Teaching Paradigm and Values in Mathematics: An Explanatory Approach

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Abstract *– The kind of teaching paradigm a teacher adheres to determine the kind of teaching approaches he applied in the teaching of mathematics. This, however, influences the mathematical content to be taught, the pedagogical strategies employed, the disciplinary organization of the class, and so on. The way he puts into practice the learning theory he adhered to posit the necessary values he wanted to convey to the students implicitly or explicitly as Grant Bright adds that a person's paradigm, therefore, dictates his behavior. But what kind of relation is there between the mathematics values and the teaching paradigms of the secondary mathematics teachers? It is essential to reveal the existence and level of relation between the two variables.*

The study focused on the mathematics teachers' teaching paradigms and mathematical values specifically the positivist and constructivist mathematics and mathematics educational values of secondary mathematics teachers in the division of Surigaodel Norte. The study utilized the explanatory sequential mixed method research design. Results showed that there was high manifestation of positivism paradigm among mathematics teachers and very high manifestation of constructivism paradigm. Mathematical values specifically the positivist and constructivist mathematics and mathematics educational values were also evident and transpired based from the responses during the interview conducted. Hence, Mathematics teachers in the division of Surigaodel Norte are eclectic, they tend to blend both teacher-centered and student-centered teaching paradigms.

Keywords: Constructivism, Mathematics educational values, Positivism, Teaching paradigms.

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INTRODUCTION

When teachers plan their instruction for a mathematics course, they have to think about the desired outcomes they want from their students. With no clear national consensus on what mathematics concepts should be taught in each grade level or how they should be taught, it is up to teachers to ultimately decide how and what to teach.[1] There is evidence that what a teacher believes to be true about mathematics instruction influences how they teach [2]. Teachers' own perspective about their own learning theories have long been viewed influential to all aspects of teachers' decisions about teaching. How one plans and organizes instruction is directly impacted by one's beliefs about learning. In addition, teachers' views of learning guide them as they make decisions about desirable means of implementing and assessing instruction. [3]

Grant Bright, editor of the website Bright Quotes, documented both the dictionary and the "every day" definitions of the word paradigm. [4]Merriman-Webster's Dictionary states that a paradigm is "a philosophical and theoretical framework … which has theories, laws and generalizations … broadly: a philosophical or theoretical framework of any kind." Bright adds that a paradigm is in essence a set of "glasses" that we look through when we view the world. Bright quoted AnaisNiln to explain how a paradigm works thusly -- "We don't see things as they are, we see things as we are. Therefore, a person's teaching paradigm defines his teaching philosophies and influences his teaching practices and values.[5] The kind of teaching paradigm a teacher adheres to defines how he views his teaching profession and thus, directs him to the kind of teaching theories he want to partake in teaching and learning mathematics.[6]

The widespread interest on the different teaching paradigms among mathematics education theorists, researchers, and practitioners has led to a plethora of different theories of learning. The educational philosophies with regards to teaching mathematics are broken down into two categories: positivism and constructivism.[7]Positivism upholds the teacher-centered paradigm in which teacher's

explanations and ideas constituting the focus of classroom mathematical practice. It is the teacher's job to make sure directions are clear and students understand what and how they will be learning. The teacher's major role is to provide a direct and clear demonstration of solution procedures in each mathematics problems, and then to assist students to acquire and merge problem-solving skills by giving them a chance to practice, administrating periodic tests to check their competence, and repeating the demonstration or step-by-step instruction whenever needed. In fact, the teacher focuses more on whether students can perform the standard algorithms than on whether they understand the mathematical principles and processes. Students' central role then is to pay their full attention to the teacher's demonstration and explanation, to memorize facts, and to practice routine procedures with many problems until they master them.

