

CREATING REAL LEARNING EXPERIENCES RATHER THAN TEACHING BASED ON THE TRADITIONAL TRANSFER OF MATHEMATICAL INFORMATION, AT COLLEGE LEVEL

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ABSTRACT: Innovation in Education is a must in the 21st century education around the world. TEC de Monterrey in México as a system, is working hard in preparing and making their teachers innovate and use new educational models. Teachers are constantly implementing new teaching and learning techniques, not only to have better teaching practices in all fields, but to build life skills in their students. Competences such as collaborative work, problem solving, leadership and critical thinking are some of the skills that are cultivated through these techniques. A group of Mathematics' teachers at Tec de Monterrey Campus León in Guanajuato México, have been using challenges in class as a way to create real learning experiences by using technology, flipped learning, mystery stories to improve reading comprehension skills and mathematical knowledge. Mathematics lessons have changed from simply transferring extensive amounts of information to creating the conditions for students to develop long life experiences. In a preliminary survey about math lessons in our campus, more than 54 % of the total students in this project, mentioned that they find math courses in general very hard, tedious, mechanical and without challenges. This study suggested that students learned math faster and deeply in a dynamic and fun way, 91 % of students in the final survey answered that learning math in this way was more meaningful and enjoyable, improving the enthusiasm about learning math among students. Math scores went up in the groups that followed this new educational technique.

Key words: Learning experience, dynamic, innovation, challenge.

INTRODUCTION

We are living in times of significant change, our societies, institutions, businesses, occupations and the way we communicate and interact with others continue to evolve, therefore it is the responsibility of the educational community to generate new learning platforms, models and strategies that when implemented to the students will help them coalesce to the XXI century professional life. In the Tec de Monterrey, we strive to provide relevant learning experiences that include hands on experience in the community and an important level of maturity to deal with different cases, situations, problems and projects. As Karl Fisch so wisely stated in 2007 (Fisch, 2015) "We are currently preparing students for jobs that don't yet exist, using technologies that haven't been invented in order to solve problems we don't even know are problems yet", and our challenge as educators consists of taking advantage of our students' years with us, so as to help form the future leaders of these changes.

We live and learn with every aspect of our personality. When we combine our emotional knowledge with our physical knowledge, we achieve true human learning, which, according to Claxton (Claxton, 2008) occurs when we no longer know what to do, and therefore any learning experience will pose a certain risk, a gamble in which we must accept uncertainty free from any anxiety or anguish, living each new challenge as an element of a complex society in which a culture for learning will emerge that will stimulate the individual's confidence in his or her learning ability in any situation. Let us embrace this idea and allow every student to actively experience their responsibility for their own learning and that of their teammates, (Gomez, 2016) following a determined set of instructions, training and actions that based on technology and several communication strategies will develop personal and social skills which will transform into a habit of collaborative learning.

Although we will not generalize, it is a common to find in students entering higher education in Mexico, that a large percentage of them deem certain subjects as too difficult, rejecting fields such as mathematics, arguing that

it is a boring and useless branch of education. According to a survey conducted by the National Survey of Habits, Practices and Cultural Consumption by CONACULTA (Cultura, 2010), 77 % of the population of Guanajuato reported not reading any books, 49% reported not reading newspapers and 58% never reads magazines. With this data, it came as no surprise that in 2012 of the 108 countries that make up the UNESCO, Mexico has the next to last place in reading index, estimating that a mere 2% of the Mexican population has a permanent habit of reading.

METHODS

The pedagogical proposal presented in this innovation project was to promote the passion for reading while simultaneously uncovering the charm behind the world of mathematics, for this purpose the book: *The Mathematical Novel* was included in the classroom and homework sessions, thus allowing the students to experience a more individual and collaborative approach to the numerical challenges presented in this book, along with weekly activities associated with the Schoology educational platform.

Text Selection and Generation

One of the motivators behind this project was to increase each student annual reading tally by at least one book by the end of this mathematics course. For this reason, choosing a book that would be of an attractive genre and writing style for students between the ages of 18 and 21 was of paramount importance. A murder novel was chosen; in which the challenge was to discover who the killer was.

