



WERKLUND SCHOOL OF EDUCATION

Flipped Learning in Junior High Math Classes

Almadina Language Charter Academy

Research Brief

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Introduction

This design-based study at Almadina Language Charter Academy focused on supporting students in math classes at the junior high school level (grade 7 and 9) by implementing a flipped learning model. Flipped learning is defined as a pedagogical approach where learning moves from the group to individual space and there is an increase in interactivity for students through, in this case, technological applications situated in math learning (Bredow et al., 2021). As the research indicates, flipped learning can support higher degrees of engagement, increased knowledge acquisition and conceptual understanding when the pedagogical design is focused on moving from a group to a student focus (Bredow et al., 2021; Cesare et al., 2021). This level of personalization is accomplished through the use of videos that are aligned with the mathematics curriculum and program outcomes for students. Personalization of learning can relate to independence, mathematical literacy development, collaborative learning, and facilitating learning outside of the direct classroom in order to support student development at home as well (Mischel, 2019; Ofgang, 2021a; Ofgang, 2021b). Additionally, the role of student regulation in relation to choice, completion of work in the flipped classroom context, and agency around the learning are key facets of the student lens in this type of instructional method (Sun et al., 2018). In the classroom or small group context, peer to peer collaboration, and the data obtained through flipping the learning can provide key inputs for just in time support or instructional adaptation to support mathematical conceptualization (Zou & Xie, 2019).

Although flipped learning is still a burgeoning concept and model, many schools during times of emergency remote learning such as the global pandemic have taken up elements of flipped learning within the frame of online or blended learning models. More formal flipped learning is defined as a pedagogical approach that integrates technology into student learning (Bredow et al., 2021). The definition of flipped classroom used for this study is (1) the use of audio-video materials for students' class preparation as out-of-class activities, followed by (2) regular in-class activities that build on audio-video materials (Lo & Hew, 2017). Within this context, this design-based study used EdPuzzle math videos to support student learning prior to class based activities. In grade 7 and 9, students were encouraged to watch the content and process videos to attain introductory knowledge of the material. This 'at home' support approach was used to help equalize the learning by harnessing technological applications such as EdPuzzle to mitigate initial mathematical conception challenges, increase math literacy, and serve to help students that may not have the parent or guardian resources at home (Shelby & Fralish, 2021).

KEY ISSUES IN THE LITERATURE

- Studies show increase to engagement and motivation when using a flipped classroom approach
- Video quality is an important element of the flipped classroom approach (teacher voice included and using language understandable to students)
- In-class activities, methods for differentiation, and formative feedback need to change or there will be no significant difference for student learning

Background

Almadina Language Charter Academy has a unique emphasis on meeting the needs of English language learners (ELL) and has a commitment to conducting research in the school. This study was designed as a research partnership project and a collaboration among researchers from the Werklund School of Education at the University of Calgary and practitioners from Almadina Language Charter Academy. The focus of the research was to engage and support students in junior high mathematics classes using flipped learning. The application of a flipped learning model was timely during the COVID-19 pandemic and considered to be a good choice as a medium to support students at home as well as in the classroom.

Teachers indicated there can be constraints that exist at home for students to attain help in learning math outside of the regular school hours. As a result, embedding a flipped learning model with the primary use of videos for previewing mathematics concepts prior to the classroom instruction and activities was the primary approach for this study. Using the application, Ed Puzzle, the students were enrolled in this application online with access to teacher-selected videos that included questions to support knowledge and skill acquisition.

Additionally, Ed Puzzle provided students with an opportunity to rewatch any sections of a video multiple times if they needed this support. The teachers felt this application gave ample support from a multi-modal learning approach which would be extended through the classroom activities. Given this background, the study focused on exploring the perceptions of teachers and students when using a flipped learning approach to teaching and learning in junior high mathematics. Other areas explored through this study included:

- Benefits of flipped learning
- How flipped learning supported learning responsibility and agency
- How flipped learning supported learners in strengthening questioning skills to clarify their understanding of mathematics concepts
- Challenges of flipped learning
- Changes that took place in the classroom when flipped learning was used as an instructional approach
- How data analytics from videos can inform instructional designs in junior high mathematics

Purpose

The purpose of this study was to explore how a technology-enhanced pedagogy, such as a flipped classroom intervention, can support students in junior high mathematics.

