples, representing concepts, and interpreting concepts. The perfect score column indicates the maximum possible score for each indicator. The control and experimental groups are the two groups being compared in the study. The control group received traditional instruction, while the experimental group received the social trends-based instruction.

Table 1. Mean scores and standard deviation of the pre-tests and post-tests of conceptual understanding test.

Conceptual Understanding Indicators	Perfect Score	Pre-test				Post-test			
		Control		Experimental		Control		Experimental	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Defining concepts	5	1.08	.66	1.05	.55	3.38	1.23	3.48	1.06
Making Examples and Non-Examples	5	1.27	.73	1.27	.68	3.58	1.15	3.92	1.07
Representing Concepts	4	.70	.46	.75	.44	2.33	.73	2.73	.91
Interpreting Concepts	5	.83	.64	.90	.59	2.50	.73	3.02	.73
Overall	19	3.88	.62	3.95	.57	11.78	.96	13.15	.94

It can be observed in Table 1 that both the control and experimental groups showed an increase in their mean scores from pre-test to post-test for all indicators. In general, the control group obtained a mean of 3.88 with a standard deviation of .62 during the pre-test, it was also increased to 11.78 with a standard deviation of .96 after the implementation. However, the experimental group consistently had higher mean scores and lower standard deviations on the post-test compared to the control group. From its pre-test mean score of 3.95 with a standard deviation of .57 have increased to a mean of 13.15 with a standard deviation of .94 during the post-test. This suggests that social trends-based instruction had a more positive effect on student learning.

While both groups showed improvement, the social trends-based group had a larger increase in their mean score. This suggests that the social trends-based method may be more effective in improving conceptual understanding, although both methods led to significant gains. Also, looking at the specific indicators' mean scores, the experimental group's improvement was particularly noticeable in indicators like "Defining Concepts" and "Making Examples and Non-Examples" where they had higher post-test mean scores and lower standard deviations compared to the control group. This suggests that students in the experimental group exhibited a stronger ability to accurately and precisely define key mathematical terms and concepts. They likely demonstrated a deeper understanding of the underlying principles and could articulate them clearly. The lower standard deviation in the experimental group's post-test scores also suggests that the social trends-based

instruction led to more consistent student performance. This shows that the intervention successfully reached a broader range of learners.

The result highlights the crucial importance of comprehending the problem. Understanding mathematical concepts goes beyond mere calculation or formula memorization; it demands a deep understanding of underlying principles and the ability to apply these principles flexibly and creatively. Furthermore, the results also underscores the importance of cultivating a deeper understanding of mathematical concepts. Students must develop the ability to interpret problems, connect concepts, and apply their knowledge flexibly to solve real-world challenges. Mathematical proficiency requires more than just computational skills. It demands a deep understanding of concepts, the ability to define concepts, interpret problems accurately, and the flexibility to apply knowledge in various contexts.

By employing innovative and integrative teaching methods, these can lead students to deeper understanding, better retention, development of crucial skills, and more positive attitudes towards mathematics. As stressed by Tomlinson [12], integrative methods in teaching mathematics have gained significant attention in recent years due to their potential to enhance student engagement, conceptual understanding, and problem-solving skills. This method involves connecting mathematics with other subjects, real-world contexts, or student interests. Students can also develop a deeper understanding of content and improve their understanding of a complex problem [20].

3.2. One-way Analysis of Co-Variance on Conceptual Understanding Test

Table 2. Results of the ANCOVA for Conceptual Understanding Test

Source of Variation	Sum of Squares	df	Mean Square	F	p
Pre-test	3.74	1	3.74	0.589	0.445
Instructional Method	38.30	1	38.30	6.039	0.016
Residuals	488.34	77	6.34		

Table 2 shows the analysis of data by comparing the mean conceptual understanding test scores of the participants exposed to conventional and social trends-based instruction. In the model, the post-test scores were utilized as the dependent variable, the instructional method as the categorical factor, and the pre-test scores as the covariate. It can be observed that in the method portion, the p-value is 0.02, which is less than the conventional significance level of 0.05. This suggests that there's a statistically significant difference in post-test scores between the different instructional methods. In other words, the type of instruction used has a significant impact on students' conceptual understanding. This means the observed differences in performance are unlikely to be due to chance alone.