To generate empathy, the novel revolves around four young university students who witness the last minutes of life of the city's ruler, whom explains to them the importance and the negative impact on the community if they do not catch his murderer. Therefore, with his dying breath of air, he urges them to catch his murder and he gives them the first clue that they must follow. Coincidentally, the beginning of this novel also elaborates on the traits and hobbies of the students, who share a dislike for mathematics.

Each chapter of the novel includes two elements that allow the reader to link mathematics with reading comprehension innovatively:

- One challenge (from a total of 9) that they must solve and send online to the city's ruler to demonstrate that their investigation is on the right track. To solve this challenge, it is necessary to use the mathematical knowledge and skills that were presented in class each week.
- One clue (from a total of 9) that can be solved by using mathematical logic, deduction and common sense that have been acquired in previous stages of the students' life. This clue will allow the characters to continue their search and come closer to finding the murderer's hide-out.

Activity Distribution for the Students

This activity was designed to be implemented in 12 weeks, the project began with a survey of reading habits, and the students' opinion about the relationship between learning about math and reading comprehension.

- During the first project class, when the project was presented, the students were divided into groups of four and roles were assigned, stressing the importance of individual work, which in this case consisted of reading the chapter pertaining to each week; and teamwork which consisted in
 - one student who would be responsible for organizing the time allotted in the classroom,
 - one responsible for formalizing a proposed solution,
 - one in charge of questioning and validating the results,
 - and finally, another that would deliver the work to the platform.
- During the first two weeks, the students had to read chapter 1 and 2 respectively and during class on Fridays they would take a reading comprehension quiz. This phase helped determine each student's initial reading comprehension level as well as introducing the story to the students.
- From week 3 to 11, the individual reading was divided into two parts:
 - The first part of the corresponding chapter was made available every Monday, in which the characters are confronted by two elements: a challenge and a clue. To have time to read the chapter and propose solutions individually the students disposed of half a week, since during class on Thursdays, the students were given time out of class destined to work collaboratively on solving both elements, generating evidence and come to a proposed solution which must then be uploaded to the Schoology platform.
 - The second part of the chapter becomes available for the students to read from Friday to Sunday. During this section of the chapter the characters describe the correct solutions they reached and

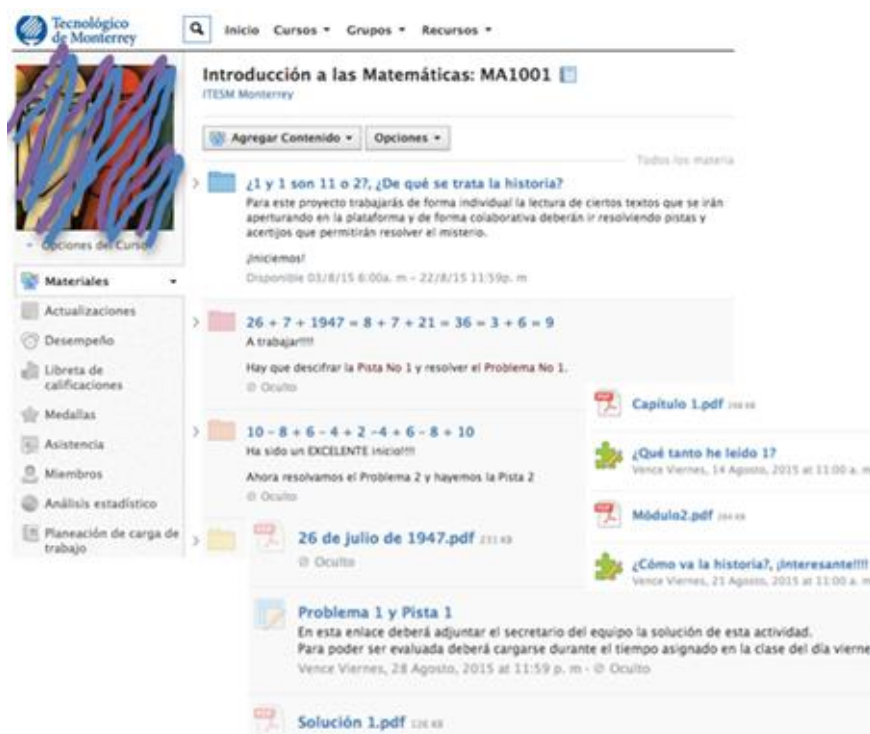
they continue their search. This way the students can effectively compare their proposal to that of the characters' and witness the correct interpretation of the challenges and clues.

