Using movie-making to visualise pre-service teachers' perceptions of technology

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ABSTRACT

This study uses a Bourdieusian framework to determine pre-service teachers' perceptions of technology before their engagement in any formal coursework of a technology education teachers preparation program. The analysis focuses on movies depicting three states of technological capital, revealing a duality between movie narratives and written reflections. These movies underscore a Western-centric perspective on technology, ethics, and social understanding. One film triggered self-awareness among students regarding smartphone use, demonstrating the potential of movie-making for prompting personal reflection. The study emphasises experiential learning through stop-motion movie creation. Moreover, aesthetics emerges as an avenue for students to articulate technological viewpoints, transcending conventional instructional methods. Aesthetic processes unveiled students' technological capital, although effective transformation centres on pedagogical adaptation. The study's methodological integration of storyboards and reflective components gives insights into students' evolving knowledge. The discussion shed light on technology education within the STEAM classroom. Findings show that by embracing students' perceptions and facilitating knowledge expression, educators can contribute to exploring technology's multifaceted role in the educational landscape.

Key Words: Technological Knowledge, Technology Education, Multimodal, STEM, Pre-service teachers, Teacher Education

1. INTRODUCTION

This article focuses on the education of pre-service technology teachers within a STEAM (Science, Technology, Engineering, Arts, and Mathematics) environment. In Sweden, technology education is an interdisciplinary field. Its purpose is to cultivate technological knowledge, skills, literacy, and a multifaceted understanding of technology's dimensions (The Swedish National Agency for Education, 2022). Despite sharing STE(A)M goals, the subject encounters challenges in defining its position within it, as it covers more than just technology (T) or engineering (E) alone (Sultan et al., 2022). Teaching technology education within an interdisciplinary STEAM framework poses challenges, as it not always interconnected regarding content or pedagogy, and typically STEAM subjects are taught in isolation from each other, with a primary focus on Science (Allen & Matthews, 2016; Bertrand & Namukasa 2020; Bryan et al., 2015; Wickman et al., 2021)

However, despite the growing popularity of STEAM education, there is limited empirical data and understanding of the challenges associated with its implementation and teaching.

Design has been identified as a promising element for unifying STEM subjects (Hallström & Ankiewicz, 2019; Lewis, 2006). Design can be recognised within technology education and be seen as a form of Art (Earnshaw et al., 2015). Integrating Art (A) with STEM further highlights the significance of design, creativity, and innovation in STEM learning (Bautista, 2021; Breiner et al., 2012; Liao, 2016). An aesthetic learning process serves as a representative method of learning, where symbolic expressions play a crucial role in representing perceptions of the world, emotions, or objects. However, learning processes can only occur when practical knowledge, reflection, and connections to prior experiences converge with newly acquired knowledge (Bergfeldt, 2022; Horh, 1998). Horh (1998) emphasises that aesthetic activities can be used to express the inexpressible. The learning experience evolves into an aesthetic learning process when it leads to knowledge.

2. BACKGROUND

Sultan et al. (2022) were inspired by the works of Hallström and Schönborn (2019), Herro et al. (2019), Hsu and Fang (2019) and Kelley and Knowles (2016) and proposed several strategies to enhance technology education in steam. Strategy one: Provide an extended timeframe for students to understand, engage with, and reflect on the task, enabling more profound and meaningful learning experiences beyond time limitations. Strategy two: Encourage students to create visual storyboards with a maximum of six frames before starting the movie-making process. This helps students articulate their ideas, make deliberate choices, and facilitates reflective discussions on their decisions and effective presentation strategies. Strategy three: Scaffold students in using artistic elements to convey their intended messages in the movie. Strategy four: Guide the students in selecting and highlighting relevant aspects that align with their concepts and subject knowledge, fostering a comprehensive understanding of technology within their creations. Strategy five: Create opportunities for students to verbally express their thoughts and reflections on the final movie. Encourage them to articulate their ideas, explain the creative process, and share the insights they gained throughout the project. This component enhances communication skills and nurtures critical thinking abilities.

By implementing these strategies, technology education within the STEAM framework can be enriched, providing students with valuable learning experiences and promoting interdisciplinary understanding. Therefore, this study aims to determine students' perceptions of technology before engaging in any formal technology education teacher preparation program coursework by adding the recommendations by Sultan et al. (2022).