Executive Summary

This design based research project explored how technology enhanced pedagogy such as flipped learning can support students in junior high mathematics. The data collection methods included teacher reflections and surveys, student surveys, and video analytics analysis. Teachers were invited to reflect based on a series of prompts from the inception of the flipped learning to the end of the year. Overall, 123 student surveys were completed across two grade seven and four grade nine classes. Overwhelmingly, 123 valid surveys were attained of the approximately 143 number of students that were administered during class time. The video analytics were collected over 24 grade seven and eight grade nine math concept-oriented videos. Through this data, themes around the initial research intentions of course satisfaction, active learning, and willingness to communicate were transcribed to reflect literature based themes which included student engagement as a result of the flipped learning model, student agency within flipped learning, and the utility of the video themselves. We felt it was important to shift to these themes as the survey results in particular reflected these areas more readily. We utilized both aggregate and respondent data to manifest the results.

Key Findings

Student Engagement with Flipped Learning Model

- High achieving students rewatched, leveraged the videos, and asked for a reset
- Students were more comfortable demonstrating their learning in small-peer groups
- Math literacy or disciplinary literacy was supported in the videos for each content area
- Front loaded supports embedded in the videos helped student learning
- Students communicated that content-wise they preferred to ask questions in small groups or one to one and not in the class as a whole.
- Follow up with students is important
- As complexity of math functions and processes increased, students watched and rewatched more readily.
- Flipped learning offered a touch point for students to learn the concepts prior to class work.
- Teachers discussed multimodal approaches to teaching and learning and how these enriched the overall learning of math concepts and skills
- Teachers recommend It is important to establish ownership of the flipped learning process early to encourage student agency and shared accountability

Student Agency

- Student confidence in math was a determinant of student engagement for students in this study
- Ownership of the flipped learning happened once students understood 'why Edpuzzle'
- Building trust with students and shifting the responsibility for learning from teachers to students was essential
- Flipped learning approaches offered accountability for both teachers and students
- Even though some videos did not have corresponding questions, students took the time to watch the sections to gain a better understanding

Utility of the Video's

- Video content and approach is important to student utility—humorous videos were appreciated more than stoic ones
- Completion rates at times varied and it was difficult for teachers to ascertain understanding of math concepts
- Videos can help students understand initial concepts in math
- As teachers indicated, the videos helped students that had limited support at home and this was reflected in the student feedback as well
- Usage of videos increased as the year unfolded and there was more comfort with the process
- Watching multiple times resulted in higher results on questions in complex areas
- At times, students struggled with staying on task with watching the videos and answering the questions which was part of their responsibility and this caused some frustration from teachers; however, overall, the process served to support mathematical learning in the class.

Qualitative Results

Within the study, teachers were asked to reflect on their application of flipped learning throughout the year. The reflection parameters included how the model was working, what were some of the constraints and benefits, as well as any other key considerations the teachers had as it pertained to implementing this approach in the classroom. Below is a visual representation of the word frequency set at 15 that depicts key language, themes, and concepts from the lens of the teachers.

confidence level in the topic being introduced prior to participating in the subsequent in-class learning activities. The latter is a powerful example of the students' commitment to advancing their learning independently.

In our analysis, we also looked at a cross section of activities; three EdPuzzle videos across a complexity range from introductory to higher order math skills were selected for each of the grade levels with the intention of a more comprehensive analysis of the time spent (and by extension the number of video sections viewed and reviewed by students multiple times) versus the perceived complexity of the subject matter being introduced by the video. The average total time spent watching each video was calculated on aggregate for the grade seven and nine classes respectively. The final step was to compare the percent increase in time spent versus the time spent watching the video with no repeated sections. As demonstrated in Figures 1 and 2 the amount of time spent reviewing the videos (thus the number of video sections being reexamined by students multiple times) increased for both grade seven and nine students as the perceived complexity of the math skill and process increased. The results suggest that as the complexity of mathematical processes or conceptions increased, in turn, the students harnessed the videos to support their learning more readily.

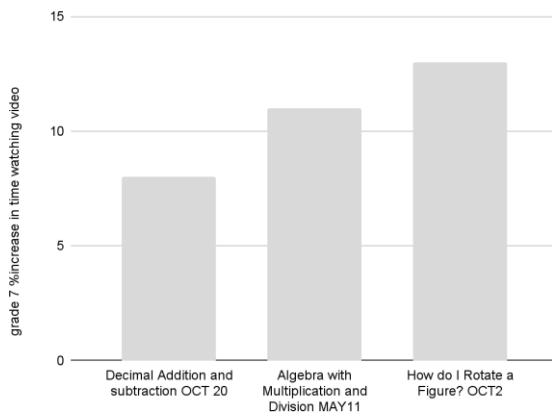


Figure 1. Grade 7: Percent increase in total time spent for EdPuzzle activities of increasing complexity