Against the typical instructional practice described above, educational leaders are seeking to change teacher-centered pedagogy to a student-centered approach. NCTM has initiated and propelled a reform movement by the publication of standards on curriculum, teaching, and assessment (NCTM 1989; 1991; 1995; 2000). This reform requires substantial changes in the teaching and learning of mathematics. Creating a learning environment with mathematically rich tasks and discourse supports the new curricular emphasis of mathematics as problem solving, reasoning and proof, communication, connections, and representation (NCTM 1989; 2000). Student's contribution and responses constitute the central rendezvous of mathematical activities. Instead of listening and following a teacher's instruction, the students are expected to have the opportunity to be immersed into a mathematical discourse in which they invent, explain, and justify their own mathematical ideas and critique others' ideas. Certainly one of the most influential views of learning during the last two decades of the 20th century is the perspective known as constructivism.[8][9] The constructivist perspective assumes that learning occurs through cognitive conflicts by which the individual's mental structure evolves into more viable structure. [10] Thus, the main concern of constructivist teaching in mathematics education is to help students enhance their cognitive structures with respect to specific mathematical content [11]-[12].

The kind of teaching paradigm a teacher adheres to determines the kind of teaching approaches he applied in the teaching of mathematics. This however influences the mathematical content to be taught, the pedagogical strategies employed, the disciplinary organization of the class, and so on [13]-[14]. The way he put into practice the learning theory he adhered to posit the necessary values he wanted to convey to the students implicitly or explicitly as Grant Bright adds that a person's paradigm, therefore, dictates his behavior. Many mathematics educators believe that the values which teachers of mathematics bring to various aspects of their work profoundly affect what and how they teach, and therefore what and how their students learn [15]-[16]. Teachers' awareness about these values will give them direction on their classroom practices [17]. As a result, the more mathematics teachers understand about their own pedagogical value positions, the more flexible they will be in their thinking about, and practice of, classroom teaching of mathematics [18]-[19].

What kind of relation is there between the mathematics values and the teaching paradigms of the secondary mathematics teachers? It has been seen that there are no studies conducted on this subject in literature. Therefore, as there are no similar studies, it is essential to reveal the existence and level of relation between the two variables. The present study aimed at investigating the teaching paradigms and the kind of mathematics educational values the secondary teachers hold, finding how these two aspects are inter-correlated and how each of them influences each other.

OBJECTIVES OF THE STUDY

The present study aimed at investigating the teaching paradigms and the kind of mathematics educational values the secondary teachers hold, finding how these two aspects are inter-correlated and how each of them influences each other.

Methodology

Research Design

The researcher utilized explanatory sequential mixed method research design. It is characterized by the collection and analysis of quantitative data followed by the collection and analysis of qualitative data[20] . The rationale for this approach is that the quantitative data and their subsequent analysis provide a general understanding of the research problem. The qualitative data and their analysis refine and explain those statistical results by exploring participants' views in more depth [21]. Creswell's explanatory sequential mixed method is shown in [22]-[23]Figure 2.

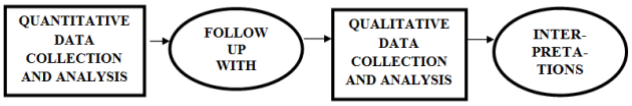

Figure 2. Creswell's Explanatory Sequential Mixed Method

The research data were collected through a survey questionnaire including items on a Likert type scale to ascertain the mathematics teachers' teaching paradigms and mathematics teachers' mathematics educational values. After the quantitative data collection and analysis, the researcher collected and analyzed the qualitative data on the second phase as a follow up to the quantitative results. The interview substantiated the findings and interpretations of the responses gathered from the survey questionnaires.

Participants and Sampling

The participants of this study were the eighty (88) secondary mathematics teachers at the secondary schools of Surigaodel Norte Division. The teacher-participants were qualified according to the number of years they've been teaching mathematics and those teachers who were conferred the degree Bachelor in Secondary Education major in Mathematics only. All mathematics teachers who have a minimum of five (5) years in teaching mathematics and a graduate of BSED-Mathematics were the respondents of the study but during the course of data gathering, some of the mathematics teachers were not present. Some of them were attending trainings and others were at the Athletics training in Surigao City.

