

BS Mathematics Student's Personal Beliefs in Engaging in and Learning Mathematics

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Abstract— *Belief-change among students in mathematics learning is an elemental source of concern in the field of mathematics education. In the Philippines, BS Mathematics is one of the programs less chosen by many students. In spite of the efforts of the schools to market the program, it remains in the last options for those who are planning to take mathematics in the tertiary level. This study, through a qualitative research, explores the beliefs and feelings of BS Mathematics students of De La Salle Lipa about engaging in and learning Mathematics. It presents the change in beliefs of the students particularly those who did not intend to enroll in the said program. The views and feelings expressed by the subjects during a face-to-face interview reflect the kind of experience they have in school. The findings of the study indicate that (negative) beliefs of the students about pursuing mathematics as a program and learning the subject can change with the sound support of the school to provide an encouraging and learning environment. Such can eventually promote positive reception and achievement in the subject among the students.*

Keywords— *beliefs, belief-change, engagement, mathematics learning, learning environment.*

I. INTRODUCTION

The study on students' beliefs about mathematics has long been a timeless concern in the field of mathematics education. It has been associated with different factors like attitude (Nicolaidou & Philippou, 2003; Wilkins & Ma, 2003; Ignacio, Nieto & Barona, 2006; White, Way, Perry, & Southwell, 2006) and self-concept (Wong, 1992; Ignacio et al., 2006; Wang, 2007; Tang, 2011; Obilor, 2011) to confirm their effect on one's engagement or achievement in mathematics. A student's perception on mathematics as a subject (Maasz & Schloeglmann, 2009; Swars, Stinson, & Lemons-Smith, 2009), his self-concept as a learner (Obilor, 2011; Tang, 2011), and his attitude toward the subject (Wong, 1992; Nicolaidou & Philippou, 2003) proved to have impact on mathematics achievement. This makes mathematics learning a multi-faceted concept in the field.

Student-beliefs' connection with mathematics achievement continuously gets the attention of many researchers primarily because of the former's diversity (Goldin, Rosken, & Torner, 2009). Making up one's beliefs are self-concept and self-efficacy which are both considered predictors of performance (Bong & Skaalvik, 2003). Self-concept is defined as the "totality of individual's thoughts and feelings having reference to himself as an object" (Rosenberg, 1979 as cited in Bong & Skaalvik, 2003). While Obilor (2011) reported that mathematical self-concept is significantly related to mathematics achievement, Wong (1992) verified that academic self-concept together with attitude predicts mathematics achievement. This is parallel to a study conducted by Tang (2011) who further adds that a student's *college* self-concept in mathematics strongly impacts his performance in academics. Self-efficacy, on the other hand, is described by Schunk (1991, as cited in Ferla, Valcke, & Cai, 2009) as one's conviction that he can perform a task successfully at a certain level. In an in-depth analysis on self-efficacy, Zulkosky (2009) found that self-efficacy beliefs sway one's thoughts, feelings, actions, and motivation. Likewise, Li (2012) found that self-efficacy significantly predicts effort which is an indirect factor in the relationship that exists between self-efficacy and achievement.

Being aware that changing beliefs of students can relevantly improve their attitude toward mathematics, Wilkins & Ma (2003) used multiple-point measures of mathematical affect to investigate variables that change students' attitude toward and beliefs about mathematics. This had also been the goal of Swars et al. (2009) work which revealed, through the use of "learning-focused" curriculum, that specific curricula and instruction can change beliefs and improve the performance of students even in a short period of time. Relative to this, Kim & Kellert (2010) perceived a limited investigation on facilitating availing beliefs; and thus toiled on a research focusing on belief change strategies to improve students' attitudes, study habits, and achievement.

One's capability to do mathematics is strongly shaped by his attitude rather than the cognitive skills (Jackson, 2008). On which note, several researchers considered studying in

particular, the negative attitude of students toward the subject to address problems related to mathematics learning (Townsend & Wilton, 2003; Wilkins & Ma, 2003; White et al., 2006; Zan and Di Martino, 2007). In a case study conducted by Hannula (2002), (negative) attitude toward mathematics changed dramatically to a more positive one, in a relatively short time. With proper intervention, this negative attitude toward the subject can be a useful tool in enhancing one's positive self-concept. Zan and Dimartino (2007) pointed out that the diagnosis of a negative attitude guides the teacher to devise a medium which is aimed at modifying the components identified as "negative" for the student.

