Funds of Knowledge in Technology Education

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Abstract

When participating in technology education students require a range of academic, social and physical skills in order for them to collaboratively develop technological solutions to meet identified needs or opportunities. This paper reports part of a study that explores the role students' Funds of Knowledge play in contributing to learning in technology education in the primary classroom.

Funds of Knowledge are the developed bodies of skills and knowledge that are accumulated by a group to ensure that they can function appropriately within their social and community contexts (Lopez, 2010).

The study was undertaken in a primary school with 6 and 10 year old students. The data reveals that students used knowledge from their home and community to assist to make sense of their learning and to assist them in developing technological outcomes. The paper introduces two sub-categories of Funds of Knowledge and compares and the use of Funds of Knowledge within each sub-category between the two year levels and across a unit of work.

This study is significant because it highlights the use of Funds of Knowledge in technology education and examines aspects within Funds of Knowledge that are applicable to technology education.

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Introduction

This paper reports part of a study that explores the nature of learning in the technology classroom using a collaborative approach; more specifically it explores the role students' Funds of Knowledge play in contributing to learning in technology education in the primary classroom. The paper outlines the scope of the study and the data gathering processes. It then reviews relevant literature, particularly on classroom conversation and Funds of Knowledge, a term used by Gonzalez, Moll, & Amanti (2005) to describe knowledge and skills gained through community and family encultureation which students bring to their learning, in the classrooom. The paper introduces two methods participants used to gain knowledge and skills from their culture and community. These are Partipatory Enculturation and Passive Observation.

The Study

The aim of this of the study was to gain an enhanced understanding of the learning that influenced students when developing technological solutions with the purpose of answering the following research question.

> How do children's prior and ongoing experiences influence their learning and action when developing technological solutions?

The study took place in a New Zealand primary school and focused on six children in each of Years 2 and 6 (six to seven and ten to eleven year olds respectively). Over the period of a year, two technology units were taught in each class. At the conclusion of Round One, six participant children were selected to be full participants in Round Two of the study.

Three methods of gathering data were employed in Round Two. The first was in-depth and semi-structured recorded interviews between the children or the classroom teachers and the researcher at intervals during the project. . The second was audio recordings of the students as they worked in groups of three; recordings were transcribed and augmented with researcher observations. Student work samples were the third, allowing triangulation of data. The last round of semi-structured interviews with the students used Stimulated Recall with students' autophotographs. The whole school technology theme for Round Two was the Olympic Games. The technology task the students undertook was to design and develop props for use in the school production. In Year 2 this consisted of acting a traditional tale from Taiwan, and in Year 6 it was the Olympic Games era of 1896-1936.

After transcription, recorded conversations were analysed and coded. Initial data suggested four distinct stages to the unit: Stage 1-The Character and Function of props; Stage 2-Planning of Technological Outcomes (Props); Stage 3 -Creating a mock-up and Stage 4- Construction of the Props.

Literature Review

There are two aspects of literature relevant to this study. The first is the nature of conversation that advances thinking in an educational context and the second, community and cultural knowledge drawn on by students to assist their learning.

Learning and the development of new knowledge involves a process of deep collaboration and inquiry. Innovative solutions arise when people in groups draw on evidence and on outside explicit knowledge and combine it with tacit knowledge in response to authentic problems (Nonaka and Takeuchi, 1995). When people work together in problem solving situations they do much more than just talk together. They "inter-think" by combining shared understandings, combining their intellects in creative ways often reaching outcomes that are well above the capability of each individual. Problem solving situations involve a dynamic engagement of ideas with dialogue as the principle means used to establish a shared understanding, testing solutions and reaching agreement or compromise. Dialogue and thinking together are an important part of life and one that has long been ignored or actively discourage in schools (Mercer & Littleton, 2007). Structured conversations based on various forms of evidence can result in a real change of learning (Earl & Timperley, 2008), however having the conversations and the evidence is not enough. In such conversations participants are required to reveal what they believe and why. Community and cultural environments impact on this knowledge (Earl & Timperley, 2008).

Gonzalez, Moll and Amanti (2005) call explicit outside cultural knowledge mentioned in the above paragraph Funds of Knowledge. Funds of Knowledge are information, knowledge and skills students bring to learning from their culture, home and community. The literature states that knowledge from experiences and activities undertaken at home or within their wider community and culture of the students are brought into the classroom to contribute to the students engagement in and understanding of the lessons being taught (González, et al., 2005) is known as Funds

of Knowledge (FOK). The term was first coined by Gonzalez, Moll and Amanti in 2005. They suggest that it is the responsibility of each teacher to attempt to learn something special about each child they teach" (Lopez, 2010, p. 2). Generating an understanding of students and their families' Funds of Knowledge is one way teachers can do this.

