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ABSTRACT

The focus of our research project was the question Can children’s creativity be enhanced by including a period of non-conscious cognitive process (NCCP) time? During this non-thinking time the brain makes connections between independent ideas, forgets inappropriate responses, and makes available more relevant responses for problem solving. The research generated cases of several primary school classrooms as the teachers incorporated NCCP time in their design technology sessions. Children were observed and teachers interviewed about their perceptions of children’s creativity as the children designed and produced recycling devices. The cases revealed an optimum time frame of several days for non-conscious cognitive processing. These findings have implications for teachers of technology who assign the same day and time each week for technology learning. During the non-task time, which included the NCCP time, children were able to discuss their ideas with family members. As children learn in socio-cultural contexts, these discussions can be fruitful. The teachers indicated that peer discussions also played an important role after the generation of designs.

Keywords: Children’s creativity, design technology, non-conscious cognitive processing (NCCP) time.

INTRODUCTION: CREATIVITY IN TECHNOLOGY EDUCATION

Creative problem-solving is an integral component of technology education in schools (Barak & Goffer, 2002). Peterson (2001) contends that “Creativity is closely associated with advances in technology, and it is logical that an important aspect of technology education is the development of creative abilities”. He recognizes that creativity in technology education relates to students being actively engaged in generating novel products as solutions to technological problems. The broad range of topics and the versatility of approaches that can be included within the technology classroom provide a range of opportunities for the technology teacher to implement programs aimed to foster higher order thinking skills – in particular both analytical and creative thinking. A structure that employs a careful balance between content knowledge and process (Jones, 1997) but also successfully incorporates higher order thinking should be implemented within the technology classroom (Middleton, 2005).

In the technology process, it is through the imposition of the unsolved problem that stimulates the thinking student to discover a viable solution to satisfy a human and/or environmental need. This aspect of the technology process suggests that the learner seeks innovation in a practical context. Creative and analytical thinking support cognitive processing in the context of student problem-solving and therefore are compliant in sustaining the development of the technological knowledge, skills and values, according to Howard-Jones (2002) who proposed a model of creative cognition for supporting strategies.
that foster creativity in the classroom. Howard-Jones also suggested that when thinking creatively, children generate new ideas through remote associations and brainstorming and this type of thinking is enhanced when attention is allowed to wander in a relaxed and uncompetitive environment. Other researchers (such as Forgays & Forgays, 1992) have also indicated that being involved in unrelated activities have promoted solutions to problems and increased children's creativity. Larger numbers of initial ideas also increased the likelihood of children developing a more original final solution (such as using brainstorming sessions). To allow the generative state to occur, Howard-Jones (2002) suggested the use of a period of time in which student attention is not focused on the technology task. This time allows the individual to be able to sub-consciously combine concepts and produce novel combinations of remotely-associated ideas. It was this idea of a non-conscious cognitive process (NCCP) time that was tested in a study by Webster, Campbell and Jane (2005) in an intervention program undertaken in primary technology classes. Reflection on that research has enabled us to theorize how design technology education with a built in NCCP time can contribute to children’s creative thinking.

AIMS OF THE RESEARCH

The overall purpose of the research was to investigate the notion that children’s creativity can be enhanced through the inclusion of a non-conscious cognitive processing (NCCP) time in the technology process. The purpose of the research was two-fold. Firstly, we aimed to explore the structures, relationships and content of the technological experiences at several school settings. This exploration entailed engagement of the interpretive categories of the social, educational and professional values, beliefs and attitudes of the main participants. Secondly, we aimed to study how the children’s creativity was enhanced through the introduction of an intervention strategy – that of NCCP time.

RESEARCH DESIGN

In our preliminary discussions we decided that a case study approach would be most appropriate as our basic intention was to seek to describe and develop an understanding of the setting and the children’s creativity, rather than for the research to be an active agent in evaluating outcomes or instigating change. However, an intervention process was also required, as in discussion with our teacher participants, we realised that what we were suggesting, was something new and different to their normal classroom practice. Accordingly we developed case studies of each of three sites – primary schools in the state of Victoria, Australia, by gathering data to describe the experiences of the children and teachers, and to illuminate the approaches to learning and the developing creativity. Both the perspectives of teachers and children were sought. Since this interpretive study was ‘bounded’ in both time and space, we identified the case study as the most appropriate research approach due to its capacity to accommodate the complexity of the situation as it actively engages the changing dynamics of the setting and its social aspects (Campbell 2000 p. 80). Additionally we recognized the validity and compatibility in this study of Stake’s assertion (Bryman 2001, p. 55) that ‘The utility of case research to practitioners and policy makers is in its extension of experience’; and that case studies centre on ‘…research on a single case with a view to revealing important features about its nature’.