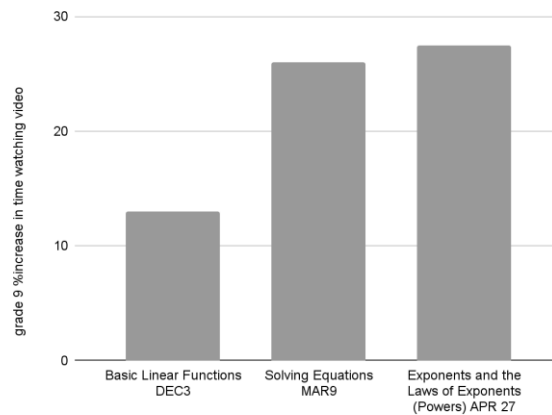


Figure 2. Grade 9: Percent increase in total time spent for EdPuzzle activities of increasing complexity

Another data set was gathered through student surveys. The student surveys consisted of 16 questions that were electronically disseminated to all grade seven and nine students as a class activity. Response wise, one hundred twenty three (123) valid surveys were completed and returned. Eleven students provided their assent along with corresponding parental consent to report on the specifics of their survey results. Based on the comparative analysis between video analytics and aggregate / individual student survey data the questions posed to students were grouped into three major themes and will be elaborated in terms of results below:

- Student engagement with the flipped learning model
- Students' perception of how watching videos using EdPuzzle impacted their learning
- Student agency

Student engagement with the flipped learning model

The majority of grade seven and grade nine students felt that the flipped learning model supported their mathematical process and helped with learning math and problem solving. There were 91% of students who were satisfied with the flipped learning approach while 82% of students felt that classroom activities complemented video use and helped to improve their understanding of math.

Students' perception of how watching videos using EdPuzzle impacted their learning

Grades seven and grade nine students in the study indicated that reviewing math concepts on EdPuzzle prior to in-class activities was helpful as an instructional method. There were 82% of students who felt that the videos were easy to understand, while 91% found that being able to view / review parts of the video more than once was beneficial to their learning. However, only 18% of respondent students that we had assent and 28% of all grades seven and nine students found the topics presented in the videos interesting enough to be inclined to spend extra time exploring other resources or trying to obtain more information about the viewed content.

Student agency

Students' self-reported level of engagement with EdPuzzle videos seemed to have been reflected by their own individual perception of the quality and entertainment value of the specific video introducing the math concept. Most grade seven and grade nine students felt that watching introductory videos on math topics helped to inform the follow-up questions they would come to class prepared to ask. Students indicated a very strong preference to collaborate in small groups or paired with peers for in-class activities with a much greater comfort level than with full-class discussion.

We have highlighted below some additional graphical depictions of the responses based on survey questions we have pulled that are of particular interest in this study. Please note that the responses are split into the aggregate whole class and aggregate respondent group so that a comparative or relative understanding based on the smaller sampling and the class as a whole can be reflected. With further research and more student responses (with student assent and parental consent), we anticipate these results can be presented on a broader scale.

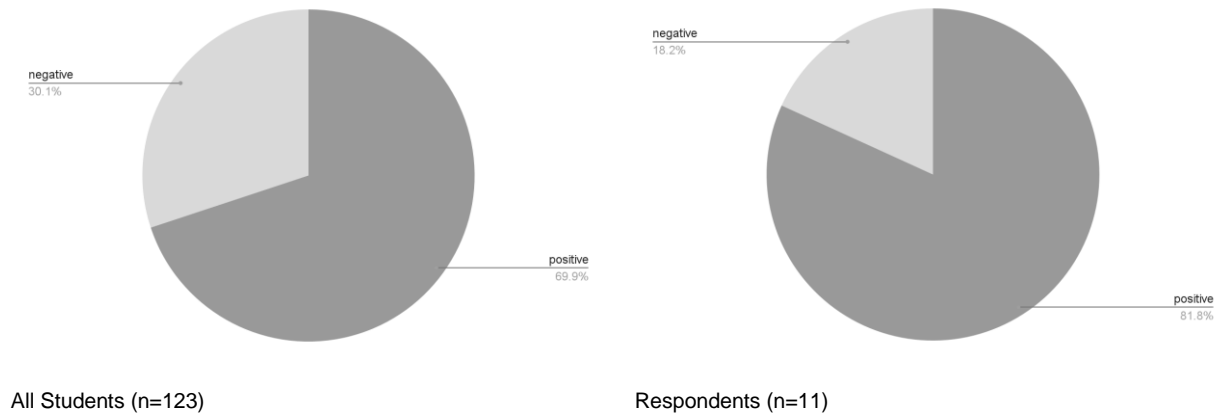


Figure 3. Q1. The learning activities in the videos help me understand what I need to learn in Math 7/9