Alongside personal factors are the external factors which contribute to students' learning in mathematics. Change in affect relates to environmental variables, in particular, influence of teachers, peers, and parents (Wilkins & Ma, 2003). Sullivan, Clarke, Clarke & O'Shea (2010), in their study probed the actions that teachers carry out to transform tasks into learning opportunities. This is where the vital role of teachers comes into the picture. The learning experience a teacher can give is very significant in that it could change students' feelings and attitude toward the subject eventually (Hannula, 2002). The teachers' capability to provide the students with effective learning experiences will cultivate their interest, develop their confidence and increase their self-expectation (Wong, 1992) and will develop amongst students positive attitude toward mathematics (Maat & Zakaria, 2010). Attard (2011), in her interviews, looked into the influence of teachers and their practices on students' engagement in mathematics. According to her study, the most powerful influence on engagement in mathematics is the teacher and that students re-engage if they feel that their teachers are aware of what they need. Boaler (2009, as cited in Attard, 2011) writes that students acquire a sense of belonging in the opportunity of establishing positive pedagogical relationships with their teacher. This, she adds, is an important aspect of an effective mathematics classroom. With the foregoing, a big challenge is posed for the teachers to provide an effective learning environment for their students.

In the Philippines, BS Mathematics program is not much enrolled by students despite the many efforts to market the program. Aside from the fact that anxiety in the subject is a known global matter, there's a strong industry demand on information technology and health sciences according to Commission on Higher Education (CHED) (The Manila Bulletin, 2013). To address critical lack of manpower in the available jobs in the market, CHED identified Mathematics

to be one of the priority courses for college students. Likewise, in De La Salle Lipa, as a means to promote the program, the Lasallian Assistance Management Program office offers a scholarship grant to those students who enroll in BS Mathematics, provided they qualified in the conditions that the scholarship has for the program.

Most, if not all of the students under the BS Mathematics program did not have BS Mathematics as their first choice among the courses they would want to take in college. Each has reasons, although not necessarily the same, for not regarding the program as his or her top pick. Majority of them are in the program because of the scholarship offered to them when they take the course. The conduct of this study will validate whether the students' insights on learning and engaging in mathematics change over time, after having been exposed to various and meaningful learning experiences. I would like to investigate if the students' views and feelings about taking (or not taking) mathematics as a course have transformed in any way.

The objective of this study is to explore the beliefs and feelings of BS Mathematics students about engaging in and learning Mathematics. This research will verify if after giving them learning opportunities and experiences in De La Salle Lipa, their viewpoints about taking Mathematics as a course do change. The problem is stated as: "Do the students' personal beliefs and feelings about taking Mathematics as a program change over time? Do their experiences in the program influence the way they learn and engage in mathematics?"

It is a major consideration in this study that the subjects are under the program not by choice but because of a scholarship grant. Academically, they are qualified for the program; however, they would have preferred a different course if given the chance. Secondly, the impact of the learning experiences they get from the program will be ascertained. The result of the study, by some means, will help the Mathematics Department of the college assess the nature of learning experience they provide the students. The views and feelings that will be expressed by the students will somehow reflect the kind of experience they have in school and how this experience is helpful in their stay in the institution.

In a similar way, this study will help the institution as the findings may be used as basis to assess the BS Mathematics program in terms of the activities and learning opportunities that it offers to the students. Also, if the expected output will be met, this may serve as a marketing concept for the BS Mathematics program in inviting students who may be

considering but having apprehensions about taking BS Mathematics as a course.

II. THEORETICAL FRAMEWORK

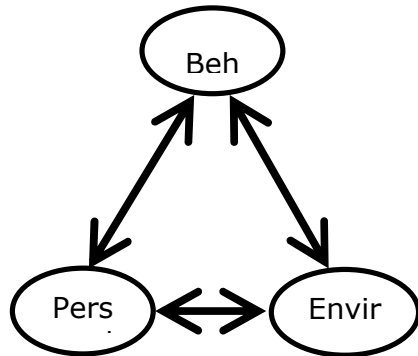


Fig.1: Bandura's Reciprocal Determinism

This study is anchored on Reciprocal Determinism by Albert Bandura which claims that how a person behaves is a product of the combined association of personal, behavioral and environmental factors (Pajares, 2002). The reciprocal nature of the three determinants makes it possible for the change of beliefs to occur. Pajares (2002) cited an example of teachers having the challenge of improving the academic learning and confidence of the students under their supervision. Bandura (1978) stated that behavior is influenced by the environment, but also stressed that the environment is partly of a person's making. By their actions, teachers have the role of creating circumstances, which, in one way or another contribute to the change of mindsets of the students affecting how they behave or react in a given situation. From the social learning perspective, there is a continuous reciprocal interaction between the three determinants.