Each setting or site we investigated was a ‘bounded system’ in several ways. From the physical perspective, the system is located as a dedicated area and described by the specificity of the technology task within the classroom environment. One school was in an urban area, one in a rural area and the third in a regional centre. Each site is also bounded in that we collected information over a specific period - a snatch in time. The research approach needed to be sensitive to the constraints and opportunities that presented within the research study. Reflection on the data enabled us to provide an interpretation of the
learning related to enhanced creativity exhibited by the children as evidenced by the technological products they produced within the context of each site.

Participants were primary school children and their teachers, situated in three schools across the state of Victoria, in metropolitan Melbourne, regional Geelong and rural Mornington Peninsula. Two teachers (at year three or four level) from each school agreed to participate in the study and their role was to teach a technology unit across at least four lessons. Surprisingly to us, most of these teachers had no practical experience teaching technology, although they had taught science. Accordingly, professional learning sessions were conducted with the teachers to ensure that they were aware of what classroom technology was in practice. These sessions led to a change in their approach, with most teachers incorporating some form of brainstorming at the start of the process. Another change in practice was allowing the children time during the planning and construction time to ‘think through’ their ideas and problem-solve with others. Problem-solving thinking is an important aspect that can lead to enhanced creative thinking. The study was conducted in an authentic setting – the normal classroom in which children’s learning occurred. The children worked in pairs or small groups to address the following open-ended design brief.

Design and make a model of a small recycling device for the home or garden. Your product should be made mainly from recycled materials.

The teachers were requested to incorporate NCCP time between session one - when the design brief was introduced and the brainstorming (or familiarisation process) was undertaken - and session two. In practice the NCCP time varied from school to school, depending on the classroom timetable and time constraints. The length of NCCP time was: School A~ 5 days, School B ~3 days, and School C~ 7 days for one class, 14 days for another class. In this way the teachers gave children thinking time or extended periods where discussions between them were encouraged. Teachers also allowed modifications after the evaluation time. Children were encouraged to document their ideas in a journal - My Thinking and Ideas Book, as a means of recording previous ideas and being able to return to them should they wish. The journal belonged to the child and was not assessed by the teacher as part of the process. This approach gave the journal some legitimacy in the children’s minds as a personal tool rather than a teacher requirement.

As it was not our intention as researchers to take an artefact focus, we studied the generation of new or different solutions as a function of creative thinking, by taking account of the children’s initial suggestions for their recycling devices, both written and drawn. Evidence of the children’s involvement in the technological process was obtained through their documentation of their drawings, ideas, sources of ideas and reflections in their journal - My Thinking and Ideas Book. We spent time in the classrooms observing the children as they engaged in the technological process, and listened as the children shared their technological knowledge during presentations to their peers. Informal conversations occurred naturally with the children as they eagerly shared with us how they made their recycling devices. Photographs of children’s designs were taken, both from the point of view of illustrating any novel or creative idea but also as a validation to the children of the value of the task. Once the technological unit was completed, we carried out informal interviews with the teachers who revealed their perspectives of the influence of NCCP time on children’s creativity.

RESEARCH RESULTS

In responding to the Design Brief, most children indicated that they read books and spoke with their parents, teachers and each other, in an attempt to think of something that was new, or at least different, to what was currently available on the commercial market. Many took examples of familiar items and attempted to modify them so that they were more efficient or
'better'. Some tried to think of an entirely new way of approaching the problem or issue. As part of their routine classroom studies, the children had a strong understanding of the background information about recycling and environmental health. For most of them, the topic was sufficiently familiar that they did not need to have additional information. However, the teachers did spend some time brainstorming both the idea of recycling and discussing aspects of the design task required of the children. The following comments are representative of the teachers interviewed.

- Children were frustrated with that [NCCP time] because they wanted to get started.
- In hindsight, a week for incubation [NCCP time] was too long.
- Once they had set up what they wanted to do…very, very rarely did they change that idea. The kids that changed mostly were the more practical kids.
- Unexpectedly several children who had not been observed showing creativity prior to the task, had generated very unusual designs.
- There were ‘quite a few’ children who needed to change their designs to accommodate functionality.
- Additionally, children had to modify their designs based on limited resources or limited personal manipulative skills. This they found particularly frustrating – having an idea but not being able to produce from it.
- There were not many new concepts that the children could generate, but there was a diversity of ideas within a particular topic.
- The children needed to have an adequate understanding of the topic. Children who possessed a broader knowledge of recycling appeared to produce devices that were different.
- Allowing children to take their ideas home was particularly helpful as this gave them time to discuss ideas with family members.
- Some children showed original, creative thinking, while others ‘shared’ ideas with their peers and then made modifications.

