Gender Aspects Associated with Teaching Design, Make and Appraise in an Early Years Classroom

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RESEARCH

Abstract

A case study was conducted in an early years classroom in which a Design, Make and Appraise (DMA) program of activities was being implemented. Arising from the study were a number of structural and organisational issues. One issue of significance that emerged was that DMA was seen to have the potential to assist teachers to work towards a more gender-neutral and inclusive curriculum. A brief overview of the literature will first be presented and then this paper will explore a number of gender aspects associated with the DMA program observed. Some of these aspects were concerned with an examination of the children's general level of technological awareness and background. The frequency and gender of teacher-child interactions observed as well as the teacher's handling of the safety issue will also be considered. The paper will conclude with mention of some of the gender implications for teachers who may wish to implement DMA activities in their classrooms.

The Australian Education System

In South Australia, the majority of children commence their formal schooling soon after they turn five years of age and generally spend their first twelve months of school in a reception class before commencing year one. In primary schools, components of design and technology have always been part of the primary school curriculum, but it is only very recently that design and technology has been given any formal recognition (Donnelly, 1992).

Some states had previously released separate technology statements for the years of compulsory schooling (see for example, Crawford, 1988; New South Wales Department of Education, 1989). New South Wales subsequently decided to combine technology with their science statement – *K-6 Science and Technology Syllabus* (Board of Studies, 1991). The ACT has school-based curriculum, each school there is responsible for formulating its own technology curriculum. In Western Australia they have opted to link the concept of enterprise with technology (Education Department of Western Australia, 1994).

Introduction

The word *technology* is the generic term that encompasses all the technologies people develop and use in their lives (Education Department of Western Australia, 1994). Four interdependent strands of learning in technology are described in *Technology – A Statement on Technology for Australian Schools* (Curriculum Corporation, 1994). They are:

- designing, making and appraising (DMA)
- information
- materials
- systems.

According to the 1994 statement, all learning in technology involves DMA. Students explore, apply and develop information, materials and systems. The relative emphasis on the other three strands varies according to the needs of students and the nature of the programs and activities. A more detailed definition of the DMA strand refers to those opportunities presented to students which develop technological capability through planning, developing and refining design concepts; selecting appropriate tools, materials and processes for particular design purposes; carrying designs through to completion; and appraising the outcomes (Education Department of South Australia, 1990).

Gender differences are the focus of much of the research that deals with children's technological capabilities. The perspective provided by technology is especially suited to the study of gender (Layton, 1987). According to Hill and Wheeler (1991) two of the most significant areas for research in science and technological education in the 1980s were constructivism and gender. In the early years of schooling gender appears to be a contested issue, with much conflicting research about whether or not gender differences occur at an early age (Browne, 1991; Eccles, 1989; Weiner, 1991). A number of gender issues relate to teaching and learning DMA. Girls do not seem to have the same chance to develop an understanding of technological concepts, whereas boys learn through their tinkering and playing with construction sets and mechanical toys (Brown, 1989, 1990; Peck and Dick, 1989).

By the time that girls leave primary schools, most appear to have already developed the attitude that technology is not for them. Many appear to lack the confidence to readily participate in technological activities and thus inhibit their chances of eventually competing in the work place against men for high status, highly paid, hi-tech occupations (Eke and Gardner, 1991). Societal gender expectations through sex-role stereotyping seems to be unwitting and unconscious and is probably deeply embedded in the social life worlds in which the children are growing up (Smithers and Smithers, 1984).

The issue of gender inclusive curriculum materials has been addressed in a study about the development of technology materials for primary schools (Kinnear, Treagust and Rennie, 1991). Teaching materials need to be attractive and effective for both girls and boys. Different students have different interests and students' existing knowledge is also an important consideration (Jones and Carr, 1992). The National Curriculum for Technology in England and Wales states that all children during their compulsory years of schooling must engage in design and technology activities that require the use of a range of materials that encompass food, fabrics, construction materials and graphic media. The use of such a broad range of materials should help overcome some of the restrictive traditional views about which aspects of technology are appropriate for boys and which are for girls (Bindon and Cole, 1991).

It has not been possible to cover all topics from this brief overview from the literature of gender and DMA. For example, mention could have been made of children's and teachers' perceptions and attitudes towards technology. Attention shall now turn to the study of the implementation of DMA in an early years classroom. The research was initially guided by the following three questions:

1. What are some of the factors that contribute to the effective implementation of a DMA program in an early years classroom?

2. What are some of the underlying structural and organisational issues of the classroom environment that appear to emerge during the implementation of a DMA program in an early years classroom?

3. What are some of the possible implications for classroom teachers that arise out of these identified factors and issues?