Students, when they enroll in the BS Mathematics program, have their own beliefs or impression on the course. With their prior experiences during high school, they have their individual thoughts on how they are most likely to perform in the course particularly in the mathematics subjects. The school through its program and environment, and the teachers through their classrooms create that learning atmosphere for these students. In this scenario, students are placed in a situation where they can digest all the learning and experiences that they acquire thereby transforming their knowledge, views and beliefs

III. METHODOLOGY

This research used the face-to-face group interview as the method of collecting data. Being the most common qualitative research methods, it was intended to get a clear description of the students' views and opinions on issues raised.

The participants of this study were drawn from a random sampling among second up to fourth-year and newly-graduated students. The nine participants are composed of 2 newly-graduates, 4 fourth-year and 3 third-year students. These students did not indicate BS Mathematics as a first-choice-program when they enrolled as incoming freshmen students in De La Salle Lipa.

The following are the questions posed which facilitated the dialogue with each of the respondents.

1. What was your reason for not indicating BS Mathematics as your first-choice course when you entered college?
2. How would you describe yourself as a mathematics student then and now?
3. What can you say about the learning environment in terms of
 - a. facilities; and
 - b. teachers?
4. What realizations did you have about engaging in and learning mathematics?

To probe more strongly on each one's responses, the participants were divided into two groups, each consists of a newly-graduate, fourth, and third year students. The interviews which lasted for 54 minutes on the average was conducted by an experienced qualitative researcher. The questions were addressed to each of the respondents; however, the type of follow-up questions varied depending on the responses withdrawn.

A transcription grid was developed to begin with the data analysis. The responses were coded and grouped based on the themes which came up. Fragments of wordings from the interview were selected and given a code. Themes were gathered and frequencies of replies were recorded to determine the relevant issues raised during the dialogue.

IV. RESULTS

4.1 Reason for not indicating BS Mathematics as the first-choice course

The students' reasons for not indicating BS Mathematics as their entry course in the school involved dislike in the subject, perception that mathematics is difficult, and being unaware about Mathematics as a program. Of these three,

the latter emerged as the majority's response. They only knew of BS Mathematics during the time they were applying for a scholarship. The scholarship program offered to them did not include in its offerings the course they preferred. When asked about the program they were planning to pursue back then, the students cited Engineering, Accountancy, or Education Major in Mathematics.

"Ako naman po, hindi ko po alam na may course na BS Math. Parang po pinag-apply po ako ng scholarship sa La Salle, saka ko lang po nalaman na may BS Math po pala. Tapos po, Accountancy and Engineering ang mga first choices ko po." (D, fourth year)

"In my case, I did not know of the course BS Math. When I applied for a scholarship in La Salle, that's the time I knew about BS Math. Accountancy and Engineering were my first choices."

Although these students did not specify their interest in taking BS Mathematics, their responses indicated their interest on taking *applied* mathematics course. One shared that she continued pursuing BS Mathematics since it is in-line with her preferred course.

4.2 Self-account as a student in the BS Mathematics program

Students were able to gain interest in the subject and adapt in the program despite the difficulty experienced in the early years. They used to describe themselves as "easy-go-lucky" when it comes to studies. One of the significant responses that were pointed-out is about the students' being complacent in the first two years to being keen later on. One commented that she felt the pressure to excel in mathematics to level-up with her classmates who were good in the subject. This pressure motivates the student to be conscientious when it comes to his studies until such time that he already adapts the attitude.

"Nahirapan po ako simula first year hanggang second year po kasi yung mga problems na binibigay hindi ko masyado na-encounter noong una, so parang tamad po ako mag-practice noon, pero noong dumating po ang second sem noong second year natuto po akong mag-practice up until now pong third year. Nagpra-practice po ako ng mga problems na hindi gasinong binibigay ng mga prof namin during discussion. At nagiging madalas na po ako sa library kasama ang mga kaklase na nag-aaral." (I, third year)

"It was difficult for me from first year up to second year because the I did not encounter much the problems given to us. I was kind of lazy to practice at that time, but when the second semester of second year came, I learned to practice up until third year. I practice on problems that were not

often given by our professor during discussion. Also, I frequently go to the library with my classmates to study."

