Research Article

BARRIERS IN TEACHING-LEARNING PROCESS IN SECONDARY MATHEMATICS: A CLAMOUR FOR STERLING IMPROVEMENT

Received: September 5, 2019 **Revised:** December 23, 2019 **Accepted:** January 7, 2020

Ezekiel O. Pelayo[1*] and Leizl O. Pelayo[2]

[1,2]Surigao Del Sur State University, Tandag City, Philippines

*Corresponding Author, E-mail: pelayo.ezekiel@gmail.com

Abstract

The purpose of this study was to evaluate the perceived barriers in teaching- learning process in Mathematics specifically in Junior High School in terms of Pedagogy, Curriculum, Attitude towards Mathematics and Organization and Social Climate of the Classroom. This study used a descriptive survey design to collect information. The respondents of this study are the Mathematics teachers and students. Universal sampling and Stratified proportional random sampling employed in this study. In the gathering, analysis and treatment of data, the researcher used a modified questionnaire and adequate statistical tools.

It showed that the Teaching-Learning of Mathematics can be influenced by pedagogy used to teach the subject and poor pedagogy could result to poor performance of learners in the subject. It also shows the Lack of regular In-Service Training of the Mathematics teachers, the sitting arrangements of learners in the class and the lack of supplementary materials/tools/aids are all posed barriers in teaching-learning Mathematics. It is highly recommended that teachers must engage different strategies in their math classes, motivate and expose students in different math activities; teachers must also be provided by all the necessary materials that they are needed in their classes and positive and harmonious atmosphere between teacher and students in math class must be present all the time.

Keywords: Barriers, Teaching, Learning, Teaching-Learning

Introduction

Factors that inhibit or prevent people from participating in activities are referred to as barriers, constraints, deterrents, impediments, or obstacles (Silva et al., 1998). According to Snoeyink and Ertmer (2001) Teachers' face the challenges due to the barriers that exist can be classified as either external or internal barriers. Negative attitude of mathematics means having an aversion towards learning mathematics and using it in their daily life and discouraging students from choosing mathematics as their major subjects. Hostile feelings and negative attitudes toward Mathematics and science, therefore, have a great influence on general behavior and values (Gezahegn, 2007). These feelings and attitude that sustain a dislike of Mathematics or hamper any

interest in mathematics and are great barriers to the development of Mathematical literacy than any lack of particular concepts, skills, or thinking abilities' (Atweh, 2001). Brown et al. (1988) mentioned students believe that mathematics is important, difficult, and based on rules. In US, reported barriers in teaching-learning Mathematics which include limited mathematics content knowledge. Modern math, consisting of arithmetic, algebra and geometry has an important role in the field of education. Mathematics has a vital role in the classroom not only because of direct application of the syllabus material but because of the reasoning processes the student can develop (Taylor, 2006). According to Goodrum et al. (2011), teachers are the most important factors to improve students' learning; therefore, teachers may play a vital role in helping their students' understanding. Teachers must have access to continuous professional development through in-service programs, short term seminars and workshops. According to (Gezahegn, 2007) mathematics by its very nature requires a lot of exercises and practices in order to master it. Available research shows that homework facilitates achievement and attitudes of students, especially if teachers provide their feedback.

The existing method of teaching in schools is old fashioned which is highly dependent on the performance of the teacher only. It is teacher centered, that is teachers are expected to explain, demonstrate, illustrate give detailed note and the students have a minimal participation in the teaching learning process. Students reported that in majority of the cases teaching of Mathematics was lecture-oriented. This has become a barrier to teaching-learning of Mathematics in the country. Engagement and motivation are critical elements in student success and learning. Engaged students learn more and retain more and enjoy learning activities more than students who are not engaged. Engelbrecht et al. (2007, p. 94) believe that success can be realised in the classroom if teachers appropriately support their learners.

The situation bespeaks that there must be challenges and barriers in the teaching-learning process in secondary mathematics up until now. With this, it would be of interest to evaluate these possible barriers' range from Pedagogical, Curriculum, Attitude of Students and Teachers about Mathematics, and the Organizational and Social Climate of the Mathematics class in the Province of Surigao del Sur, Philippines knowing that these mathematics teachers and secondary students are encountering such challenges. To yield solutions to these perceived barriers, modified questionnaires are being utilized and given to the key informants of the study. Hopefully, this has served as an instrument or tool for strengthening the teaching-learning process in mathematics subject and will be able to shed some lights on those loopholes.