Methodology

The study focused on a single early years classroom in which a DMA curriculum was being implemented. The teacher was Jill (a pseudonym) and the class consisted of 26 five year old children in their first year of formal schooling. In order to investigate the initial research questions, a qualitative case study that was both descriptive (of the classroom setting and situation) and interpretative was conducted (Peshkin, 1993). The initial research questions underwent further modification and refinement as the data collection and interpretation process proceeded. The mainly qualitative approach also included obtaining some quantitative data in order to provide some background information about the selected early years classroom and the children's current level of awareness and exposure to technology.

The data for this study was collected while working in the classroom as a participant observer over the third school term. Observations took place every Wednesday morning, in the period between morning recess and lunch time, for a total of ten weeks. A variety of data sources were used and included detailed field notes, debriefing sessions with the class teacher following each session, audio taping of all sessions and video tapes of some of the sessions during term three. Photographs were taken of completed models and informal interviews conducted with the participants throughout the period of the study. From the assembled data a detailed narrative description of the term three DMA program was compiled. During the data collection phase emerging factors and issues (some of which led to the need to acquire additional data) were identified.

It was necessary to deliberately seek out confirming and contradictory evidence from

the multiple data sources (Erickson, 1986; Yin, 1989). This process was assisted by employing inductive analysis (Abell and Roth, 1992) in which repeated examinations of field notes, audio and video tapes, interview transcripts and documents led to the development of categories for organising the data in order to report the findings. Some aspects of the data analysis were conducted collaboratively with the class teacher who was the focal informant (Abell and Roth, 1992). Following each of the individual DMA sessions, a debriefing session with the teacher was held. The teacher was also asked to read several drafts of the case study and to make critical comments about the contents. This ensured that any obvious misinterpretations or misunderstandings were corrected.

School profile

Highfield junior primary, where the study was conducted, is a state school situated in a leafy, reasonably affluent suburb of Adelaide. The junior primary (reception to year two) and primary schools (years three to seven) share a common campus. At the time of conducting this study there were 307 children enrolled in the junior primary school in reception through to year two. There were twelve classes, five of which were taught by tandem teachers sharing the same class. On the staff there were a total of twenty female teachers, which included specialist teachers in music, LOTE (Languages other than English, e.g. Chinese, Greek and Italian) and ESL (English as a second language) and Farsi (mother tongue program). The average age of the teachers was between 40 and 50 years. Approximately 16% of the students came from non-English speaking backgrounds and approximately 6% of the students were on what is called 'School Card' (parents of limited income who are means tested to receive some State Government financial assistance).

Description of the DMA program

The DMA program for term three consisted of ten weekly sessions. The first three sessions observed served as an introduction to DMA and were used to teach the children some basic science concepts about levers; pushes and pulls; and inclined planes. In the next session the children were introduced to DMA activities using commercial plastic construction kits when they were asked (in pairs) to design, make and appraise models with wheels. For the next activity the children designed, made and appraised their own models with wheels using various consumable materials. This activity occupied the next two sessions. The final DMA task for the term involved the children working in groups for three sessions. During these three sessions they designed, made and appraised pieces of play equipment that formed part of their group's model of a playground. The last session for the term was devoted to evaluating the term's DMA program.

After the children had completed their group tasks for session three, Jill brought the children back together and proceeded to conduct a class demonstration of other properties of inclined planes. Individual children were selected to roll a toy car down an inclined plane that had the same incline but different types of surfaces such as carpet, aluminium foil, vinyl floor tiles, plastic and water. Pam, one of the girls selected by Jill to release the toy car, inadvertently placed the car backwards on the inclined plane. Although the rest of the class protested, Pam did not seem at all aware that she had the car around the wrong way. She could not understand what she had done wrong. It was clear that she was not familiar with toy cars.

After the children had been given sufficient time to draw their designs in session five, Jill had all the children gather back on the carpet and she then proceeded to systematically explain to them the safe use of most of the tools from the portable tool board. These included G-clamps, spring clamps, glue guns, bench hooks, cutting mats, hole punches, F-saws and hand drills (two of which were fitted to stands). The girls' ability to use these tools seemed no different to that of the boys.

Because I wanted an overview of the children's current level of science and technology awareness, I administered the Draw a Scientist Test (DAST). The children enjoyed drawing their pictures of a scientist. Eleven girls drew female scientists, while one girl drew a male scientist. A similar scenario occurred with the boys in which thirteen boys drew male scientists and one boy drew a female scientist.