While majority revealed that they changed in terms of how they take their studies seriously, one talked about how she was transformed when it comes to dealing with a given problem:

"Siguro po doon sa pag-aanalyze ng isang problem. Doon po ako nag-improve, na from isang simpleng approach nagagawan ko po i-solve ang problema sa ibang approach." (H, third year)

"Perhaps, it would be in analyzing a problem. I improved on it in that from a simple approach, I am able to solve a problem in a different approach."

4.3 Assessment on the learning environment of the school

The learning environment of the school was assessed in two areas -- facilities and instruction.

For facilities, the students gave high regard, generally, in the classroom instructional materials provided by the school. These materials mostly concern liquid crystal display (LCD) projectors, boards, materials, and chairs. The availability of such is the majority's answer when asked about the strength of the school's facilities. In addition, others expressed appreciation in having more than a few places to study. One student stated that they are able to use the books in the library especially in their major subjects. Aside from these materials relevant to the conduct of learning and instruction, the online viewing of grades was also identified as one strong feature in the school's facilities. Not only in the strengths in facilities did the installation of the LCD projectors got the most remark but also in the weaknesses pointed-out. Technical problems in the projectors were set apart by many as impediments for fine instruction.

"Ang strength naman po ay yung pagkakaroon po ng mga LCD projectors sa bawat classroom kumpara sa iba. For example po, sa dating school namin, ang gamit po kasi doon ay manila papers. Mas madali po kapag projectors na lang. Ang weakness naman po siguro yung napalpak yung mga projectors." (E, fourth year)

"The strength is having LCD projectors installed in every classroom compared to others (schools). For example, in our previous school, Manila papers were used. It is rather easy with projectors. The weakness would be the malfunction of projectors."

Yet, despite the flaws raised during the interview, one of the newly-graduated students gave a noteworthy remark about

how they were provided with all the things they need inside the classroom:

"Bale, strength na nga po talaga ng school is yung facilities, kasi kung iko-compare nga naman po sa ibang school, talagang laking advantage po ng La Salle ang mga facilities nito, mga classrooms, materials and the like. Compared po kasi in other schools, walang-wala po talaga. Meron po kasi na sa gym na po nagkklase, na masasabi mo pong walang matututunan ang mga estudyante lalo na po kapag ganun yung concept, unlike po sa La Salle provided na lahat, sa isang classroom nandun na lahat ng materials na kakailangin both students and teachers." (A, graduate)

"Well, the strength of the school is actually the facilities. Compared to other schools, these facilities, classrooms, materials, and the like are La Salle's big advantage. In other schools, there's practically none. Classes are held at the gym where you could say nothing can be learned, unlike in La Salle where everything is provided. In its classroom, everything that the students and teachers will need is there." Instruction, on the other hand, was given a good appraisal by the respondents. When asked to tell something about the learning environment provided by the teachers (in major subjects), the teachers' being knowledgeable in their subjects handled became the most familiar response. In connection to this, they also articulated good opinion on their well-prepared instructional materials.

"Sa major subjects pong teachers, okay naman po yung mga nabibigay nilang knowledge po. Pag sinabi pong teacher ka ng isang subject, expected na po na malawak po ang maibibigay mong kaalaman sa mga students mo and as students po, malawak na rin yung malalaman mo from them, teachers. Base naman po sa experience ko, masasabi ko pong ok naman po na sobrang knowledgeable po sila. At ang mga instructional materials naman po, ay well-prepared po sila. Sinisigurado po nila na ang materials na pinoprove nila ay ang exactly po kung ano man po ang dinedeliver nila sa class." (F, fourth year)

"For major subject teachers, they knowledge they give is okay. When you say you are a teacher of a subject, it is expected that the knowledge you can give to your students is broad and us students could learn a lot from them teachers. Based on my experience, I could say that they are very knowledgeable. The instructional materials are well-prepared. They make it sure that the materials they provide are exactly what they will deliver in class."

Another important feedback drawn out is teachers' being involved in the needs of these students in terms of explaining lessons at the needed pace. They feel that they can always approach the teachers whenever they need

clarifications on certain topics. In the interview, this was ascribed by the students to their being few in the program.

