Proceedings PATT 37
Developing a knowledge economy through technology and engineering education

Editors: Sarah Pulé and Marc J. de Vries

3 - 6 June 2019
University of Malta, Msida Campus
PATT 37

Developing a knowledge economy through technology and engineering education

Msida, Malta
June 2019

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Faculty of Education
University of Malta

ISBN: 9 789995 714796
First published in Malta in 2019 by the Department of Technology and Entrepreneurship Education
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Welcome to PATT 37 Msida, Malta
Developing a knowledge economy through technology and engineering education.

Technology is pervasive in modern life and the economies of countries usually depend on how this is understood, developed, used and critiqued. With the advent of technologies which might disrupt the way we operate, becoming technologically literate and developing technological habits of mind is increasingly important for societies that value human capital.

Design and Technology education can be seen to have multidimensional roles. Research stimulates debate about important concepts and helps to answer questions such as the following:

1. Is design and technology education only for developers or producers of technology, or is it suitable for all citizens?
2. What knowledge and skills within design and technology education are transferable to future contexts within the workplace or for life?
3. How can we democratize technological knowledge and skills through design and technology education?
4. Specialised technological knowledge versus generalised technological knowledge: which is more suited for developing a knowledge economy based on human capital?
5. How can design and technology education contribute to generating future workplaces based on creativity and innovation?
6. What pedagogies are most suited to design and technology education?
7. How can design and technology education prove useful for everyday life?
8. How can design and technology education help to develop cultural capital?
9. What are the expectations for learning outcomes from different educational levels of design and technology education, ranging from primary, secondary, post-secondary and tertiary education?

PATT conference 2019 is open to the research topics which inform on the topics above as well as others relevant to the area of technology education, such as: a) curriculum content, b) STEAM philosophy, c) classroom practices, d) technological vocational education, e) project based learning and assessment for technology education, f) design knowledge and processes etc.

PATT is an international community of technology education colleagues (researchers, teacher educators, teachers, etc.) who are interested in educational research as a support to developments in technology teaching. PATT is open to all. There is no membership. Proceedings of previous conferences can be found at the ITEEA website (https://www.iteea.org/Activities/Conference/PATT/PATTConferences.aspx).

PATT 37 is a historical milestone for Maltese education in Design, Technology and Engineering in Malta since it is the first international conference focused on the teaching of technology from the primary level of schooling, to secondary, post-secondary and tertiary. We believe that this conference will make an interesting, valuable and significant contribution to the scholarly discourses of Technology education. We are convinced that the introduction of an international perspective into technology education will act to inspire Maltese stakeholders to become more participant within the international community of researchers and we hope that Technology education will continue to grow and mature through scholarly analysis and communication.

Sarah Pulé and Carmel Navarro
University of Malta
Conference conveners
June 2019
PATT

PUPILS’ ATTITUDE TOWARD TECHNOLOGY

PATT conferences began in 1985 when a small scale workshop on attitude research about technology was held in the Netherlands. Thus began a series of international conferences that continues today. In the early conferences, colleagues from different countries came together to discuss the possibilities and share research about exploring the attitudes of young people to technology, using an instrument that has been developed in the Netherlands, and is still used today. The format of the first PATT conference set the trend for future conferences – no keynote presentations, no parallel sessions and plenty of time for discussion. While the scope of the issues for discussion and the research presented has extended to all aspects of technology education, the conferences have fostered a strong community of scholars of Technology Education, many of whom regularly attend the PATT conferences.

Cecilia Axell

ABSTRACT

The aim of this study is to explore the nature of technology education in a Sámi school, in order to identify the potential of indigenous Sámi knowledge for broadening the horizons of technological literacy. This paper presents the findings from the initial analysis of the empirical material. The purpose was to identify which specific artefacts play a central role in technology education in a Sámi school, and how the artefacts are implemented in technology education to convey technological knowledge. The participants (teachers and pupils) were all from the same Sámi School in Northern Sweden. The method employed was participatory observation and empirical material consists of field notes, recorded conversations, photographs and children's drawings. The findings show that technology education is strongly connected to specific artefacts that are important in Sámi culture. Technology Education is grounded in a holistic view of knowledge and to a large extent integrated with other school subjects. The knowledge system embedded in technology teaching is collective and related to both artefacts and activities. Myths and storytelling are frequently used to contextualise the technological content, and the historical aspect of technology is largely present since connections between older and newer technological solutions are made. Technological knowledge, activities and specific artefacts are not only attributed a practical value, but also given a symbolic value, since a common knowledge base in Technology contributes to strengthening the children’s cultural identity.