Research Questions

To guide the study, the following questions were posed:

1. What is the extent of the perceived barriers as to mathematics teachers in terms of?
    1.1 Pedagogy
    1.2 Curriculum
    1.3 Attitude towards Mathematics
    1.4 Organizational and Social Climate of the Mathematics Class

2. What is the extent of the perceived barriers as to secondary students in terms of?

2.1 Pedagogy

2.2 Attitude towards Mathematics

2.3 Organizational and Social Climate of the Mathematics Class

3. What enhancement program may be proposed to overcome the barriers in teaching-learning process in mathematics?

Research Methodology

A descriptive survey design was utilized to collect data of the perceived barriers to teaching-learning process in secondary Mathematics. A modified and validated questionnaire consisting of questions with some sub questions were used in the study, such as: For Teachers; a three-page questionnaire divided into four parts namely; Pedagogical Factors, Curriculum related Barriers, Teacher's Attitude towards Mathematics, and Organizational and Social Climate of the Mathematics Class. For the students, it is also a three-page questionnaire divided into three parts namely; Pedagogical Factors, Student's Attitude towards Mathematics, and Organizational and Social Climate of the Mathematics Class. The [1]three(3) Likert scale, [2]four(4) Likert scale and [3]five(5) Likert scale type were used and scored as follows respectively:

[1]Frequently, Sometimes, Rarely. [2]Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). [3]Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D) and Strongly Disagree (SD),

Three Secondary Schools in the Municipality of Cagwait, Province of Surigao del Sur, Philippines with 13 Mathematics Teachers and 311 secondary students were selected by Universal and Stratified proportional random sampling as respondents. The instrument was distributed purposively to mathematics teachers and secondary students from the same population. The researcher secured permission from involved authorities and was able to conduct the study within the month of March to April School Year 2017-2018. The researchers provided the questionnaire personally to all the secondary students and mathematics teachers. Results of the survey were tabulated, analyzed and interpreted using the necessary statistical tools. Below is the summary table of the respondents for this study.

Table 1 Distribution of Respondents

Name of Schools	Teachers	Students				Total
		Grade 7	Grade 8	Grade 9	Grade 10	
Unidad National High School	6	60	48	41	37	192
San Jose Victores Sr. National High School	5	25	24	24	22	100
Bitaugan Integrated School	2	9	8	7	6	32
Total						**324**

Results and Discussion

A. Extent of the Perceived Barriers-Teacher

Table 2 Extent of the Perceived Barrier in terms of Pedagogy

	Mean	Adjectival Rating
Use of different Methods in teaching e.g. (Lecture, Small-group, Peer Tutoring, Cooperative Learning.)	2.26	Sometimes
Students are asked to work on problems with no obvious method.	1.00	Rarely
Students are asked to explain reasoning behind an idea in Mathematics	2.82	Frequently
Total Mean	**2.03**	**Sometimes**

The data yields strong evidence of teachers following the lecture or the traditional method, instead of introducing modern teaching methods. Activity-based or other modern teaching methods are not practiced in the classroom to teach mathematics. It has been said that different strategies and teaching methods should be used and individual plan should be adapted to meet the student's requirements. But the existing method of teaching in schools is much more traditional and less activity based, which is highly dependent on the performance of the teacher only.

As reported that teachers are prejudice to teach the same things in the same way they were taught when they had been students. Studies conducted in Bostwana by Mapolelo (2009), reported that in majority of the cases teaching of Mathematics was lecture-oriented.

B. Curriculum

Table 4 Extent of the Perceived Barrier in terms of Curriculum

	Mean	Adjectival Rating
Lack of supplementary materials e.g. teaching aids	3.63	Strongly Agree
Lack of INSET's on the implementation of the curriculum	3.47	Strongly Agree
Lack of guidance on how to use Mathematics textbooks	3.06	Agree
Teachers resistance to New Mathematical Curriculum e.g. Mathematics Alternative	3.13	Agree
Lack of guidance on how to use Mathematics textbooks	3.06	Agree
Lack of adequate planning for the lesson on the part of the Teacher.	2.5	Disagree
Total Mean	**3.2**	**Agree**

An essential finding of this study is that from the questionnaire, major number of mathematics teachers in the group do not find curriculum factor positively. The data conveys that there is something in the aspect of the curriculum that the administration should look into. Teachers are responsible to the kind of learning and experiences the students may engage everyday as well as setting of educational goals and total personality development. Professional development of teachers on content-focused instruction has tremendous effect on student achievement. According to Goodrum et al. (2011), Teachers must have access to continuous professional development through in-service programs, short term seminars and workshops. Teachers should be provided with professional development opportunities that assist them in learning how to assess, train, teach, and be motivated to use multicultural teaching. This study also suggests that teachers should be trained to use several approaches in the multicultural classroom before they start teaching.