"Ang advantage po kase samen sa BS Math, kokonti po kame. Pag hindi po maintindihan nung isa, ma-eexplain po ng isa-isa. Matututukan po ang students para pong ang problema ng lahat masasagot po sya." (H, third year)

"The advantage for us BS Math (students) is that we are not many. If one could not catch on, a detailed explanation can be given. Teachers can focus to the students so that all the problems can be addressed."

4.4 Realizations about engaging in and learning mathematics

Different but equally substantial responses were brought forth when the students were asked about their insights in learning mathematics. The foremost of which is that a perceived difficulty in mathematics can be overcome if one will just commit hard work on it. According to one of the respondents, he actually faced his weakness in the subject and turned it into an enthusiasm. This gave him a feeling of gratification which agrees with the opinions of three other respondents. They thought that having gone through all the challenging tasks in school, taking mathematics as a course has later on brought them a sense of pride.

Other misconceptions were addressed during the interview. If before they were hesitant in taking the course as they did not know what's ahead of them after college, one of the graduate-respondents mentioned that she realized that many opportunities await a graduate of the program. Also, the infamous what's-the-use-of-math-in-everyday-life matter was raised during the interview. A student pointed out that unlike before when she thinks mathematics has no practical application, now she understands how it is actually involved in the things around us. She thought that there's indeed mathematics behind everything.

Another significant comment made by a respondent is that diligence is what helps a student persist in the program. She further adds that motivation should also come from within one's self and should not be expected to just come externally.

"Nadiscovers ko po na hindi po ako nagtagal sa program na ito dahil po matalino ako, kundi po nagtagal po ako sa program na ito dahil masipag ako. Tsaka po yung motivation, nalaman ko po na hindi lang po pala dapat manggaling iyon sa iba, dapat po pala manggaling din sa akin." (I, third year)

"I discovered that I survived in the program not because I am bright but because I am diligent. Also, I learned that motivation should not come from other people, rather, it should also come from me."

V. DISCUSSION

The findings suggest that the beliefs and feelings of BS Mathematics students change from the experiences they are provided with. These events shape how they engage in mathematics through the years. At first, the students would not choose to enter the program. However, after having been exposed to different learning experiences, they felt no anxiety but ease in the dealing with the subject. In fact, despite the academic demands faced in pursuing the course, the students claimed to have become fascinated and involved in learning mathematics. With proper learning environment together with the combined efforts of the teachers, experiencing mathematics left a big impact on students. The common belief that the subject is one tough thing to deal with is replaced with a notion that it can be overcome, enjoyed, and even mastered.

The finding that change in belief is related typically to environmental variables replicates the findings of a study conducted by Wilkins and Ma (2003). According to their study, variables associated with instructional (or curricular) experiences and environments were related to students' feelings or emotions. Constructive learning environment provided to the respondents is apparently an important contributing factor in promoting positive engagement in mathematics among them. This supports the studies of Attard (2011) and Sullivan et al. (2010) which focused on the influence of teachers and their practices on students' engagement in the subject.

In terms of learning in mathematics, Jackson (2008) stressed that the ability to do mathematics is strongly influenced by people's attitude rather than any cognitive skill. Townsend and Wilton (2003) in their findings stated that the negative attitudes often found in students taking courses involving mathematics may be improved through situated learning activities within a supportive learning environment. Further, according to White et al. (2006), a negative attitude regarding the nature of mathematics does not prevent a positive attitude to perform well in mathematics.

BS Mathematics is one program less-chosen by many students. Contrary to the familiar judgment that it is difficult to learn and engage in, this study provides evidence that it is actually something that one can overcome and take control of. The possibility of being at ease with the subject and perhaps liking it as well is high provided that a carefully-designed learning environment is there. The students benefit from such environment not only in terms of their needs being addressed but more importantly the

chance to get to know more about the subject. Usually, students see only the complexities of the subject. However, exposing them in other fields of mathematics where they can actually relate to makes them see the beauty of the subject. With the teachers' significant role of providing useful and meaningful learning activities, the students are bound to discover their mathematical capabilities. Like what is revealed in this study, they can even enjoy doing mathematics.

For future research efforts, it is recommended that belief-change be studied amongst students who had BS Mathematics as their first choice. After two to three years of being in the program, it would be interesting to know if something in their beliefs has changed or if their learning expectations were met.

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