The theory of Funds of Knowledge draws on the perspective that learning does not just happen but is a social process bound within a wider social context. People have wide knowledge, given to them through their life experiences. The knowledges that students come to school with can enhance their learning and facilitate useful interactions between knowledge found inside and outside the classroom The more teachers know about the home and cultural activities and experiences the better informed they will be to maximise learning opportunities and to make the most of knowledge and skills already accessible to some students (González, et al., 2005). Lopez (2010) and Fleer & Quinones (2009) also suggest that teachers can make more of the learning in their classrooms if they understand that students bring with them knowledge from their families, culture and background and that teachers can legitimise this knowledge through purposeful classroom engagement, "one can create conditions for fruitful interactions between knowledge found inside and outside the classroom" (González, et al., 2005, p. 20).

Findings and Discussion
The data from this study clearly demonstrates that students do use their Funds of Knowledge to contribute to their learning in technology. The data suggests that Funds of Knowledge were gained through two means: 'Participatory Enculturation' and 'Passive Observation '.

Participatory Enculturation
This involves being enculturated into an activity through engagement resulting in transferable knowledge. This engagement includes active participation, where a child is involved in the activity, and peripheral participation where the child is on the periphery of the activity but able to engage in the activity through questions and conversation. Gaining knowledge through Participatory Enculturation provided students with opportunities to know information their peers didn't and be involved in practices unique to their family and culture. Knowledge gained from these experiences can therefore provide them status or 'mana' (high status for Maori) within their peer group, and occurred through five means; family activity, afterschool activities, parents' occupation and interests, artefacts used at home and family social and cooperative practices. In the sections below each of these are discussed in turn and illustrated with a typical example.

Family Activities
Evidence of Participatory Enculturation through engagement in a family activity occurred very early in the props unit. As a part of the project the students were given a disposable camera so that they could record their process of developing a prop. The students' first task was to ask a friend to take their photograph so that the first photograph in each camera was that of its owner. Moke (Mo) was concerned that her camera was broken as this was her first experience with a non-digital camera, however Duncan (Du) was able to reassure her as he had experienced how the photos are released

    Mo: Wendy my camera is broken
     R: What makes you say that Moke?
    Mo: I cannot see the photograph inside the camera.
    Du: Oh, it's ok, you just take them to The Warehouse and they hit them with a hammer and the photos jump out.
     R: How do you know that Duncan?
    Du: My Dad had one and we went to The Warehouse and that's what they did

This conversation illustrates that knowledge gained through Participatory Enculturation gave Duncan the confidence and status to reassure his classmate that her camera was not broken. It demonstrates that use and knowledge of technological devices gained from home and community assist students' confidence in their use.

After School Activities
The data suggested that students brought learning from afterschool activities to assist them in understanding the character and function of props. After school activities are defined as activities that students do independently of their family. Typically going to external teachers for lessons or tutoring, playing sport or undertaking hobbies by themselves. When researching props much of the information the students came across was from the United Stated of America. This is illustrated in the example below. Alan (Al) explained to the researcher how he knew the symbol ″ stood for inches. He cited the reason for knowing about this symbol (not taught in New Zealand schools), through his active participation in War Gaming on the computer. He also indicated that the knowledge may have come from his father.

> R: 13 and a half something. What does that mean?
> Al: Inches
> R: How do you know that, Alan?
> Al: It's like probably, I just know that from my father
> R: But how did you know there's, you said inches. I can't see inches anywhere on that
> Al: It's those two things. That's what inches is.
> R: How do you know that?
> Al: Umm, because I do war gaming and that's what they use for inches

The above extract illustrates how the drawing on information gained through participation assisted in understanding and interpreting information relating to research in another area. It is a requirement in technology to interpret designs of others; this extract demonstrates Alan's ability to interpret a symbol of measurement not used in his school environment but one that he uses in his home environment.

Parents' Occupation and Interests
The significance of the role of parents' occupations in what the students bring to their learning and that students use these Funds of Knowledge to position themselves as an expert and to gain respect or 'mana' (a Maori term used to describe a person who has status and respect in their community) from their peers became evident in the data. This was illustrated by three Year 6 children in the 'microphone' group, as they discussed suitable materials for their microphone. Alan mentioned his Dad was a racing car designer and had a workshop at home. Dougal chipped into the conversation in a competitive manner explaining that his Dad has much more than blocks of wood because he worked in the construction industry. They had decided that the head of the microphone could be made from wood.