Teachers are obliged to adapt their teaching methods and curriculum to meet all learning requirements of individual learners including those experiencing barriers in their classrooms. The students of the teacher who participated in programs for faculty development had scored above the students whose teachers did not participate.

C. Attitude towards Mathematics

Table 5 Extent of the Perceived Barrier in terms of Attitude towards Mathematics

	Total Mean	Adjectival Rating
I want to develop my mathematical skills	5.00	Strongly Agree
Mathematics is important in everyday life	5.00	Strongly Agree
Mathematics is one of the most important subjects for people to study	5.00	Strongly Agree
Math courses would be very helpful no matter what grade level I taught	5.00	Strongly Agree
I believe studying maths helps me with problem solving in other areas	5.00	Strongly Agree
A strong math background could help me in my professional life	5.00	Strongly Agree
I think of many ways that I use maths outside of school	4.69	Strongly Agree
I think studying advanced mathematics is useful	4.92	Strongly Agree
Mathematics helps develop mind and teaches a person to think	4.92	Strongly Agree
Mathematics is a very worthwhile and necessary subject	4.92	Strongly Agree
I get a great deal of satisfaction out of solving a mathematics problem	4.85	Strongly Agree
I have usually enjoyed studying mathematics in school	4.85	Strongly Agree
I like to solve new problems in mathematics	4.85	Strongly Agree
I would prefer to do an assignment in math than to write an essay	4.77	Strongly Agree
I really like math	4.77	Strongly Agree
I am happier in math class than in any other class	4.77	Strongly Agree
Mathematics is a very interesting subject	4.69	Strongly Agree
Mathematics is dull and boring	1.08	Strongly Disagree

	Total Mean	Adjectival Rating
Mathematics is one of my dreaded subjects	1.23	Strongly Disagree
Studying mathematics makes me feel nervous	1.15	Strongly Disagree
Mathematics makes me feel uncomfortable	1.08	Strongly Disagree
Total Mean	**4.19**	**Agree**

The grounds for disliking mathematics subjects are the negative perception, lack of interest to the subject and in some cases complicacy with the subject contents (Pia, 2015). However, the data shows that most of the Mathematics teachers have an affirmative and positive perception or outlook towards mathematics subject. Yet, there is still a need to provide remediation to those mathematics teachers who have concerns regarding some topics in the subject as enumerated below.

Another study found that an emotional relationship, especially confidence between teachers and their students in the intercultural classroom, is important in establishing trust between students and the teacher. This study also suggested that the teaching material and approaches of teachers should be modified to recognize the students' cultures and to gain students' trust. Therefore, students will feel respected and safe with their teachers and classmates.

Mathematics Teachers were also asked with these follow-up questions:

Is Mathematics you favorite teaching subject"?

Mathematics Teachers responded that out of the 13 respondents there 11 teachers who responded that mathematics is their favorite teaching subject and there 2 teachers who responded that mathematics is not their favorite teaching subject.

Are there topics in Mathematics that you don't teach competently?"

Based on the response of the Mathematics Teachers, it shows that 4 out 13 respondents says "yes", this means that there are topics in mathematics that they don't teach competently and there are 9 respondents responded that as "no", this means that there are no topics in mathematics that they don't teach competently. The following are the collected topics that some of the mathematics teachers don't teach competently;

- Polynomial Functions, Geometry, Measures of Position
- Angles, Measure on Variability, Relation and Function
- Probability, Statistics, Proving Triangles

What do you propose to be done about the topics above?"