Key words: Technology Education, Indigenous Technology, Sámi School

Introduction

Technological literacy – essentially the capability to understand and use technology (e.g., ITEA, 2007; Jenkins, 1997) – is an increasingly central goal of technology education across the globe. Definitions of technological literacy vary from comprehensive to vocational, but most definitions rely primarily on Western knowledge systems (Gumbo, 2018; Marshall, 2000;
Williams, 2009). Students in many countries consequently also perceive the content of technology education in a narrow sense as being mainly about modern, Western artefacts such as computers, tablets and TVs (Dakers, 2006; de Vries, 2005; Svenningsson, Hultén & Hallström, 2018).

However, since technology is a global phenomenon, it is important that knowledge about it includes technology from different cultural contexts and not merely technologies produced and used in limited parts of the world (Edgerton, 2011; Gumbo, 2015; Ihde, 1990). Narrow conceptions of technological literacy are not only misleading when it comes to the global magnitude of technological culture but could also potentially marginalise indigenous knowledge systems in various parts of the world.

Research suggests that indigenous technology and knowledge systems can contribute to broadening the horizons of technology education and technological literacy (e.g. Ankiewicz, 2016; Bondy, 2011; Gumbo, 2015; Lee, 2011; Marshall, 2000; Seemann, 2000; 2010; van Wyk, 2000). One difference between western and indigenous technology is that the latter is often based on knowledge that has been developed over many generations (Bondy, 2011; Gumbo 2018). It is generally transmitted from one generation to the next through oral narratives, storytelling, music, symbols and art, as a way of maintaining a societal continuity (Owuor, 2007).

The Sámi are an indigenous people spread over four countries: Sweden, Norway, Finland and Russia. In 1981, the Swedish government established a Sámi School Board, responsible for Sámi schools with the mission to give Sámi children an education with Sámi orientation and teaching in the Sámi language. Today, there are five Sámi Schools in the Northern part of Sweden (Johansson, 2007; 2009; Svonni; 2015). However, Sámi knowledge has been included only marginally in the national curriculum in Sweden (Svonni, 2015), not to the same extent as countries such as South Africa (Vandeleur, 2010).

The Sámi curriculum in Sweden is equal to the general school curriculum for the compulsory school. However, in the Sámi curriculum it is emphasised that Sámi pupils should be given the opportunity to become familiar with Sámi cultural heritage (Balto & Johansson, 2015; Swedish National Agency for Education, 2018). The Sámi knowledge system is holistic, place-bound and based on inherited wisdom and knowledge. It is also often linked to practical applications and skills (Keskitalo & Määttä, 2011; Keskitalo, Määttä & Uusiatutti, 2012; Svonni, 2015).

The aim of this research project is to explore the nature of technology education in a Sámi school setting and examine in what ways indigenous Sámi knowledge can contribute to broadening the horizons of technological literacy. This paper is a presentation of the initial findings. The purpose was to identify:

- *Which specific artefacts* play a central role in technology education in a Sámi school, and
- *How the artefacts are implemented in technology education to convey technological knowledge.*

**Theoretical Background**

Keirl (2006) describes technological literacy as having three important dimensions: *the operational* (students learn to use and do the technology), *the cultural* (the students contextualise their learning) and *the critical* (students learn about and how to be with technology). Since the cultural aspect is central in this study, Ihde’s (1993) broad definition of
technology is used when analysing the data: i.e. that technology has some concrete components, that humans use these components in praxes and that there is “a relation between the technologies and the humans who use, design, make, or modify the technologies in question” (p. 47). According to Ihde (1990; 1993), technologies cannot be understood as an independent power since they are always interwoven with culture. Culture as a concept is complex but can be explained as being connected to how and why we do things. ‘How’ is about our material practice, while ‘why’ is connected to the meanings (James, 2015).

The technology that surrounds us shape our lives, our environments, our cultures, our thinking, and our being in the world (Kaplan, 2009; Keirl, 2015). Thus, technology can be described as having physical and intentional properties. The physical properties interact with other physical things in the world, whereas intentional properties relate to human beliefs, desires and purposes (de Vries, 2005; Kaplan, 2009; Kroes & Meijers, 2002). An artefact is hence a result of both physical and contextual conditions (Kroes & Meijer, 2002; Vermaas, Kroes, van de Poel, Franssen & Houkes, 2011).

