

Perception of Students in an Arts-integrated Mathematics Performance Task

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Abstract

This paper discusses preliminary findings of students' perceptions on learning Mathematics through an arts-integrated performance task for Grade 8 students. Four domains were uncovered in this paper; fun in learning, relating the arts to daily problem-solving, connecting the learning experience across disciplines, and working in teams. The results of this study show that students welcome this approach and are motivated to learn mathematics through it. It allows students to appreciate mathematics in the light of connections made with arts in a real-world context.

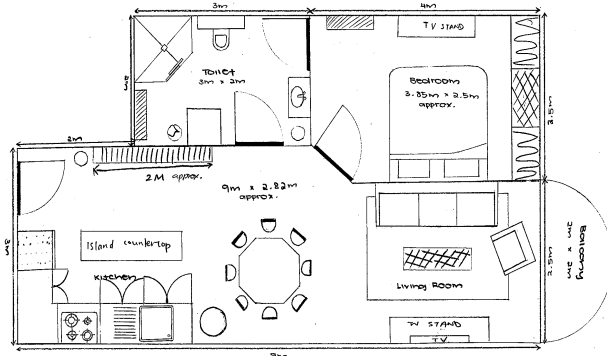
The Study & Literature Review

This study is an attempt to investigate the learning experiences of students studying mathematics in a pre-tertiary Arts institution in Singapore. It seeks to uncover students' perception of arts-integrated learning and attempts to identify the approaches to learning that they value. Grounded theory is used in this investigation as it allows the researchers to uncover the interdisciplinary relationships associated with the studying of mathematics through an arts-integrated approach.

The team adopted an inquiry, problem-based, and collaborative approach in designing a learning experience for our students as these elements reflect contemporary arts integration in the real world. Popovich [5] stressed the importance of students' interests in curriculum that is integrative. She believes that having students conduct original research is central to an arts integrative curriculum. In addition, to capture the growth process of the students, it is also important to document students' thinking processes through a variety of means, including sketches, online resources, and reflective journaling.

The performance task designed required students to apply the knowledge of ratio and proportion in designing a studio apartment for an elderly person. Students were required to submit (i) a 2-dimensional floor plan of a specific scale (ii) a 3-dimensional model of the studio apartment of an appropriate scale of their choice (iii) a 2-page group report which documented their research considerations and connection to visual arts elements and principles, (iv) a one-page personal reflection on their learning, and (v) a peer evaluation form.

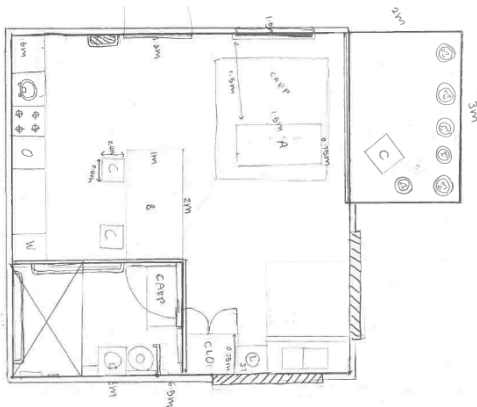
Students were assessed via two sets of rubrics. The first, which covered Mathematical learning, comprised (1) Application of Mathematical Knowledge, (2) Research through Art and Design Process, (3) Research & Communication of processes and findings, (4) Application of Mathematical Knowledge, (5) Reflection & Communication, and (6) Collaboration. The second set of rubrics assessed visual arts elements and principles: (1) Aesthetic Qualities and (2) Control of Materials and Technical Processes. According to Gulikers et.al (2004), authentic assessment consists of 5 dimensions and they are: task, physical content, social contexts, product, and assessment criteria. In this task, students were assessed on their understanding of proportion, application to a real world scenario, and ability to see connections between mathematics and visual arts [3]. This involved students having to demonstrate a repertoire of skills and good judgement to know what to apply in different contexts [4][6]. This task also brings a certain level of authenticity to the classroom as students often become more engaged when they could relate the task to the real world problems [4][6].



(a)



(b)



(c)



(d)

Figure 1: Sample of students' work: (a) and (c) 2-D floorplan, (b) and (d) 3-D model.

Methodology

The team embarked on the study with pre- and post- attitude surveys adapted from the modified Fennema-Sherman Mathematics Attitude Scales (DSMAS) [2]. Based on the surveys conducted with 89 respondents, the researchers observed that these students experienced less anxiety and greater confidence towards learning Mathematics. This then translated into a belief that Mathematics is important and relevant. These preliminary findings give the team a glimpse of the profile of the student cohort in general, about their attitude towards mathematics.