In order to gain a broader background picture of the children's technological awareness and exposure, I conducted interviews with each child. During these interviews I asked them four questions concerning their favourite toys, computer and video access at home and vocational aspirations. I also used the opportunity during the interview to ask them to explain any aspect of their DAST drawing that might have needed clarifying. I asked each child to name their favourite toys in order to discover any possible technological interest. Of the girls' responses, six named their teddy bears, four dolls and two animals. The boy's replies were more varied and tended to indicate a choice of toys that are generally more associated with technology. Four boys named their teddy bears, three animals, three transformers, two computer games and two cars.

Sixteen told me that they had at least one computer at home. Of those children with a computer at home, ten were boys and six were girls. Without exception they used them for games. Approximately one third of the class indicated that their parents owned a video camera. I also asked the children what they would like to do for a job after they left school. The purpose of this question was to see how many had aspirations that involved hi-tech vocations. An interesting range of responses were given. The girls mentioned: author, cleaner, doctor, nurse (2), pilot, scientist, shopkeeper, vet (4). The boys mentioned: boxer, drawer, fireman, fisherman (2), pilot, rocket person, school principal (2), scooper driver, shopkeeper, taxi driver, vet. Upon examination, it would seem that the girls had chosen more occupations that could loosely be associated with aspects of hi-tech than the boys.

During my time spent in the classroom I became interested in the gender balance of the teacher-child interactions. From my observations in session one, my initial subjective judgement was that Jill balanced her interactions fairly equally between the boys and girls. In order to gain some quantitative data about these interactions, I documented them over a number of sessions, along the lines advocated by Ryan (1993). From an analysis of the data obtained from the first session, it was found that the boys appeared to dominate the teacher-child interactions – 63% to the girls 37%. These results were then discussed with Jill during our debriefing following session one and in the subsequent sessions she made a conscious effort to redress this imbalance. This was achieved to a large extent in the remaining sessions with the teacher-child gender interactions averaging 50% each.

While recording the number of teacher-child interactions, I also made a careful note of the sex of the children Jill selected to be demonstrators (in front of the class); to collect various items in the classroom; and to run errands. I found that the sex balance in these situations was fairly even. Also, from an examination of the data of teacher-child interactions gained from the audio tapes of some of the sessions, it was possible to determine which children had significantly more interactions with the teacher than the rest of the class. These children have been called *target* students by Tobin (1993). In this study it was found that with these *target* students, no gender predominated. I found that in some sessions either girls or boys dominated as *target* students, while in some other sessions there was a mixture of boys and girls.

Findings

Throughout the study there did not appear to be any discernible differences in attitudes and participation between the girls and boys. Likewise, the models produced by the girls and boys displayed a similar range of creativeness and complexity. From my observations all children seemed to find their involvement in the various DMA activities to be enjoyable. This was no doubt facilitated by the use of co-operative working groups. Both Reat and Jensen (1993) argue that co-operative learning is a valuable technique to be used to enhance learning in a fun way.

Gender inclusiveness was reflected in the topics selected as themes for the children's design briefs. The range of topics and materials did not appear to favour a particular sex cohort. The DMA topics selected by Jill as themes for the children's design brief, did not appear to be gender restrictive. In the session where the children had to use the plastic construction kits, they were asked to make a model containing at

least one wheel. In the class Big Book based on the theme of 'wheels', the wide variety of pictures drawn by the children reflected that they were not given gender restrictive instructions. Similarly, in the sessions held during weeks five and six, the children were asked to make a model of something with 'wheels'. During the sessions that involved making a piece of play equipment, the children were also allowed to pursue their own interests. The use of a broad range of materials throughout the term's program of DMA activities also would have helped to overcome some of the restrictive traditional views about which aspects of technology are appropriate for girls and which are for boys (Bindon and Cole, 1991).

From the interview with the individual children it was found that there were marked differences between the toy selections made by the girls and those made by the boys. Similar results were found from a toy survey conducted in England (Burn, 1989). Such results may suggest the need for some special measures to be taken as a supplement to the DMA curriculum in the early years of schooling, in order to ensure that girls have exposure to more technological type toys. Pam's incident of placing a toy car backwards on an inclined plane would tend to support such a suggestion.

The finding in this study that more boys had exposure to a computers at home was consistent with Burn's (1989) research which found (at that time) that three times as many boys as girls had access to a computer at home. Eccles (1989) also found that girls were far less likely to access to a computer at home than boys. One would suspect that this situation will change in the future as more homes gain computers.

When asked for their occupational aspirations, the children in this study gave interesting answers. Nine of the girls chose science/technology related occupations as opposed to only four boys. This was contrary to the findings of Etaugh and Liss's (1992) study where children's occupational aspirations were found to be along typical gender stereotype lines. Though, as anyone who has worked with very young children will know, they can be asked the same question half an hour later and come up with a totally different answer!