3. METHOD

Our research approach for this study is descriptive. Descriptive studies serve as initial explorations in new areas of inquiry, providing valuable insights (Grimes & Schulz, 2002). We study pre-service teachers' perspectives and issues with teaching technology within a STEAM framework. The STEAM framework means taking an interdisciplinary approach but with the

foundations of each subject's specific content knowledge. In our study, we employed a descriptive method to understand better the potential issues that arise when teaching technology education in the context of STEAM.

3.1. Empirical setting

This study takes place in a five-week course focused on technology education. Week one of the course was dedicated to exploring the concept of technology and involved readings on various topics, such as the philosophy of technology and didactics. However, before probing into the course readings, the students were tasked with creating a movie intended to capture their perspective on technology. The movie could revolve around an artefact, an idea, a system, or anything that reflects their personal views on technology.

The participants in this study were pre-service teachers at the university level. The course was situated in the third semester of their program, and the students were concurrently enrolled in compulsory courses covering subjects like biology, chemistry, physics, sustainable development, and technology. Aesthetic learning processes influenced our approach to teaching this course, emphasising the importance of creativity throughout the sessions. Technology education accounted for 7.5 credits out of the total 30 credits in the program.

3.2. Collecting data

We conducted an observational session that enabled us to gather information regarding the technological content depicted in the students' movies about technology. We were in the same room as the students during the observation throughout the session. We observed the movie-making, listened, gave guidance and made sure the students followed through with the tasks. We specifically targeted the students' written reflections. This descriptive research also aimed to identify challenges or issues related to technological content and the broader STEAM framework.

3.3. A Bourdieusian perspective

In examining the students' technological content, we drew inspiration from Bourdieu's conceptual framework of technological capital. A Bourdieusian perspective allowed us to identify the embedded technological knowledge within the students' projects and shed light on the presence of technology, technological content and knowledge in their choices. Bourdieu's perspective views technology as a product of invention, implementation, use, and cultural transmission (Bourdieu, 1979). Romele (2021) further elucidated the Bourdieusian perspective by demonstrating how technologies are intertwined with social and cultural dynamics involving classification, differentiation, exclusion, and discrimination. In other words, technologies extend beyond mere artefacts.

Bourdieu (1979) proposed three states of technological capital:

- Objectified: This encompasses all the technologies owned, used, or designed by individuals or groups.

- Institutionalised: It refers to certain actors or groups having access to and specific ways of using technological artefacts, while others may be excluded from such access.
- Embodied: Actors or groups possess the ability to permit or restrict the use of technological artefacts in particular ways.

To complement the concept of technological capital, we found it valuable to include some technology-specific definitions relevant to teaching and assessment practices. In Nordlöf et al. (2022), technical skills are defined as the technological knowledge of that things work but not necessarily knowing how they work. Activities like designing, creating, and making can exemplify these skills. Socio-ethical technical are in Nordlöf et al. (2022) defined as understanding the relationship between technology and the human world, encompassing knowledge about technology's impact and ethical considerations.

3.4. Stop-motion and movie-making

An instructional stop-motion movie-making session was given to support the determination of students' perspectives of technology and its application. Employing iPad hardware and the iMovie software, single-frame photos of an object were captured, revealing its shadow and prior position. This enabled gradual changes between frames by temporarily removing, altering, and returning the object to its original spot. Clay, a readily available and malleable material, served as the medium. While it demands time, as noted by Orraryd (2021), it offers valuable learning opportunities. In this study, the students were tasked with expressing their understanding of technology through the use of clay and stop-motion techniques.

The first step for the students was to create a storyboard about their chosen technology content. The second step was to make the cinematic story they wanted to convey. Examples of such technological stories included "Abdi's Apartment," "Love Is In The Rain," and "The Globe." It is important to note that these stories evolved and underwent changes throughout the production phase. The students gave each other feedback on their ideas between steps one and two. The third step was to make the movie. In the fourth step, the student group watched the films and orally presented their thoughts on the result. In the last session of the workshop, the students were asked to write an individual reflection about their work. The finished movies and the student's personal thoughts served as the data for our study, providing insights into the students' understanding of technology through their creative expressions.

3.5. Written material

We aimed to gain a deeper understanding of the students' perspectives on the concept of technology and how they expressed it through their iMovie film. We were particularly interested in uncovering the aspects they thought were significant to highlight and their creative choices in presenting their ideas. By exploring the students' reflections, we sought to find the underlying thoughts and motivations that guided their filmmaking process, going beyond what may be immediately apparent in the film itself.