> Do: My Dad owns a whole yard of everything. He's got lots of things, yeah. He's a drain layer. He's an excavation worker. He's a construction builder. He has a yard, a whole yard.

The conversation illustrates that students use their Funds of Knowledge to position themselves as an expert and to gain respect or 'mana' from their peers. Understanding potential construction materials is a significant aspect to planning technological outcomes.

Artefacts Used at Home
The students also deployed knowledge gained through interaction with artefacts in the home environment. This was illustrated when Minnie and Dougal were problem solving how to hold the

head of the microphone at the correct angle before attaching it to the stand. Dougal's photograph in Figure 1.1 shows Minnie holding the mocked-up version of this. The researcher approached them and asked what they are working on. When trying to explain to the researcher what they were doing Dougal used an example from his home computer a docking station as illustrated in Figure 1.1 however he refers to this as a 'whaling' station by mistake.

R: How are you going to attach, so what is this going to be?
Do: The bass)
Mi: It's the base) [together]
R: I know it's the base and it's to make it stand up but what does it actually do?
Do: It's going to be like a whaling station at the back and um it's like, its going to have like glue around it to stand by itself

Microphone head

Connector between base and standdocking station

Figure 1.1: Dougal's auto-photograph of Minnie holding his microphone head and docking station (holder)

Figure 1.2: An example of a computer docking station image from http://shop.ebay.com.au/items. Downloaded 21 September 2011

This extract and associated illustrations demonstrates how students made use of artefacts they knew, understood and used at home and in their community to make sense of learning undertaken at school. In this case Dougal employed an idea of one thing slotting into a specific place designed to hold it, to assist his design concepts and his explanation of his and Minnie's design.

Family Social and Cooperative Practices
Funds of Knowledge deployed by students were not only artefact and process knowledge and skills directly linked to home and community culture but they also deployed their community and family social skills and knowledge. This is relevant to planning design ideas in technology education because students were frequently required to design technological outcomes cooperatively and collaboratively. The next extract is a case in point, as these three Year 2 students had to agree on one final design. Rex deployed social Funds of Knowledge as he worked with Issy and Debby on the plan of their fish. Issy and Debby were having trouble deciding on the colours of their flying fish, and who decided what. Rex attempted peacemaking by deploying a strategy his father used at home.

Dy: I like the blue one.

Is: I like the green one.

Re: You can have the blue wings, the one there. The one of yours but just the wings. What one do you like?

Is I want the body.....

Dy: But that one, yeah, have the body but not the face and I'll have the face and the

Is: But I'm drawing the face. I'm drawing the face

Re: No, that one. That one, eh

Dy: No.

Re: That one

Is: Yeah

Dy: No

Is: Yes. We like it so there's cause

Re: What I used to do is if you there was two and there was one, so I did this, be cause my Dad always says, 'which one' and then the other two wanted two and then if there's one person who likes it, then we, we don't like it though,

Is: [very softly] you just have to do it

The data suggests that students gain knowledge from their home and community through participatory enculturation. Learning through Participatory Enculturation involves the students in interaction with the context of learning. This can involve dialogue with participants, active engagement with materials, activities and artefacts, and practices that are an integral part of living in a community. The literature suggests that learning through active engagement is effective. Turnbull (2002) found that learning embedded in an authentic context proved more effective than learning in contextual isolation. Hennessey (1993, p. 15) suggests learning is most successful when embedded in authentic and meaningful activity, making deliberate use of physical and social context". Rogoff's (1990) theory on cognitive apprenticeship methods of learning suggest that the enculturation of students to authentic practices through activity and social interaction facilitates effective learning. Mercer and Hodgkinson (2008) suggest that communication can be either interactive, verbal participation of both parties or non interactive verbal participation of the teacher only. Conversation in Participatory Enculturation would be of the interactive nature.

This study shows that students gained knowledge through Participatory Enculturation in a number of ways, including engagement with parents' work and recreational activities. González, Moll and Amanti (2005) state that by drawing on household knowledge the students' experiences are legitimated and thus authenticating the nature of classroom activity.

Passive Observation

This second sub-element refers to learnt knowledge obtained through passive observations where the students were non-participatory observers; for example through watching movies, television or reading books. In this method of gaining cultural knowledge and skills, the students did not interact directly with the knowledge source. The data suggests that students used knowledge gained in a passive observatory role and applied it to the learning that took place in their classroom, which illustrates students were able to transfer knowledge gained through passive means to inform their technological practice.