However, the p-value for the pre-test is 0.45, which is greater than the significance level of 0.05. This means we can confidently conclude that the type of instruction used has a significant impact on students' conceptual understanding. Some instructional methods are clearly more effective than others in helping students develop this skill. This also suggests that the pre-test scores do not have a significant impact on the post-test scores, after controlling for the effect of the instructional method

Furthermore, the ANCOVA analysis suggests that the different instructional methods have a significant impact on students' conceptual understanding, even after considering their prior knowledge. The fact that the ANCOVA shows a significant impact of instructional methods confirms that the observed differences are not primarily driven by pre-existing student knowledge. The findings strongly suggest that the choice of instructional method has a substantial and measurable impact on students' conceptual understanding. This information is crucial for educators and policymakers as it highlights the importance of selecting and implementing effective teaching method to improve student learning outcomes.

Mathematics educators should continue exploring innovative teaching methods and techniques. By embracing innovation and combining diverse teaching strategies, mathematics educators can create more effective and engaging learning environments that empower students to succeed. The results further indicate that using a variety of teaching methods in teaching mathematics can have a positive impact on students' understanding of mathematical concepts. Through integrative teaching and learning, students can develop a deeper understanding of content and improve their understanding of a complex problem [20].

The results have shown the strengths of integrating Social Trends-Based Instruction in mathematics lessons in improving students' conceptual understanding in mathematics. Particularly, the integration of Social Trends-Based Instruction provided a relevant and meaningful usage of mathematics by tackling real-life trends and events. The present study concured with Gutstein [31] that mathematics can and should be taught in a way that supports students in using mathematics. Integrating Social Trends-Based Instruction into mathematics education can enhance student performance by making math concepts more relevant and engaging, promoting a deeper understanding of real-world applications, and increasing student motivation, particularly when they see

how math can be used to address social trends and issues that matter to them, thereby improving their overall engagement and achievement in the subject.

However, the implementation of Social Trends-Based Instruction also faces some limitations, such as the relevance and fleeting trends, social trends can be fleeting, and what's popular today might be irrelevant tomorrow. This can make it challenging to design lessons that remain relevant and engaging over time. Thus, it is important to acknowledge this limitation and address them thoughtfully when implementing social trends-based instruction. Careful planning, thoughtful selection of trends, and a focus on clear learning objectives are essential for maximizing the benefits of this approach while minimizing its potential drawbacks.

4. CONCLUSION

The Social Trends-Based Instruction shows potential to be more effective in improving students' conceptual understanding in mathematics, although both methods led to significant gains. The result of the study showed also that students exposed in the social trends-based instruction exhibited a stronger ability to accurately and precisely define key mathematical terms and concepts. They likely demonstrated a deeper understanding of the underlying principles and could articulate them clearly. Moreover, the result also suggests that the social trends-based instruction led to more consistent student performance. This shows that the intervention successfully reached a broader range of learners.

Several recommendations can be put forward for further development. First, mathematics educators should continue exploring and implementing integrative methods that connect mathematics to real-world contexts and other subject areas. Incorporating social trends-based instruction and other innovative teaching methods can foster critical thinking and problem-solving skills. Second, curriculum developers may incoporate social trends and real-world examples into math curricula to make them more relevant and engaging. Also, include authentic data and statistics related to social trends in math curricula to provide students with real-workd examples. Lastly, conduct a mixed-methods research design about the influence of social trends-based instruction to gain a deeper and more insightful understanding of the influence of social trends-based instruction on students' learning experiences in mathematics. These recommendations should guide the future development and improvement of Social Trends-Based Instruction, making it a more effective tool for boosting students' math performance.

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