Instrument

Quantitative Phase

A Likert type scale developed by Durmu and Bıçak [24] and a researcher-made questionnaire were used for data collection. Likert scale is seen as the most suitable method in assessing latent construct like values and paradigm. The Likert scale will determine the mathematics educational values and teaching paradigms with scale of five (4) strongly agree and one (1) for strongly disagree.

Qualitative Phase

The second phase was an interview with the teacher-participants. The data gathered from the interviews substantiated the quantitative results. Through this part, the researchers were able to gather information on the real scenario of their teaching philosophies and values. The views of the teachers were analyzed and recounted to the philosophical underpinnings of this study.

Results and Discussion

Quantitative Analysis

1. In terms of positivism paradigm, teachers demonstrated a high manifestation (M = 2.97, SD = 0.44).
2. In terms of constructivism paradigm, teachers tend to adopt constructivism in their teaching process because the manifestation is evidently very high (M = 3.33, SD = 0.36).
3. The extent of manifestation of constructivist value in terms of creativity among mathematics teachers resulted on a very high manifestation (M = 3.54, SD = 0.38).
4. The extent of manifestation of the mathematics teachers in terms flexibility is very high (M = 3.72, SD = 0.39).
5. There is a very high manifestation that the respondents are incorporating openness in teaching mathematics.
6. Respondents' manifestation of valuing enjoyment is very high (M = 3.65, SD = 0.43).
7. The teacher respondents showed a very high manifestation (M = 3.52, SD 0.59) on open-mindedness
8. Teacher respondents showed very high manifestation on constructivism paradigm and results showed also that a very high manifestation was evident in the respondents regarding constructivist values with a grand mean of M = 3.62 and SD = 0.33.
9. As seen in the table, respondents show a very high manifestation of the value control (M = 3.65, SD = 0.34).
10. Results show that positivist value in terms of objectivity is very highly manifested by the respondents (M = 3.52, SD = 0.46).
11. Teachers demonstrated a very high manifestation on the value accuracy (M = 3.60, SD = 0.44).
12. The over-all demonstration of positivist values indicated very high manifestations among the mathematics teacher with the general mean of 3.59 and standard deviation of 0.35.
13. Results show that there is a significant relationship between positivism and positivist mathematics educational values and constructivism paradigm and constructivist mathematics educational values. Hypotheses were then rejected.

Qualitative Analysis

The following themes emerged based on the responses of the teacher respondents.

1. Teacher as the Source of Knowledge – Hinchey [25][26] describes the role of the educator in the positivist classroom as follows: "The task of

teachers is to become somewhat expert in what is known, and then to pass information along to their students. There is a need for teachers to discuss the general concepts first. Informant F who turned out to be a positivist believed that teachers are the ones who transmit mathematical knowledge to students. According to her: "*I believe that teachers are the ones who transmit mathematical knowledge to students. We need to discuss theories, mathematics concepts and relations to students to provide them with a full background. The students in this way are already acquainted and guided in their learning process.* (If1.2)". I.A also asserted, "*I teach students based on the knowledge I acquired from textbooks, prior knowledge and from experiences*" (Ia1.1). "*I discuss to them all the necessary concepts so they can understand the lesson well*"(Ia1.2), "*I will discuss a little and then more on student activities*" (Ic1.2), "*I will discuss first with concrete materials*", (Id1.1), "*Discuss first then give problem...*"(Ie1.2), "*Discussion first before application*"(If1.1), "*Discuss then application*" (Ig1.1), "*Discussions first before then students will do the application*" (Ih1.2).

2. Teacher as Demonstrators of Learning

On the other hand, a constructivist teacher like informant B teaches students through concrete materials and actual demonstrations, in other words, concept formation through concrete examples. She shared; "*In presenting the concepts to the class, I use actual demonstrations using concrete materials so students can easily understand the general concept presented to them. Through this, students will be able to conceptualize generalizations of the concepts presented* (Ib1.3-4). Informant H also claimed that "*Concrete models will be presented because I believe that visual materials aid students in learning* (Ih1.3)". "*I allow the students to experience solving problems of their own* (Ia2.1), "*Immersing the students to actual manipulations of mathematical knowledge is important for me* (Ib2.1), "*They should experience how to solve problems, how to illustrate problems and how to derive generalizations (*Ib2.2)", "*I am more on student-centered activities so students can experience how to construct ideas, derive correct answers and illustrate problems on their own. In this way, they will easily grasp the concept and the level of understand will increase also (*Ic2.1-2)".