- More review in this particular topic
- Further study and mastery
- More INSET and Curriculum Training

D. Organizational and Social Climate of the Mathematics Class

Table 6 Extent of the Perceived Barrier in terms of Organizational and Social Climate of the Mathematics Class

	Mean	Adjectival Rating
The teacher considers the sitting arrangement of students in Mathematics Class	4.00	Strongly Agree
The sitting arrangement in Mathematics Lesson enhance learning	3.92	Strongly Agree
The students seek help from others whenever I give a Mathematics problem to be solved in class	3.92	Strongly Agree
Activities in this class are clearly and carefully planned	4.00	Strongly Agree
Students know exactly what has to be done in our class	3.24	Agree
New ideas are seldom tried out in this class	4.00	Strongly Agree
Students in this class pay attention to what others are saying	3.92	Strongly Agree
This class seldom starts on time	2.24	Disagree
Total Mean	**3.66**	**Strongly Agree**

Most of the teachers responded in the questionnaire that an unorganized seating arrangement in the class hinders students' mathematics learning, and it acts as a barrier for better understanding of the subject. Mathematics Teachers are really emphasizing the importance of the environment in the classroom, especially in Mathematics Class. Teachers are also considering the effects of proper arrangement and organize setting in the classroom. If classroom setting will not be considered, teachers and students may have problems in communication, teaching, learning because students do not adapt to the classroom's environment.

Challenges experienced in teaching learners experiencing barriers in mathematics are the central idea of this study. Challenging situations impede successful teaching and learning. In the face of these challenges teachers are expected to judiciously carry out their responsibility of educating learners and ensuring they all receive quality education. The inclusion policy further mandates teachers to include every individual learner in the learning process and cater for their individual learning needs, which precipitates many challenges.

Some sub questions were asked with regard to the Organizational and Social Climate in Mathematics Class.

Does sitting arrangement of students in the Mathematics Lesson enhance learning? "Explain your answer.

There are 10 teachers responded as "YES" to this question and 3 teachers responded as "NO" to this question. This means that sitting arrangement affects the learning of the students.

Here are the responses of some Mathematics teachers who gave their explanation with regard to the question above.

- The sitting arrangement keep them(students) behave

- It enhances learning because weak students can sit beside advanced student and coach them in the lesson.

- Seatmates is a factor in being able to learn

- It depends on the student knowledge and in the topics have been discussed.

Extent of the Perceived Barriers-Students

A. Pedagogy

Table 7 Extent of the Perceived Barrier in terms of Pedagogy

	Mean	Adjectival Rating
I assist another to solve Mathematical problem/s	2.21	Sometimes
I seek assistance form another student in solving Mathematics problems.	2.27	Sometimes
We do class assignment as a group	2.23	Sometimes
My Mathematics teacher lets me go to blackboard to solve a problem	2.55	Often
Total Mean	**2.32**	**Sometimes**

The results relay that most of the mathematics teachers in all secondary schools in the District of Cagwait, Surigao del Sur Province are engage in doing board work activities. Other indicators such as student assist another to solve mathematical problem, student seek assistance from another student in solving Mathematics problem and students do assignment as a group has an adjectival rating of Sometimes. Students tend to engage their selves in these strategies in order for them to learn Mathematics better.

B. Attitude towards Mathematics

Table 8 Extent of the Perceived Barrier in terms of Attitude towards Mathematics

	Mean	Adjectival Rating
I enjoy learning mathematics	4.04	Agree
Mathematics classes/lessons are interesting	3.08	Neutral
I would like to continue doing mathematics after completing secondary school education	3.31	Neutral
To understand mathematics is difficult	2.77	Neutral
Mathematics is very useful in life	3.92	Agree
I think it is the teacher who can make mathematics learning easier	4.14	Agree
Among the subjects taught, mathematics is my favorite	3.57	Agree
I am given a lot of unnecessary mathematics assignments	3.13	Neutral
I am well provided with mathematics textbooks and other learning resources	2.24	Disagree
I feel extremely anxious and fearful, when mathematics examinations are mentioned or brought	2.94	Neutral

	Mean	Adjectival Rating
Mathematics should not be a compulsory subject	2.05	Disagree
I do a lot of mathematics exercises on my own or with a friend	3.44	Agree
Mathematics is possible to learn	3.26	Agree
Learning mathematics is just remembering what the teacher says and does while in class	3.34	Neutral
The best way to learn mathematics is to discover a concept by oneself	4.07	Agree
My grades are always low in mathematics	2.69	Neutral
I do mathematics for the sake of it	2.49	Disagree
I like my mathematics teacher	4.23	Strongly Agree
My friends don't like learning mathematics	2.92	Neutral
My parents and siblings encourage me to learn mathematics and to perform well in the subject	3.89	Agree
Being a girl/boy interferes with my learning and my performance of mathematics	2.45	Disagree
I learn mathematics well regardless of the gender of my teacher	4.24	Strongly Agree
Total Mean	**3.17**	**Neutral**