The team then embarked on qualitative interviews with 11 students to find out perceptions of students about this task. During the interview sessions, questions asked were: (1) Did you enjoy mathematics before joining the school? (2) What do you like about your experience in learning mathematics in the school? (3) What is the difference between solving this performance task compared to solving problems from the textbook? (4) What are your thoughts about including visual arts elements and principles in this performance task? (5) Were they (arts elements and principles) useful in helping you to solve this problem? (6) Did you prioritize the use of visual arts in making the 3-D model? (7) Do you see possibilities of connecting your art discipline with mathematics?

Findings: Four Domains Uncovered

Domain 1: Fun in learning. All students shared that they were motivated to learn mathematics through this performance task. They described this task as “fun”, “interesting”, and “enjoyable”. Some shared that

they were more enthusiastic in solving this task as compared to the typical repetitive and de-contextualised questions from their textbooks. Students felt a greater autonomy in deciding on their approach to solving the task. For instance:

“I like to use my hands to make things so I find this project quite fun and it also gave me more freedom to explore.”

“[The project] is obviously different but there were also familiar things like doing the map scale... So it was different because it was a lot more hands-on and not just theoretical.”

Domain 2: Relating the arts to daily problem-solving. Students reflected that exploring visual arts elements (e.g. colour and texture of the flooring) made mathematics concepts relatable.

“I think that if we didn’t use our artistic ways it would look a little bit more bland and like the flooring ... with this kind of flooring it kind of makes it look more interesting and more presentable.”

“Because of the visual arts elements in the lecture, we can probably take some inspiration and the things they teach us in order to design, and also considerations like what makes a house. The factors that we put into it like what can we put into it to make it appealing to people of that group because it’s a studio apartment for old people.”

Domain 3: Connecting the learning experience across disciplines. Most students agreed that they could connect their knowledge of visual arts with mathematics through this performance task, and there could be possibilities of connecting other art forms with other subject disciplines.

“... when we were just introduced to this project, we were taught various elements of visual arts that could apply to this project such as line, texture, shape, mood and various other elements. I think it is very helpful because we were able to apply these elements to create our model.”

“... as a dance student myself I think in integrated arts that combine math and dance, I find it really a very good experience because I had a new platform to try and explore different ideas that could combine both my dance and math.”

“Maybe a theatre piece could be based on how much space we use in a theatre studio. Or a music piece, how long the music piece is or like the ratio of the music piece to maybe to the dancers who are performing with it. There are a lot of things that we can explore with just one subject and so many art forms. There is good potential in art forms and mathematics coming together. Not just mathematics, many subjects also have this platform where you can always apply your skills into it.”

Domain 4: Working in teams. Generally, students enjoyed the collaborative nature of working with friends to solve the problem. The terms ‘teamwork’ and ‘communication’ were mentioned a few times by the students.

“And we also had to work in groups which is not something you do on textbooks. So it’s a very different experience because you need to meet up and do everything together and making all the tiny objects inside is also pretty meticulous and when you are on textbook, you just need a pen and paper.”

“I think this really helps build teamwork skills and through project I think we had our ups and downs... But I think things work out.”

Analysis

The key takeaway of this integrative approach is that it brings much joy to the learning process for students. We have found out that the choice of performance task significantly influenced students’ approach and attitudes towards learning. Students seemed ready for an arts-integrated approach to learning. Through this performance task, the teachers were able to help students make connections between Mathematics and Visual Arts while bringing a real world context into the classroom.

In education, Mathematics is typically viewed and treated as a discipline characterised by rational, cognitive thinking activities with specific “right” answers to a problem. The arts, on the other hand, may be viewed as a discipline that is more open-ended for which there are no fixed answers. As such, these two subjects are usually taught separately. However, instead of a dichotomous view of Mathematics and Arts, we identified inherent qualities in these two subjects which provide opportunities for integration. When we do this, we develop the means to observe, describe, and imitate the world of the arts, in this instance, architectural and interior design, while solving a mathematical problem.

The approach to designing this task also provided an opportunity to recognise and meet the diverse learning needs of our students. In addition, the collaborative nature of this task enhanced the pleasant effects of artistic affective experiences, increased students’ enjoyment of learning and alleviated their individual anxiety towards mathematics. Bresler [1] describes four arts integration “styles”: subservient, co-equal, affective integration, and social integration. In elaborating on the affective integration style, Bresler emphasizes the potential of the arts to evoke feelings, and gives students an opportunity to express themselves and be creative across disciplines. The social integration style suggests a way to employ the arts as a means to connect with communities through partnerships and projects. In particular, this task offered a place where mathematics could be explored both individually and in collaboration with others, where students could take intellectual risks, experience both success and failure in the process of designing and creating.

Summary and Conclusion

An artistic experience among students proved very beneficial in motivating their learning. The arts enhances the regular academic curriculum and offers students much more than merely a perfunctory education. It captures reflective learning, students’ attitude and allows new birth of creative expressions. Integrating the arts into other subject areas such as Mathematics may foster development of the holistic learning, linking and strengthening competencies in both subject areas. Art integration brings reality and enjoyment, and adds “life” to the learning experience.

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