- From weeks 6-12, during class on Fridays, students were evaluated individually and online regarding the elements that were described in the chapters, so as to measure the variation in reading comprehension.
- During week 12, and after each team handed in their proposed solution to the ninth and final challenge and clue, the final solution and conclusion to the mystery of the novel became available on the platform.
- During week 13 the students were again surveyed on their reading habits and their opinion of the relationship between learning mathematics and reading comprehension.

Implementation

This project can be found on the Schoology platform and was implemented on the students of the August-December 2015 semester of the class MA1001 Introduction to University Level Mathematics, which is integrated by students who are lacking in some of the required areas to begin mathematics in their corresponding careers.

To begin the semester, the platform was organized and each student was given clearance to access it. The two surveys were uploaded, along with three reading evaluations, the 9 block, including the readings with the problems that must be solved and the clues that must be deciphered, as well as the solutions that were reached by the characters from the novel and the 9 spaces in which each team must turn in the result of their work. Each of these elements was programmed so that it would only become visible to the students after a specific date.



Responsibility of the Teachers

The development and implementation of this project required the collaboration of several teachers that were in charge of different responsibilities: a language teacher was responsible for writing the novel, a mathematics teacher was in charge of the problems and mathematical challenges that were related to the subjects covered each week as well as programing the math classes into the semester; an instructional designer validated the pedagogic proposal and uploaded the program on Schoology, and last but not least, was the teacher in charge of accompanying and evaluation the students' work, who also was responsible for encouraging individual reading and emphasizing each team's responsibility of uploading their work onto the platform. Each week the teacher evaluated each of the solutions and assigned the appropriate sticker to each development, it is important to note that the although the solution might not have been accurate, creativity, enthusiasm, team work and strategy were evaluated, so as to encourage the passion for math and reading.

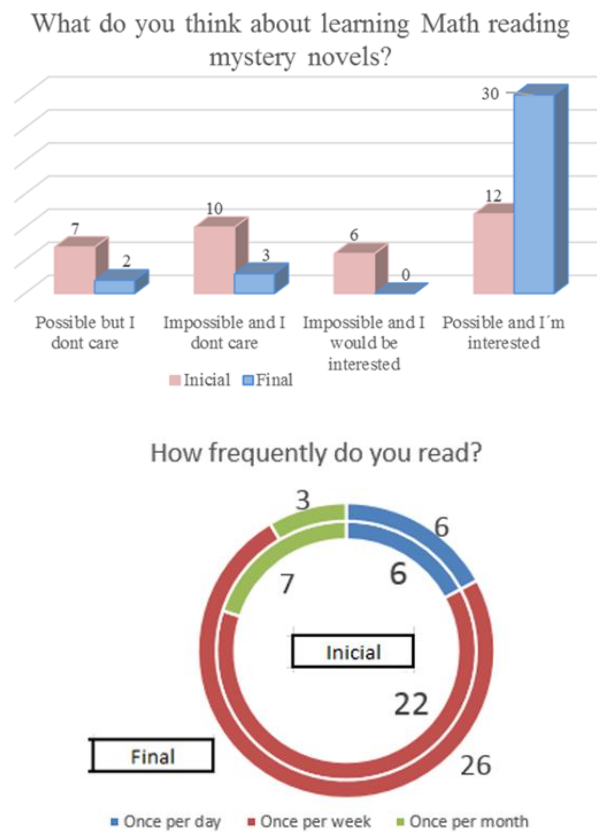
The team of professors that collaborated in this project would record weekly incidences to measure the project's effectivity and implement improvements, in which the following variables would be reported:

- The planned activity could be carried out, virtual activities were completed each session by means of the platform,
- All products or evidence were handed in/received in time for their evaluation,
- Instruments were employed -such as rubrics and checklists- from the platform to evaluate the activities,
- Describe the reasons that lead to registering an incidence or lack of.