From an analysis of the children's DAST drawings, the scientists drawn did not appear to be the male stereotypes which have been found in the findings of studies which used older children (Fort and Varney, 1989; Jannikos, 1995; Kahle, 1993). In the study conducted by Newton and Newton (1992), children as young as six years of age were found to draw the stereotype picture of a male scientist. However, Chambers (1983) believed that children have to be a little older in order to develop a certain image of a scientist. He discovered that with children from about seven years of age, the stereotypical image of a scientist began to emerge and increased in frequency with age. Other studies have concentrated more on the gender of the scientist drawn. Both Hobden (1993) and Pickford (1992) found in their studies that children produced either all male scientists or only a few female scientists. Thus it would seem that the children in the class used in this study have not yet formed any stereotypical images of scientists delineated along typical gender specific lines.

As mentioned earlier, the teacher – child interactions that occurred in this study were initially heavily biased towards the boys. Following awareness raising with Jill, she was able to provide a more balanced pattern of interactions during subsequent sessions. What was interesting in this study was the fact that no one gender emerged as being *target* children. The *target* students identified in this study were a mixture of boys and girls. This was contrary to Tobin's (1993) findings in which he found that the majority of *target* students in mixed classes tended to be boys. Another finding to emerge from this study was that the actual target students themselves were not consistent throughout different DMA sessions. Different *target* students dominated the interactions in each of the sessions monitored. This could be explained by the fact that since children at this age have not been at school for very long, they may still be sorting out their social dynamics and therefore are still discovering their particular niche within the complexity of classroom interactions.

It was found that in this study the issue of safety was given important prominence. The children often needed to use materials and especially some tools that had potential dangers. Throughout the period of observation in the classroom, the teacher frequently stressed to the children the need to take safety precautions rather than stressing the dangers. Such an approach has been advocated to promote female-friendly science/technology (Roeder and Simms, 1993).

Implications for teachers

This study has revealed the diversity to be found in young children's technological awareness and experience. Teachers therefore need to be aware of this when teaching DMA since many girls often have more experiences of relating to value judgements concerned with the home, shopping and 'people-care', while boys may have had more experience of skills associated with making and evaluating artefacts (Benson, 1990). It may therefore be necessary for teachers to ensure that girls have the opportunity for extra exposure to construction kits and boys could be provided with additional activities that relate to say creating environments.

Given that this study did not find the children had developed male stereotypical images of scientists/technologists, it is therefore crucial during these early years of schooling that children are exposed to female role models of scientists/technologists through large pictures, library reference books, story books, invited guests and excursions. It may even be helpful for other teachers to make notes inside the front covers of some of the library books, highlighting significant text and pictures depicting female scientists/technologists contained in the book. Such exposure may assist in reducing the male stereotyping of scientists found to develop in older children.

The initial frequency of gender teacher-child interactions found in this study is probably fairly typical to those found in most mixed classrooms. Teachers therefore need to be constantly vigilant of their own potential for having subtle and deeply embedded discriminatory gender practices (Eggleston, 1992). Cawthorne (1988) has claimed that it is not easy to spot our own discriminatory or ill-considered practices, let alone identify and internalise alternatives. To assist teachers to detect for example, the gender levels in their teacher-child interactions, they may wish to audio or video tape their DMA sessions. This can sometimes be quite difficult and so it may be necessary to enlist assistance from a colleague.

Finally, in this study the teacher used co-operative learning strategies to great advantage. The children worked on their DMA tasks mainly in groups. Such an approach promoted cooperation rather than competition. It has been found that girls act co-operatively in single-sex groups but competitively in mixed-sex groups, while boys tend to be competitive in all contexts (Harlen, 1985). It is therefore to the girls' advantage if teachers implement and encourage co-operative DMA learning strategies and so enhance the girls' self-confidence and self-esteem, both of which are keys to girls' success in design and technology (Howell et al., 1993).

Summary

From the above discussion of gender aspects associated with teaching DMA in an early years classroom, it could be argued that DMA activities are an ideal area of the curriculum for introducing and developing non-sexist pedagogical initiatives. The teaching of DMA in Jill's early years class revealed that it can be a gender-neutral curriculum in which girls and boys are equally able to fully participate in DMA learning activities. Both the girls and boys were able to enjoy their participation and there appeared to be no obvious differences in the models produced. This study has demonstrated that all children can benefit greatly by introducing DMA activities at an early stage of their primary schooling. Such an approach may alleviate the necessity for implementing remedial measures for developing girls' technological capability at the upper primary/secondary level. DMA activities are able to provide new windows of opportunity through which to build real equality of opportunity for all children.

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