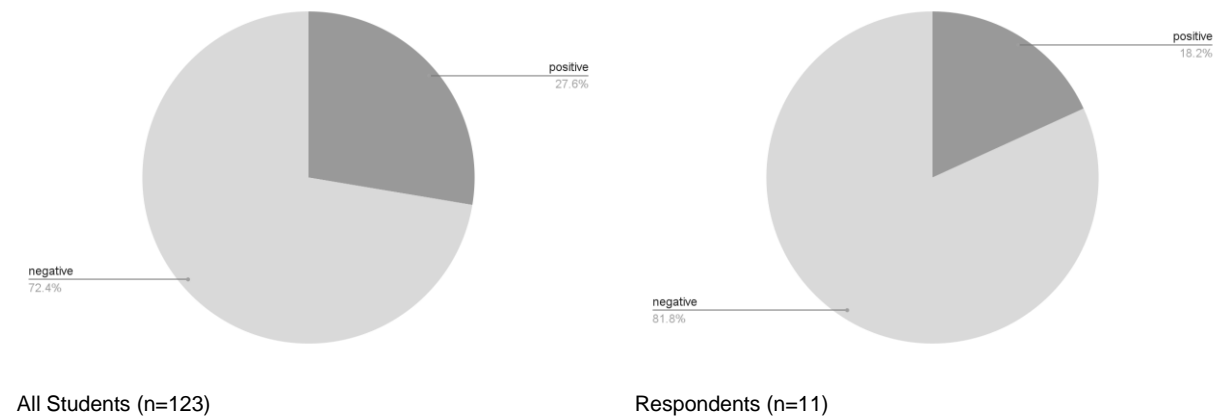


Figure 4. Q7. I find most new topics in Math 9 videos interesting and often spend extra time trying to obtain more information about them.

There is a clear indication from figure 3 above that surveyed students reported a mostly positive outlook on the learning benefits of the flipped classroom model. Student engagement and interest level in the topics presented in the EdPuzzle videos (or perhaps with the videos themselves), however, remains a strong area of focus for potential improvement of the method moving forward as can be noted in figure 4. Our video and survey analysis for the limited number of respondents for which student assent was received can also be justified as it appears from the similar trends in the figures above that our student subset is a valid and reasonable sample of the entire class population.

Participant Quotes

“It is easy to learn using videos.”

“I believe that the flipped approach in learning is much better than the normal one. With flipped learning I gain a better understanding of the concept and it is also easier to ask my teachers questions about the topic.”

Research Partnership Lessons Learned

- To note, student interest levels for a particular topic were not necessarily correlated to students' interpretation of the ease of understanding due to flipped learning
- A student strong in math may find their own agency to obtain desired learning outcomes using strategies outside the flipped learning method
- Instructional design of the flipped learning approach extends from the planning and choices of the videos, to the in class activities, to the showcase of learning in the assessments
- The data analytics provides a rich background for teachers to ascertain student engagement, areas of challenge, and scaffolding opportunities.
- Transparency of the benefits of flipped learning from a student and teacher lens are integral to applying this method with success not only from the application of online tools but how this relates to the in-class processes or design.
- Process and product oriented reflections from the teachers which included the intent of the study, teacher perceptions around flipped learning, and their goals served to enlighten our research findings throughout an unprecedented year.
- Being open to more adaptive practices based on flipped learning design and in class activities in light of changing learning environments can support more fluent research results as flipped learning can be a consistent approach throughout the year.
- Teachers take time to reflect on the research and existing studies and appreciate the positive aspects of flipped learning that the students benefit from.

Conclusion

Findings from this university-school research partnership indicated that the majority of students felt that flipped learning supported their mathematical processes for applying mathematical concepts and helped with problem solving skills. Almost all students were satisfied with the flipped learning approach and felt that classroom activities complemented video use and improved their understanding of math. Both teachers and students recognized the importance of using engaging videos to spur curiosity and inform learning.

The flipped learning method offered an entry point for students to be introduced to mathematical concepts and helped to increase disciplinary literacy prior to the in-class work. This instructional strategy also helped to enrich and solidify the overall learning of mathematical concepts and skills through a multimodal approach (viewing video and answering interactive online quiz questions).

Arguably, students with limited access to help outside of school may benefit from a flipped learning approach. At times, students struggled with staying on task with watching the videos and answering the questions which was part of their responsibility and this caused some frustration for teachers; however, overall, the process served to support mathematical learning in the class. It is clearly important to establish student ownership of and accountability in the flipped learning process early to encourage student agency and shared responsibility. Future study is recommended to apply lessons learned from this design-based study and to continue following the progression of math students who were in grade seven at the time of the study. Additionally, exploring the flipped learning design during a second year could develop understanding for integrating flipped learning with other pedagogical approaches.

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