3. Teacher as Facilitators

Informant B agreed with this by stating that *"The tasks of the teacher are to teach mathematical knowledge, facilitate learning, and encourage students to answer, participate and engage themselves in the teaching learning process (*Ib3.1) and this was seconded by informant C who further shared that "*I give necessary information of the topic discussed through discussion and then I will become a facilitator only because for me students should be involved in the discovery and construction of ideas* (Ic3.1)".

4. Problem solving in scientific way

For a positivist teacher like informant A, teaching the problem-solving skills to students is through "*Step-by-step procedures on problem solving will be discussed to them and always remind them to follow the steps I presented to ensure accuracy*" (Ia1.5). This way of teaching is also practiced by informant B where he emphasized "*In the process of problem solving, I will present to them the steps on how to solve problems, and then give examples to illustrate the steps I presented* (Ib1.6)". Informant I further elaborated that "*Problem solving is a step-by-step process so if students are already immersed with the corresponding competencies in problem solving, they too can apply these competencies in solving their own problems in real life. They too could adapt the step-by-step procedures at arriving at the correct solution to their own problems* (Ii4.2-3).

5. Mathematics in Real Life

Informant H shared that "*Teaching math to students enhances their critical thinking skills and their ability to assess and analyze problems. In so doing, the learners are now confident to deal with real life problems* (Ih4.1-2)". Constructivist teachers also like informant E believed that "*Students will be wise enough to face real life problems* (Ie4.2)" if they are exposed to an environment where problem solving occupies the forefront of mathematics teaching. *"Math is everywhere so if they are well-equipped with necessary competencies in problem solving, they will gain confidence in facing them* (If4.2)". "*The essence of teaching math is for students to acquire necessary skills, the skills that will help them in their future endeavors* (Ii4.1)" and further elaborated by informant G stating that "*We need to teach mathematics to students so that they will know the different strategies in solving problem* (Ig4.1)".

6. Implicit Integration of Values in Math Teaching

Informant A where he shared "*We teachers sometimes do not know that we have inculcated values*

already on drills, board works and games (Ia6.2)" and further agreed by informant F by stating "*Sometimes we are not aware that we have already imparted values to students through the strategies we used* (If6.2)". as informant F shared that "*It is really important that teachers must be aware of these values because these will be basis in attaining the desired outcome we want for our students* (If6.3)" and seconded by informant G "*Values formation is important in math because we can help students achieve desirable traits in life* (Ig6.1)".

Recommendations

Based on the findings, conclusions and implications, the following recommendations are laid out: Teachers should be aware of the different mathematics educational values for them to explicitly convey these values to students. In this manner, they would be able to ascertain the kind of teaching styles and techniques that will best suit to the different needs of the students. Constructivism as a paradigm of learning should be the pillar among learning theories of the teachers. It brings forth greater impact in the acquisition of knowledge and comprehension level of the students. Teachers should explicitly demonstrate and emphasize the values embedded in their teaching pedagogies. This should be done every after the activities are complied by the students. In this manner, students cannot only generate conclusions but also inculcate the values in their senses.