RESULTS

To evaluate the project, two variables were considered. On one side, the students interest and perception for reading and the possibility of improving their mathematical skills reading, and on the other side, their competence in solving mathematical reasoning problems as well as their reading comprehension, both of which are basic for the Plan 2020 of the Tecnológico of Monterrey.

Considering that the project included the months of August to November, 12% of the participating students reported a change in their reading habits from 1 time a month to one time a week. There was also a significant increase of those of the sample who believed they could learn mathematics reading a mystery novel, at the beginning of the semester 34% believed this affirmation was possible, whereas by the end of the semester 86% agreed with this affirmation.



Figures 1 & 2. Results at the inicial and final of the project

Regarding the reading comprehension competency measurement of the project, the group had an average of 46/100, 85/100 and 78/100, which was related to the increasing number of visits to the course on Schoology and the time each student was connected to the platform. As time the semester continued, these indicators also increased, demonstrating a 69% rate of improvement of their reading scores as measured by their level of retention, comprehension and memorization.

As far as the work turned in regarding the mathematical clues and challenges, these evaluations also demonstrated an evolution in the group average since they were of 76/100, 87/100 and 93/100 at the midterm cut. This

demonstrates an improvement in their competence for logical reasoning and mathematics. It is important to mention that even by the second evaluation, the students continued to question the validity of the evaluations since not all of the elements in the book had yet been covered by their math sessions; however by the last delivery dates, this was no longer an influential factor and the academic achievement rose by 22%.

These numbers allowed us to consider the project successful, however these are some of the comments we received from the students:

- It was easy to read and solve the problems as a team because we helped each other out.
- I liked that the lectures were programmed and distributed from the start. We got better at how we solved the problems and we also helped each other with the reading.
- Schoology's calendar would let us know via email about the deadlines on the reading, which was helpful, especially since there was a lot of reading for some of the weeks.
- During exam week, I lost the thread of the story.
- I don't like reading, and I didn't like that I had to read to do math, however this semester I read this book.

that inspire us to keep innovating, creating more stories and new ways to make their learning experience more meaningful.

CONCLUSION

The objective of this project consisted in implementing some of the tools proposed by the Model Tec21 to improve the students' abilities by joining two elements, mathematics and Reading. One of the most important findings of this project was that the students were able to learn in a completely different way, without so obviously following a lesson plan, the learning experience became something innovating, stimulating and challenging. In the students' mind, it seemed impossible to imagine that a mystery novel would hold all the elements of a math program. It was also equally gratifying for the students to discover that their preconception that "I was born bad for math and for problem solving" was nothing but a myth. The students were able to propose creative and insightful strategies to find the solutions to the clues and challenges from the novel. Although they sometimes doubted their proposed solutions because they recognized it did not fully adhere to the methodology proposed in the classroom, they discovered that there are several different ways to apply their knowledge to solve a problem. This project would have been demonstrated less effective results if we had not integrated several of the elements that these new generations learn and work with, including: the importance of knowing their role in a team, so as to guarantee their participation in teamwork, the use of a technological platform not only made the reading easier, it also enhanced the follow-up, turning in the assignment and the feedback from each student. These elements made the project more familiar and pleasant for the students.

RECOMMENDATIONS

The next step consists in inviting more teachers from different areas to join us in linking their corresponding subjects to a good story. This project won't only apply to mystery and mathematics; it applies to any subject in which the student can take their knowledge and the information they learn in class to a fun, imaginative context in which they can practice it.

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