4. RESULTS

This section provides an overview of the studied movies, accompanied by selected frames that capture key visual expressions. To give you an overview of the analysis and visuals of the movies we have supplied Table 1 as help. Following each movie description, we will present our analysis based on the findings.

Table 1:
Students' movies

Movie	What we saw	What the students described	Nouns and adjectives used in the reflective texts
Film nr 1 – The Globe 	The difference in water availability and living standards around the world	The film shows how technology is used differently worldwide, seen from a global perspective.	Injustice, rest, laziness, Earth, human, furniture, faucet, electric stove, refrigerator, freezer, mobile phone, weapon, drone, bomb, water, mug, child, city, lighting, cars, White goods, television, pots, carrying shawl, pure (water), poor,
Film nr 2 – Love Is In The Rain 	The evolution of rain protection, from a leaf to an umbrella	The film aims to show the good side of technology's Janus face.	Bus stop, trees, birds, stone, road, buildings, cars, parking lot, clay figures, umbrella, clouds, raindrops, hearts, angry, sour, jealous, dry, wet, joy, laughter, love
Film nr 3 – Abdi's apartment 	The human social impact of technology (the mobile phone)	The use of technology facilitates everyday life, but when the use becomes a burden instead of an asset.	Apartment, living room, kitchen, sofa, TV, kitchen counter, window, friend, package, telephone, mobile phone, the light, feeling, anxiety, change, recognise, scroll, obsessed, Available, Like, Energy, Social, Fun, Dirty, Flipped

4.1. Technology from a Bourdieusian perspective

We here summarise the states as we initially observed them in our data. The states are Objectified (O), Institutionalised (I) and Embodied (E).

Movie 1

- O: Different water technologies used or designed

- I: Not everyone has access to water and water of good quality. Only the rich part of the world has
- E: Again, the rich part of the world can tell who can and cannot use the technology to purify water.

Movie 2

- O: We see artefacts in the movie that speak to us that is technology that not only the single individual can take part in the bus stop, trees, birds, road, buildings, cars, parking lot, umbrella
- I: Not everyone has protection against rain. Not everyone has an umbrella when it is most wanted to shelter the rain.
- E: Having a rain cover daily is an access of luxury.

Movie 3

- O: We see artefacts in the movie that speak to us - technology in an apartment: living room, kitchen, sofa, TV, kitchen counter, window, friend, package, telephone, mobile phone,
- I: The mobile telephone is, perhaps today, a technological artefact that almost everyone can use. However, not everyone can have it as a pastime. Furthermore, when it becomes a pastime, it can become something you can be addicted to.
- E: We cannot allow or restrict the use. The technological industry has no limits and sets its rules to a large extent.

4.2. Adding the students' reflections

In the text, the students reflected on the film they created. They showed an awareness of how they perceive themselves and their environment from a broader, global perspective.

Excerpts drawn from the reflections of Film #1:

> The film is important because it shows injustice and differences in society. For me personally, the film evokes a lot of emotions and thoughts about how unfair we have it.
>
> It is scary and sad that technology developed to help does not reach everyone who needs it and how technology is used to destroy.

Excerpts drawn from the reflections of Film #2:

> The film's purpose is also to show that we humans can be brought together and create new relationships with the help of technology. In the film we can draw parallels to our

> private life, with examples of waiting for the bus, meeting someone, romance, attractions, and caring.

Excerpts drawn from the reflections of Film #3:

> The film was like food for thought for me. There are so much fun and other things to spend time on than surfing away a whole day. I realised the negative aspects of the phone, and the Janus face of technology became more apparent.

The excerpts were chosen as they pointed to different perspectives described by the students. Film #1 gives an example of their sociotechnical understanding as students themselves highlighted the societal perspective. Film #2 excerpt shows how artefacts influence human activity and life. Film #3 put forth the student's relationship with technology.

5. ANALYSIS

The movies were watched multiple times during data management sessions. Initially, the authors watched the movies together in silence while taking notes. Subsequently, we engaged in content discussions, drawing upon our diverse subject backgrounds. Finally, we sorted the movie content based on our specific subject knowledge, allowing for an analysis of the movies' themes and messages compared to the written material we collected.