Artefacts play an important role in teaching and learning about technology. To explore their compositions, the material they are made of, their design and their possible functions can support students’ interest and knowledge in technology (de Vries, 2005). However, a problem highlighted in previous research is that students often are not given the opportunity to analyse the technology in a meaningful context. Consequently, the connections between artefacts and humans, and what kind of implications the artefacts have in a societal/cultural context, are overlooked (Mawson, 2010; Siu & Lam, 2005; Turja, Endepohls-Ulpe & Chatoney, 2009).

Methodology

The method employed in this study was participatory observation. Marshall and Rossman (2011) define observation as “the systematic noting and recording of events, behaviors, and artifacts (objects) in the social setting” (p.139). Participatory observation enables the researcher’s involvement in a variety of activities over an extended period and therefore provides a deeper understanding of the studied field (DeWalt & DeWalt, 2002). The observations can be of different degrees: non-participation, passive participation, active participation and full participation (Spradley, 1980).

The participants (teachers and pupils) are all from the same Sámi compulsory school in Northern Sweden. The school provides education from preschool class to year 6, children aged 6 to 12. The study followed Swedish Research Council’s (2017) ethics considerations and guidelines and the participating pupils had their caregivers consent to partake in the study. The data was collected during a period of two years and during four visits to the school. Each visit lasted four to six days.

The data consists of observations of the daily activities with the pupils, as well as teacher meetings and other events of the school day. The participating observations varied depending on activity, and they were recorded by field notes, photographs, audio recorded interviews/conversations and children’s drawings. In the classrooms, both Swedish and Sámi languages were spoken, as the pupils’ knowledge of the Sámi language varied. However, when teaching was carried out in Sámi, the teacher translated and explained to the author afterwards.

The material was analysed by using a qualitative content analysis inspired by Erlingsson & Brysiewicz (2017) description, i.e., a repeated and interpretive process in which the meaning of a part can only be understood as related to the context. Based on the research questions, the objective was to identify recurring themes in the empirical material.
Findings

The initial analysis of the material showed that there were some specific artefacts that functioned as starting points for various activities related to technology, including

- Sámi footwear (Bellinge-shoes)
- Sámi Shaman drum

The activities connected to these artefacts, took place with year 2 and 3 pupils (8-9-year-olds). In the following descriptions of the technology activities, parts of field notes and photographs have been selected as illustrations of what was found significant for how the artefacts were implemented in the technology teaching. The quotations have been translated into English by the author.

Activity 1: The Sámi leather shoe – making threads of reindeer sinews

The traditional Sámi winter shoes are made of hide from the legs of the reindeer. Since the hide is thicker in different places on the reindeer’s legs, it is important that each piece is put in the right place. On the underside, the fur pieces are placed in two directions, so the wearer will not slip (Figure 1 and 4). The toe hook was originally for putting on skis.

Figure 1: A Sámi Bellinge-shoe.

Narratives such as fairy tales and myths are often used in the teaching in this school, and the teacher introduces the activity for the pupils by reading aloud in Sámi from a Sámi picture book, Silbámánnu “Silver Moon” (Horndal, 2016). The story is about a Sámi girl who is very good at spinning threads. One day, she is captured by Stallo, a well-known character in Sámi mythology. Stallo is a giant troll who eats people. However, the girl outwits Stallo by releasing one of her threads, all the way to the place she is held captive. She is rescued and Stallo is killed. The picture book contains illustrations of artefacts with an old history; Sámi clothing, Sámi shoes, a wooden spindle, a wooden milk bowl, a walking stick, and longbows. However, modern artefacts such as a snowmobile, binoculars, a walkie talkie, and electric power lines are also depicted.

The teacher gathers the pupils in a circle on the floor. She has brought an old Sámi wooden spindle – like the one found in the pictures in the book (figure 2). The teacher shows the spindle to the pupils and uses its Sámi name. She has also brought a bag with sheep wool and takes a wad of wool and rolls it against her leg (figure 3).
**The teacher:** “You soak it a little bit like this [with water] ... and put the threads over each other. Look, now it becomes a little bit longer! I can use these threads to knit a sweater.”

*Figure 2: A Sámi wooden spindle. Figure 3: The teacher rolls the wool.*

**The teacher:** “But if I'm going to sew shoes […] I need a strong thread.”

The teacher shows a Sámi winter shoe made of reindeer hide. She has also brought an object that looks like a bunch of yellow, thick threads.

**The teacher:** “What is this? Banana peel?”

**A boy:** "Sinews!"

**The teacher:** “Where are they from, the reindeer sinews? Where can you find them?”

**A girl:** “Behind somewhere.”

**The teacher:** “Yes, they are on their legs, so they can move.”

The teacher puts sinews on a wooden board and starts to process them with a rubber hammer (figure 5).