As seen above, most of the students in this sample group regard mathematics as an essential subject, but some of them still do not at all like this subject. The mean of the students' rating with regard to this factor is 3.17 and has an adjectival rating of Neutral. Thus, this conveys that there is still a need to conceptualize a plan on how to improve even more the attitude of some of the students towards the subject especially to those students who find math unlikable. It also shows that students are not depending on anything, they can learn mathematics in the way they wanted and it seems that they just go on to what is present regardless of anything.

Students' perception on the situational characteristics of the learning environment can be applied on the teachers' personality, pedagogical approach and to the subject content. On the basis of experienced, students tend to dislike the subject as he dislike the teacher, as the "domino" effect, this perceived difficulties becoming his subjective experienced causes the loss of interest to learn the subject.

Sub questions were answered by the students with regard to the attitude of the students toward Mathematics.

"Do you like solving problems of Mathematics on your own?"

Based on the data, there are 197 who answered "yes" and 114 students who answered "no" out of 311 students with regard to the question if they like solving mathematics in their own.

"Do you read Mathematics at home or during your free time?"

Based on the data, there are 179 students who answered “no” and 132 students who answered “yes” with regard if they read mathematics books at home or during their free time.

“Are you discouraged by your desk mate from solving Mathematics problems?”

It shows from the response of the students, 190 responded as “no” and 121 responded as “yes” with regard if the student is being discourage by his/her desk mate in solving mathematics problem.

“Mathematics is meant for the intellectually strong”

In this statement, students were able to answer via True or False, based on the data, 175 responded as “True” and 136 responded as “False” with regard if Mathematics is meant for intellectually strong.

“Some people are born knowing Mathematics”

Based on the data, 195 responded as “True” to this statement and 116 responded as “False” to this statement. This means that most of the students believe that there are some people who are really born knowing Mathematics.

C. Organizational and Social Climate of the Mathematics Class

Table 9 Extent of the Perceived Barrier in terms of Organizational and Social Climate of Mathematics Class

	Mean	Adjectival Rating
The teacher considers students feelings	3.65	Strongly Agree
The teacher talks rather than listen	3.04	Agree
The class is made up of individuals who don’t know each other well	1.56	Strongly Disagree
The students do not look forward to coming to classes	1.22	Strongly Disagree
Students know exactly what has to be done in our class	3.39	Strongly Agree
New ideas are seldom tried out in this class	3.38	Strongly Agree
All students in the class are expected to do the same work, in the same way and in the same time	3.67	Strongly Agree
Students put effort into what they do in classes	3.34	Strongly Agree
Students are dissatisfied with what is done in the class	2.24	Disagree
Students are generally allowed to work at their own pace	2.84	Agree
The teacher goes out his/her way to help students	3.66	Strongly Agree
The teacher helps each student who is having trouble with the work	3.64	Strongly Agree
The seating in this class is arranged in the same way each week	3.75	Strongly Agree
Total Mean	**3.17**	**Agree**

From the above analysis of data it is disclosed that students’ perception towards organizational and social climate has a mean of 3.17 and interpreted as Agree. Students have displays evident adherence on the seating arrangement in their class which is organized in the same way each week, Students are also expected to do the same work, in the same way and in the same time in class. On the other hand, the teacher goes out his/her way to assist students and helps each student who is having trouble with the work. In connection,

students are given enough time and guidance by their mathematics teacher in order to perform their tasks better. But teachers must still not be comfortable of this knowing that students are diverse in nature. Engelbrecht et al. (2007, p. 94) believe that success can be realized in the classroom if teachers appropriately support their learners.

Follow-up questions were also asked to the students with regard to the Organizational and Social Climate of Mathematics Class.

"Who decides who you sit with in the class?"

With regard to this question, out of 311 respondents there are 197 students responded that their Class Teachers were the ones who decides to whom they will sit with in the class, 100 students have responded that it's their selves or "Myself" who chooses to whom they will sit with in the class and there 14 students who responded that it is their Parents who decides to whom they will sit with in the class.