Appendixes

Table 1. Sample Transcripts of the Five Respondents who uphold Positivism as their teaching Paradigm with Conceptual Category and Values

Lines	Natural Unit	Transform Unit	Conceptual Category	Values	Teaching Paradigm
Ia1.1	I teach students based on the knowledge I acquired from textbooks, prior knowledge and from experiences.	Teaching based on knowledge acquired from books, prior knowledge and experiences.	Teaching based from books, prior knowledge and experiences	Control	Positivism
Ia1.5	Step-by-step procedures on problem solving will be discussed to them and always remind them to follow the steps I presented to ensure accuracy.	Step-by-step procedures in problem solving will be discussed to ensure accuracy	Discussion of problem solving step-by-step procedures.	Accuracy	Positivism
Ib1.6	In the process of problem solving, I will present to them the steps on how to solve problems, and then give examples to illustrate the steps I presented.	Present the problem solving steps and illustrate them through examples	Discussion precedes application	Control	Positivism
Id1.4	Before, I embraced the teacher-centered approach because there were no models, concrete materials and even not enough books for students.	Embraced teacher-centered due to lack of models, concrete materials and books	Embraced teacher-centered due to lack of models, concrete materials and books	Control	Positivism
Id1.5	So I teach them through thorough discussions.	Thorough discussion was employed	Teaching through discussions	Control	Positivism
If1.2	I believe that teachers are the ones who transmit mathematical knowledge students.	Teacher believes that knowledge is transmitted from the teacher	Mathematical knowledge is transmitted by the teachers	Control	Positivism
If1.3	We need to discuss theories, mathematics concepts and relations to students to provide them with a full background.	Need to discuss mathematics theories, concepts and relations to students	Need to discuss mathematics theories, concepts and relations to students	Control	Positivism
Ig1.2	Theorems and mathematical concepts will be discussed for students to have basis of understanding the topic.	Need to discuss theorems and concepts for better understanding of the topic	Teaching theorems and concepts for better understanding	Control	Positivism

Table 2. *Sample Transcripts of the Five Respondents who uphold Constructivism as their teaching Paradigm with Conceptual Category and Values*

	Natural Unit	Transform Unit	Conceptual Category	Values	Teaching Paradigm
Ib1.3	In presenting the concepts to the class, I use actual demonstrations using concrete materials so students can easily understand the general concept presented to them.	Presenting concepts through actual demonstrations using concrete materials are applied in teaching concepts to class.	Actual demonstration using concrete materials	Creativity	Constructivism

Ib1.4	Through this, students will be able to conceptualize generalizations of the concepts presented.	Students will conceptualize generalizations of concepts presented	Conceptualizations of generalizations by the students	Progress	Constructivism
Id1.2	I am into illustrations, groupings and cooperative learning wherein students will answer or do the activity.	Teachers employing illustrations, grouping and cooperative learning in teaching	Teacher use cooperative learning and illustrations	Openness	Constructivism
Ih2.3	Through letting them experience learning, "Doing by learning" in other words.	Teacher letting students to experience learning	Teacher adhered to Doing by Learning principle	Openness	Constructivism
Ii2.1	I want my students to enjoy while learning math.	Teacher makes sure students enjoy math while learning	Enjoyment in learning math	Enjoyment	Constructivism
Ie2.3	We are successful in teaching the concepts if the students answer the problems and activities given to them.	Teacher is successful if students arrived at the correct answer	Successful teaching if students arrive at accurate answers	Accom-plishment	Constructivism

Table 3. *Sample Transcripts of the Five Respondents Conveying Positivist Values with Conceptual Category and Teaching Paradigm*

Lines	Natural Unit	Transform Unit	Conceptual Category	Values	Teaching Paradigm
Ia5.1	You give examples to students that are in line with the problems in real life situation.	Teacher gives problems in real-life situations	Giving real-life problems	Control	Positivism
Ia5.6	We need to teach students on how to be accurate because that is the main goal of math, students gain understanding on how to arrive at the correct answer.	Teacher teach students how to be accurate to gain understanding on how to arrive at correct answer	Teaching accuracy to students	Accuracy	Positivism
If5.4	It is by teaching them concepts, mathematical symbols and operations and relations so they will be acquainted with all of these.	Teacher presents concepts, symbols, operations and relations	Teacher being objective in class	Objectivity	Positivism
Ig5.1	By simply emphasizing that it is imperative to follow the steps in solving problems, steps illustrated and discussed by the teacher	Teacher emphasized strict adherence to steps illustrated in problem solving	Strict adherence to steps presented by teacher	Control	Positivism
Ih5.5	Checking of answers is essential to ensure accuracy.	Teacher checks answers to ensure accuracy	Teaching accuracy in class	Accuracy	Positivism
Ii5.3	Accuracy is simply giving exact and concrete examples, teaching the step-by-step process in problem solving.	Teacher teaches accuracy through concrete examples and steps in solving problems	Teaching accuracy to students	Accuracy	Positivism