**The teacher:** “Look, now I have loose threads ... When they are this small, I soak them ... [she soaks the threads with some water from a cup], and then I spin them like this, against my leg.”
She puts several threads together and rolls them back and forth on her leg.

_The teacher:_ “Now it’s finished. Look, how nice! There are 12 threads ... I’ve got these from my mother [the sinews].”

The teacher passes some sinews to the pupils. She repeats the Sámi word for “sinews”.

_A girl:_ “I have sewn with sinews at home.”

All pupils are given the chance to work the sinews with the rubber hammer and then twist the threads with help from the teacher. The challenge is to let the threads split. The pupils explore the structure of their threads. One of the boys pulls the thread to see how strong it is and realise that it is very hard to break:

_A boy:_ “You can use it as dental floss!”

_The teacher:_ “Yes, if you don’t have sinew threads, you can use dental floss [to sew the shoe].”

Most of the pupils want to use the sinew threads as bracelets and the teacher helps them tie the threads around their wrists.

In the afternoon, the class watch an old documentary about the lives of the Swedish Sámi people. While watching the film, the teacher points out things that can be linked to the activity with the sinews, as well as another activity in technology they previously had carried out: building a model of a lavvú (a Sámi dwelling).

_The teacher:_ “Look, they used shoe hay instead of socks in the past.”

One of the children immediately respond to what the teacher said:

_A girl:_ “I have done that!”

By comparing past and present, as well as confirming what the pupils say, the teacher makes links between older technological solutions and newer.
Activity 2: The Sámi Shaman Drum

According to the teacher, the Sámi shaman drum has never been a “magic drum”, even if it was given that epithet by those who had the intention to eradicate Sámi religion. The use of the drum was forbidden, and the drums were collected and burned. Today, not many are preserved, but according to the teacher it is still a strong and important Sámi symbol.

The Sámi drum project starts with a visit to the new Town Hall, and the teacher gives the pupils the task to memorise what the handles of the doorway look like. Back in the classroom, the teacher introduces the technology project by showing pictures on the Smartboard. The first one is a photo of the handles on the Town Hall door (figure 6).

The teacher: “Why do the handles look like this?”

A girl: “Drums.”

The teacher: “That’s right! They are made of birch and the white is reindeer horn, and there are engraved signs. They look like the bottom of an old drum, which the Sámi used. And what did they use them for?”

A girl: “To know where to find reindeer grazing.”

The teacher: “Yes, it was used to see where to go with the reindeer, to make sure that childbirth went well, and where to find moose to hunt. With the help of the drum, they talked with the Gods and it was the Noaidi [the shaman] who used it. […] Then people from outside arrived. They were Christians and they said that [the Sámi] should not believe in this. The drums were collected and burned. One man was also burned when he refused to give up his drum. Some [of these people] thought the drums were nice … they brought them to Rome, Paris … Today only 71 remain. But last year they found one behind a stone. It had begun to rot.”

The teacher shows a picture of a drum decorated with bear teeth.
**The teacher:** “The bear was holy. It has a skeleton that looks like a human skeleton [...] every sign [on the drum] means something. The signs are popular today, but [people] do not know what they mean.”

The teacher presents pictures of drums decorated with illustrations of Sámi Gods, and talks about the different roles they had in the mythology. The pupils receive a sheet of paper on which the Gods’ symbols are depicted (figure 7). They are given the task to write down facts about four of them, the Goddesses who have their residence in the lavvú. In the conversations about the drum, the teacher and the pupils make connections to the lavvú activity. The fact that each technology activity is linked to many different perspectives and subjects can be interpreted as that the teaching is based on a holistic view of knowledge.

![Figure 7. Sámi symbols of Goddesses.](image1)

![Figure 8. Preparation of the Sámi Drum.](image2)

The teacher has prepared 12 frames, made of concrete to form cylinders.

**The teacher:** “We’ll be stretching hide tomorrow, but you have to prepare. Paint any colour you like. When you have finished and it has dried, you can paint symbols.”

The teacher gathers the pupils around a table and shows how to mix colours, and they start painting their drums (figure 8).

**The teacher:** “Here, I have a technical solution!”

In order to make the painted drums dry faster, she has fetched a hair dryer.

**The researcher:** “Is the drum ... “technology?”

**A girl:** “Yes, [it’s technology] because you can use it to find grazing for the reindeer and to cure diseases.”

While decorating the drums with symbols, the teacher and the pupils discuss the historical illustrations (figure 9). Just as with sinew thread activity, the teacher links the past with the present.
The teacher: “They depicted things that were important for them. What symbols could [be] on the drum if it was used today? A car? A computer ...?”