"Do you think the one you sit with influences how you learn Mathematics?"

Based on the data, there are 171 students who responded as "Yes" and there 140 students responded as "No" with regard to this question. This means that most of the respondents think that the one they sit with will influences them on how they learn Mathematics.

Recommendations

From the findings however, it is suggested that;

1. Mathematics Teacher should continue integrating different methods in teaching that they think that it is an effective method and perhaps use another method also that will consider and cater the diversity of learners especially in Mathematics class.

2. Administrator and Teachers must look into the aspect of Curriculum because it can be seen in the result that there is a need to for this factor to be addressed. Curriculum factor has a vital role in the educational arena. Teachers are encouraged to engage INSET every month if possible tackling about Best Practices in teaching the subject and etc. for them to be more equipped and be more competent. Teachers must also be given enough supplementary materials e.g., teaching aids or tools. Teachers can provide remedial classes, tutoring and make-up classes if necessary to enhance learning in Mathematics. Foundations topics in Mathematics must be given importance in their teaching especially those teachers who are teaching Mathematics in the lower level in order for the students to master it.

3. Mathematics Teacher should always show concern with regard to attitude of the students as well as their selves towards mathematics, in order to strengthen the positive approach of the students towards the subject. Teachers and parents are also encouraged to find ways in motivating some students who find Mathematics subject as uninteresting subject. The researcher would like to recommend that schools should create a Mathematics Group or Club in order to strengthen the positive approach, develop the interest of other students and love Mathematics even more.

4. Mathematics Teacher must always blend with the students in order to maintain the optimistic social climate and the organized classroom environment of the Mathematics class for them also to strengthen the harmonious relationship between the teacher and students.

5. Further researches are encouraged for some future researchers regarding this topic in order to look for a possible solution or in order to strengthen the teaching-learning process in Mathematics.

References

Atweh, B. (2001). Continuous In-Service professional development of Teachers and school change: Lessons from Mexico. In Atweh, B., Forgasz, H., Nebres, B. (Eds.). *Sociocultural Research in Mathematics Education an international perspective.* London: Lawrence Erlbaum Associates (LEA) publishers.

Brown, D., Salim, M., Chavalimu, E., & Fitzhugh, H. (1988). Intake, selection, apparent digestibility and chemical composition of Pennisetum purpureum and Cajanus cajan foliage as utilized by lactating goats. *Small Rumin. Res.,* 1, 59-65.

Engelbrecht, B., Comita, L., Condit, R., Kursar, T. A., Tyree, M. T., Turner, B. L., & Hubbell, S. P. (2007). Drought sensitivity shapes species distribution patterns in tropical forests. *Nature,* 447, 80–82. https://doi.org/10.1038/nature05747

Gezahegn, Y. B. (2007). *Barriers to teaching and learning mathematics in grade four* (Master thesis). Norway: University of Oslo. Retrieved from http://www.duo.uio.no/sok/work.html

Goodrum, D., Druhan, A., & Abbs, J. (2011). *The status and quality of year 11 and 12 science in Australian Schools.* Retrieved from https://www.asianscientist.com/wp-content/uploads/2011/12/The-Status-and-Quality-of-Year-11-and-12-Science-in-Australian-Schools.pdf

Mapolelo, D. C. (2009). Students' experiences with mathematics teaching and learning: Listening to unheard voices. *International Journal of Mathematics Education in Science and Technology,* 40(3), 309-322. https://doi.org/10.1080/00207390802642229

Pia, K. F. (2015). Barriers in teaching learning process of mathematics at secondary level: A quest for quality improvement. *American Journal of Educational Research,* 3(7), 822- 831.

Silva, E., Ullu, E., Kobayashi, R., & Tschudi, C. (1998). Trypanosome capping enzymes display a novel two-domain structure. *Mol Cell Biol*, 18(8), 4612-9.

Snoeyink, R., & Ertmer, P. A. (2001). Thrust into technology: How veteran teachers respond. *Journal of Educational Technology Systems,* 30(1), 85–111. https://doi.org/10.2190/YDL7-XH09-RLJ6-MTP1

Taylor, P. (2006). Challenging mathematics and its role in the learning process. *Lecturas Matem´aticas,* 349-359. Retrieved from www.scm.org.co/Articulos/867.pdf