The students were able to locate technology in historical and cultural contexts through Passive Observation. There were two aspects of historical location identified in the data. The first illustrated below, was that the students were able to understand that props assisted in the historical location of a play or setting. The students were given a range of photographs of play props. As Minnie (Mi) talks to the researcher (R) she recognises a cart. She knows they are from the past as she had heard about them in the song Little House on the Prairie- set in pioneer times in the midwest of the United States of America.

Mi: Ohh, it's from the olden days, a cart or something
R: So when do you, when did they use them?
Mi: Probably like a hundred years ago or sooner, like. There's that song, Little House on the Prairie

The second was that students understood the function and form of an artefact in a historical setting. This is illustrated in the next extract. The students' main task was to develop props for the Olympic Games from 1896 to 1936. Alan (Al) and Dougal (Do) were able to recognise microphones from this era as they had seen on television and the movies.

R: So how did you know that microphones looked like this?
Al: Because umm, I saw a thing on TV
Do: Yeah, like on movies and stuff

This extract demonstrates that the knowledge the two boys had about microphones from the past came from watching television and movies, both activities commonly associated with their culture. This demonstrates that in technology education the students used prior observation to assist their personal construct of an object from a different era.

Students also gained an understanding of the purpose and role of props through Passive Observation. In Year 2 students listened to Julian (Ju), the props manager from the local theatre. Julian explained the purpose and function of props. He illustrated his talk with a range of props his company have used in the past. He discussed how each was used in situ. In the first extract Issy (Is) is reminded of a show she saw in the previous school holidays. As an audience member she observed one particular prop used in a variety of ways.

Is: I saw a show about a magic truck in the holidays and it changed [voice trails off
Ju: Ohh, 'Auntie McDuff's Magical Trunk' [name of the performance]. That was the show that we did in the last school holidays. Yeah, so what they did was hey had this big box and they opened up bits of the box and when they opened up the front bit of the box, they put umm, a, a, they used a blackboard and they put a little drawing of some wheels at the bottom of the box and then that prop became a train or a car and then they'd close another bit and they'd open another bit and they'd put umm, a flag on it and it would become a boat. So sometimes...
Is: ....and a dog
Ju: and it became a dog at the end. Yeah. So sometimes you can use a prop a lot, lots and lots of different ways.

This extract illustrates that Issy used the knowledge she gained from attending the theatre to assist her understanding of the definition of a technological outcome. Her input into the conversation indicated that she may have understood that the truck, as a prop, had multiple purposes.

The students continued to deploy knowledge from passive observation to assist them in the construction of their designs. This occurred when students were problem solving possible solutions to design issues thus facilitating the construction of their designs. They deployed information learned through the watching of movies and television.

When learning through Passive Observation, the students were only observers and unable to interact with the suppliers of the knowledge. Typically, this came about through reading, watching television, movies, or theatre. The data suggests that learning in technology education, obtained through passive means, is later deployed through active authentic means. These findings are somewhat surprising when taken in light of much of the research on effective learning. At the time of actual learning for these students, the context was not embedded in authentic meaningful activity; however, we can see that students deployed knowledge gained through these means to

inform their practice, thus authenticating its deployment rather than the actual learning. Mercer & Littleton (2007) and Shields & Edwards' (2005) argue that teachers need to engage in quality dialogue with students and parents to help them make sense both cognitively and experientially of the world in which they live and work. By doing this, teachers may be able to facilitate deployment of knowledge and skills learning through Passive Observation. González, Moll and Amanti (2005) suggest that teachers need to know and understand the communities and cultural practices of their students. By having an understanding of the activities their students are not only actively but also passively engaged in will, assist teachers in maximising learning opportunities in the classroom by actively making explicit connections to these practices and facilitating the deployment knowledge gained.

Conclusion

The study identified two major methods for gaining Funds of Knowledge: participatory enculturation and passive observation. If teachers are aware of the activities that their students are engaged in at home and in their communities, they can then assist their students to make authentic links between home and school.

The study showed that learning through Participatory Enculturation occurred in a number of conduits: parental occupation, family activity, students' afterschool activity, artefacts used at home and through social behaviours and guidelines implemented at home. The study also found that learning through passive observation played a role in students' learning in technology in that they were able to deploy this knowledge to assist their own and other's technological practice. Funds of Knowledge had considerable impact on learning as they assisted students' understanding of the historical and cultural location of artefacts and of practices of significant adults in work, recreational and in social settings.

This study attempted to answer research questions regarding the acquisition of Funds of Knowledge in technology education. The findings in this study are significant because they indicate that students bring knowledge gained at home and in their community to technology education and use it to assist them in understanding and contributing when developing technological outcomes in a collaborative manner.

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