The children’s creativity was demonstrated in various ways. How the children approached developing the design of the product indicated an engagement with the creative ideas. The novelty aspect was evident in some of the children’s designs. One Year four teacher commented; “some children came up with their own, original ideas (e.g. theme park for worms!). Some designs involved a variety of processes (e.g. crushing, rolling etc.) that were creative”. The designer of the worm farm wrote in her journal.

My worm farm recycles food scraps. It has a playground and a sorting belt that sorts out scraps. I was thinking how to construct my model and what to use. The worms break down the vegetables and turn it into compost. My worm farm looks good because it’s different to everyone else’s project. It is different to what I’ve seen because it involves my own ideas. If I had different materials I would make an improved version. I think my project is a great success and I’m proud of myself (Year four girl).

Throughout the construction of their devices, the children were actively involved in a problem-solving process – often having to devise new solutions. Some children created novel ideas, but were hampered by the limitations of resourcing and even expectations of their age group. One child had a very creative idea to clean a cat litter tray using a magnetic force. Unfortunately, practicalities forced her to abandon her original creative idea and to move to something that was ‘do-able’. Another child, at a different site, wrote in his journal that he was so frustrated by not being able to complete his fire-log maker machine as he wasn’t allowed to use electricity and didn’t know how to do that part anyway. In the end, he created a box with specific instruction on the outside, but no content, because he could not include any machinery.
DISCUSSION: SOCIAL CREATIVITY AND NCCP TIME

In that intervention program, at all three sites, teachers took time to introduce the task, to brainstorm or to undertake familiarization activities prior to the children commencing the project. Time was spent clarifying with the children what the design brief and the specifications meant. Teachers were aware to leave the task as open-ended as possible so that they would not impose further restrictions or specifications outside the design brief itself. This allowed children to interpret the task in their own mind and by their own set of understandings and experiences. We observed that children already had strong content knowledge of environmental education – refuse, reduce, reuse and recycle was a theme that had already been introduced to the children previously.

During the interviews the teachers commented that allowing the children to discuss their ideas with family members was beneficial. This valuing of community orientation to learning, rather than viewing learning from an individual's perspective, is consistent with Gordon’s phenomenological study of eight families involved in Starwatcher activities. Gordon (2006, cited in Fleer & March, 2009) found that engagement in learning was enhanced through experiential learning when children and adults participated in hands on activities associated with astronomy. Our study identified that the provision of time between sessions allowed children to discuss their ideas amongst their peers and family members, thus deepening their content knowledge (as a prerequisite for creative thinking) and allowed NCCP time to be activated. In so doing, shared expertise and social creativity came into play. In her study on expertise and creativity, Reilly (2008) expanded the notion of expertise by not restricting it to being situated in an individual. Rather it "can emerge from a system of shared experience" (p. 59). Our study revealed that the path from the initial introduction of the design brief to ideation involved two or more people over an extended period of time. The NCCP time was occurring outside these social interactions, but providing further 'new ideas' to be discussed with others. Thus the shared time can facilitate social or collective creativity. Barrett (1999,
cited in Reilly, 2008) points out that “Social creativity has come to mean the functional and dialogic relationships between persons concerning a task embedded in a specific environment, which is nested in a socio-historical frame” (p. 64). In our study, when the children worked together in pairs or small groups on the technological task, language became a tool of creativity. Therefore dialogical interaction in the context of technological activity can foster creativity. Solutions to problems can emerge through conversations between group members. So the ‘copied’ ideas that are then modified can be viewed as part of a social creativity process. Even for those children who tended to work alone and appeared to generate their own novel ideas, the social context would have provided additional stimulus for creativity.

CONCLUSION

In undertaking this research, our initial aim was to ‘enhance children’s creativity through the inclusion of a non-conscious cognitive processing time (NCCP) in the technology process.’ This was a distinct intervention. We acknowledge that other factors such as brainstorming, task criteria, children’s knowledge, learning dispositions and higher order thinking practice all aid a child in the development of their creative thinking. These other factors became apparent at the time of talking with the children and teachers about the entire process. While we can definitively state that the inclusion of NCCP time enhanced creativity, the other factors were present as part of normal classroom practice. This is a very positive outcome of the research – that many of the pre-conditions necessary to enhance creativity are already present in some classrooms.

The use of the non-conscious cognitive processing (NCCP) time cannot be ‘taught’. Rather it is activated at the individual level through free-flow mental states. Remote mental connections can be made non-consciously which produce unusual and original ideas. The implication of our study for teachers is that when NCCP time is allowed for in curriculum planning, and incorporated as part of the technological process, novel ideas and creativity are enhanced. With the provision of NCCP time comes a period of non-task time when children are given opportunities to informally share their fledgling ideas in a social context. Teaching design technology in this way can contribute significantly to enhancing children’s creativity.

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REFERENCES