The following day, it is time to attach the drumheads to the drums. The teacher has brought 12 circular reindeer leathers. She gathers the pupils in a circle on the floor and demonstrates how the reindeer hides have been scraped with a specific tool and tanned in a decoction of water and sallow bark.

![Image of students working on drums](image1.png)

The hides are wet and kept in a plastic bag and the teacher explains this is to stop them from drying out. The pupils explore the structure of the hides and how stretchable they are (figure 10). The teacher then assists the pupils to attach the drumheads to the frames using a staple gun (figure 11).

The teacher: “But you will probably also have to fasten [the hides] with bolts and screws and attach a ribbon over. They will tighten as they dry.”

While waiting for assistance to fasten the hide, the pupils are told to draw a drum on paper. The teacher says they are free to decorate it with old symbols, but they can draw things that are important for them personally as well.

The teacher: “It was probably how they thought in the past too.”

Some pupils draw pictures of the Sámi Gods, of reindeer and Sámi dwellings, while others write names of relatives and pets. The drums are then left to dry (figure 12).
In both the described activities, the teacher’s pedagogy is characterised by a “show-and-copy” strategy. This can be interpreted as a natural choice since the technological knowledge linked to the specific cultural artefacts is collective and passed on from one generation to the next.

Conclusions

From the content analysis the following themes emerged:

- Cultural artefacts
- Links between past and present
- Myths and storytelling
- Collective knowledge
- Holistic view of knowledge
- Symbolic value

Technology education in this Sámi school can be described as strongly connected to specific cultural artefacts. Previous research indicates that too strong a focus on artefacts can have the consequence that the connections between artefacts, humans and culture are disregarded (Mawson, 2010; Siu & Lam, 2005; Turja, et al., 2009), but the findings in this study demonstrate the opposite. By using artefacts with a strong connection to culture and a focus on ‘how’ the artefact is used and ‘why’ (James, 2015), the activities become meaningful for the pupils. The artefacts are presented as having both physical and intentional properties (de Vries, 2005; Kaplan, 2009; Kroes & Meijers, 2002), and as being a result of cultural conditions (Ihde, 1990, 1993; Kroes & Meijers, 2002; Vermaas, et al., 2011).

There is also a strong link between past and present. Although the knowledge is old, it remains important and relevant. By using the cultural artefacts as a starting point in the teaching, the pupils are given the opportunity to see that technology is more than high-tech; it is an age-old tradition of problem solving, modification and adaptation to fulfil human needs (Lee, 2011). The teacher makes connections between older and newer technological solutions, which creates opportunities for the pupils to develop an understanding of the driving forces behind technological development and change and how objects in pupil’s daily life have changed over time (Swedish Agency for Education, 2018).

Myths and storytelling, are important teaching elements, frequently used to contextualise the technological content. The knowledge is to a large extent conveyed orally by the teacher but often, known to some extent, by the pupils. Their responses indicate that they have obtained
this knowledge in a context outside school. These findings are in line with Owuor (2007) who notes that indigenous knowledge and skills are often transmitted from one generation to the next through narratives, symbols and art. This also confirms previous research that suggests that narratives and stories can be used in technology education to contextualise the technological content (Axell, 2015, 2017, 2018).

The technological knowledge mediated in this Sámi school can thus be described as connected to inherited knowledge, but also linked to practical applications and skills (Keskitalo & Määttä; 2011; Keskitalo et al., 2012; Svonni, 2015). During the activities, the teacher and pupils frequently refer to activities outside school, which confirms that indigenous technology is collective and based on knowledge that has been developed over many generations (Bondy, 2011; Gumbo, 2018). Additionally, technology teaching is implemented by using a thematic approach, including other school subjects like Natural Sciences, Religion, History and Crafts. This confirms that the knowledge system is holistic (Keskitalo & Määttä; 2011; Keskitalo et al., 2012; Svonni, 2015). It also indicates technological literacy in this Sámi school is grounded on a holistic view of knowledge. Technological knowledge, activities and specific artefacts are attributed a practical value, but also given a symbolic value, since a common knowledge base in technology contributes to strengthening the children’s cultural identity.

To summarise, this study confirms that artefacts can play an important role in technology education (de Vries, 2005). The findings indicate that indigenous knowledge can contribute to broadening the horizons of technology education (Ankiewicz, 2016; Bondy, 2011; Gumbo, 2015; Lee, 2011; Marshall, 2000; Seemann, 2000, 2010; van Wyk, 2000). By using artefacts that are of importance to Sámi culture as a starting point, several of the objectives in the Technology Curriculum can be achieved.

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