Table 4. *Sample Transcripts of the Five Respondents Conveying Constructivist Values with Conceptual Category and Teaching Paradigm*

Lines	Natural Unit	Transform Unit	Conceptual Category	Values	Teaching Paradigm
Ib5.1	Creativity means presenting the lesson in a way the student's interest heightens.	Creativity is a way of presenting lessons that heightens students' interest	Creativity heightens student's interests	Creativity	Constructivism
Ic5.3	A teacher is flexible if he accepts the fact of individual differences and provides them with what is duly needed according to the level of their understanding.	Teacher accepts individual differences and teach them according to their level	Accepts individual differences	Flexible	Constructivism
Id5.8	Encourage students to feel free to ask if they were not able to understand the topic.	Students able to ask questions if topics not understood	Students find courage to ask questions	Openness	Constructivism
Ie5.6	Teaching mathematics in a fun way arouses student's interest to learn math.	Teacher teaches math in a fun way	Teacher teaches math in a fun way	Enjoyment	Constructivism

Ie5.2	Being flexible means accepting the different solutions and techniques of the students in finding answers.	Teacher accepts different solutions	Teacher being flexible	Flexibility	Constructivism

Table 5. *Sample Transcripts of the Respondents Conveying Social Values with Conceptual Category and Teaching Paradigm*

Lines	Natural Unit	Transform Unit	Conceptual Category	Values	Teaching Paradigm
If2.2	My efforts will be worthless if majority of my students are still experiencing difficulty in math.	Efforts are wasted if students experienced difficulty in math	Teachers' efforts are wasted if students experienced difficulty in math	Account-ability	Positivism
Ie1.3	Review is done to relate to the new topic.	Review is done for connectivity	Review for connectivity	Connection	Positivism

Table 6. *Sample Transcripts of the Respondents Conveying New Sets of Values with Conceptual Category and Teaching Paradigm*

Lines	Natural Unit	Transform Unit	Conceptual Category	Values	Teaching Paradigm
Ic2.3	They will feel satisfaction and fulfillment once they would come up with a correct answer all by themselves.	Sense of satisfaction and fulfillment are achieved if correct answers are attained	Sense of fulfillment and satisfaction if arrived at correct answer	Accom-plishment	Constructivism
If2.1	What I am after of is the fact that my students understand everything that I have discussed to them.	Teacher is after of students able to understand everything discussed to them	Student's conceptual understanding is important to the teacher	Commit-ment	Constructivism
Ib3.2	Also, it is the job of the teacher to help students who are having difficulty in learning math.	Teachers assist students having difficulties in math	Teachers assisting students having difficulties in math	Responsi-bility	Constructivism
Ig2.1	I want my students to gain knowledge in mathematics with the help of me and their own effort as well.	Concerted efforts between teacher and student is needed to gain knowledge	Teacher-student concerted efforts	Collabora-tion	Constructivism
Ia4.1	Teaching mathematics to students is important so that they can apply the skills that they have learned to solve problems of their own.	Math is important so students can apply skills learned to solve problems of their own	Importance of math in the application of real-life problems	Significance	Constructivism
Id5.4	Even though students commit mistakes in the problem solving process, I will still appreciate him for his participation.	Teacher appreciates students' efforts and participation	Teacher being open and considerate	Apprecia-tion	Constructivism
Ib6.1	We automatically inculcate values to our students by our way of teaching them.	Teachers inculcate values by way of teaching	Values inculcation to students	Integration	Constructivism
Ii6.2	We need to integrate values in our teaching so the learners will adapt these values too.	Teachers need to integrate values so learners can adapt the values too	Values integration	Adaptability	Constructivism

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