5.1. Analysing the data

In analysing the data, which consists of three movies and nine pages of by students' written material, we first employed an inductive analysis approach to sort the data from a STEAM perspective. In our study, the STEAM perspective means an interdisciplinary approach but with the foundations of each subject's content knowledge. For the S in STEAM, this meant focusing on all aspects of the natural world. The T, E and M were highlighted as all things made by humans, solving a problem, or designed to solve one. Here, the technological knowledges as described by Nordlöf et al. (2022) was used. The A approached the data by looking at the different aspects of the aesthetic process and language.

Based on nouns and adjectives from the written material, this first step gave us four categories – traits, emotions, artefacts, and environment. The categories came from its connections to STEAM. Art here represents words describing human beings as social creatures, Technology, Engineering, and Mathematics represent words describing the human-made world, and Science represent words describing the natural world.

These categories served as guides into the Bourdieusian perspective and what we, as researchers, saw in the movies. We then could match the three states, Objectified (O), Institutionalised (I) and Embodied (E), with the four categories. We present the categories and examples of nouns and adjectives matched.

Category one, traits combined with Bourdieusian perspectives: laziness, jealousy and social. We analysed this category as being both institutionalised and embodied due to its possibilities for actors or groups having access to and specific ways of using technological artefacts. It possesses the ability to permit or restrict the use of technological artefacts in particular ways.

Category two, emotions, combined with Bourdieusian perspectives: injustice, anger, and anxiety. We analysed this category being institutionalised as they pointed to how usage and access impact being human.

Category three, artefacts, combined with a Bourdieusian perspective: the freezer, cars, and apartment. We analysed this category as being objectified. This is because they encompass all the technologies owned, used, or designed by individuals or groups.

Category four, environment, combined with a Bourdieusian perspective: Earth, raindrops, and light. We analysed this category as an embodiment. The natural world becomes an actor possessing the ability to permit or restrict the use of technological artefacts in particular ways.

6. DISCUSSION

While this study has limitations due to its specific setting and narrow scope, a few conclusions can still be drawn.

Drawing upon Bourdieu's framework (1979), we could unpack the students' perception of technology before engaging in formal technology education teachers' preparation program coursework. The movies displayed examples of technical skills as they presented artefacts in context but not how they worked, just that they did work. Their socio-ethical understanding was dominant as they, in the movies, showed an understanding of how humans are in relation to technology. Nevertheless, there is a dualism in their expression of technological knowledge. There is a difference between the narrative of the movies and the written reflections. The technological perspectives became more visually conveyed in the movies when the students' reflections were communicated to us through a Bourdieuan lens (1979); we observed that the movies represented objectified, embodied, and institutionalised artefacts from a Western and modern perspective of technology, ethical issues and the social understanding of technology.

Regarding the movie "Abdi's Apartment", it surprised us to find the student's film's impact on themselves. They started to question the time they consumed on their smartphones. The students' written reflections raised questions in us about what else we, as teachers, miss when we have little time to reflect with the students. How students perceive and define technology can impact our future teaching and learning.

When the students engaged in creating a stop-motion movie, it allowed them to learn skills such as working with clay, constructing environments, and using movies as a means of communication while exploring technology. The relationship between what the students did and what they understood fostered a learning experience beyond mere unreflective action. The distinction between simply "making a movie" and the learning process that resulted from the students'

engagement with animation lies in their awareness of the connection between their creative output and their reflective thinking.

The work and care the students gave in creating the film we analysed as an aesthetical experience that they can use to meditate on a technological perspective. Art becomes a language with which they can communicate and convey a message. The aesthetical approach is more than making a movie. Through filmmaking, the students have the opportunity to create their own world, an essential part of their experience of being human in the world. This differs from technology and Science, where the students are expected to step into an already fixed world. For example, in technology, there are technical rules and standardisation symbols, and in Science, we have agreed on names of species that the students need to learn to be a part of those worlds. In the storyboard, an imaginary world is created based on one's and others' experiences. The aesthetic creation is a central part of this process, and the students can use this newly acquired knowledge in their future profession as a teacher.

Aesthetic learning processes can serve as a tool for understanding students' existing and emerging technological capital but transforming it into a tool for learning requires a different approach. The experience described in this paper highlights the importance of changing one's teaching to allow the students to show their knowledge. In Sultan et al. (2022), the students did not have storyboards, and they did not write reflections. In this study, those pieces made all the difference, making it possible for us to see the students' technological capital.

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