An Examination of the Starting Point Approach to Design and Technology

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Abstract

This study examines the Starting Point Approach (SPA) to design and technology, which is intended to maximize creativity while being manageable for the teacher. The purpose of the study was to examine whether the children could do what the approach requires and in particular whether it promoted their innovative thinking. Data were collected during teaching sessions with 27 Year 6 children in London and rural Finland (ages 11-12). The theoretical framework of the study is qualitative in nature.

The participant researchers videoed sessions in their respective countries that were taught according to an agreed "script". This included guided brainstorming chaired by the researchers. Children were introduced to some technology and explored its use in the wider world. They were then shown how to make their own working example that was the starting point for their designing. After brainstorming, children went on to develop a wide variety of different projects of their choice.

In the UK and Finland, children in a specific class usually are required to design products with the same purpose. In this study, the *SPA* approach allowed children in the same class to design products with many different purposes. They developed the starting point to fit with their own experience and interests or the needs of others around them. One major advantage of the *SPA* is that it seems to reconcile the often-conflicting demands of teaching specific skills and knowledge while encouraging individuals to be as creative as possible. The common starting point was crucial to making this feasible.

Introduction

The importance of creativity in education has been highlighted in the UK by the National Advisory Committee on Creative and Cultural Education (NACCCE) report (1999). Numerous papers on creativity in design and technology have followed (Kimbell, 2001; Spendlove, 2003). The DATA International Research Conference 2004, focused on creativity and innovation. Creativity is sometimes associated with genius or exceptional achievement, but there are other interpretations. Benson (2004) states that while teachers may have a future Picasso or Freud in their classes, it is more likely that they will have children who have "an original idea or solution that is original to themselves and not necessarily totally original". This is what Craft (2002) calls little "c" creativity that is arguably within the reach of all children, especially when it is properly promoted. We should remember however that the students who Benson calls future "world-view changers" are in some classes *right now*.

The NACCCE report (1999, p.30) called the highest category of creativity "historic originality". The levels of creativity available to most children are nonetheless still worthy of development. We do not give up teaching children creative writing because we think they might never be capable of winning the Penguin Prize for Children's Fiction! The study described in this paper was based on the premise that all children are capable of a degree of creativity in identifying design problems and generating "original" solutions.

Technology has been described as human innovation and problem solving in action (ITEA, 2000; McCormick, Murphy,Hennesse, and Davidson 1996). Problem solving should relate to children's real-life environment, allowing them to make appropriate and meaningful connections (Schwarz, 1996). Moreover, this opportunity should enable them to explore and pursue their own needs and interests as well as those of others. Children should be encouraged to identify problems and deficiencies in their everyday environment; they should be given opportunities to apply technological knowledge and skills they have acquired in previous problem-solving situations (Adams, 1991).

This study arose out of the researchers' combined experience as technology educators. This experience indicated that the starting point approach (*SPA*) was an effective way of promoting creativity in a manner that would be manageable to teachers. The *SPA* approach had been used increasingly in their work with children, student teachers and teachers in the UK and

Finland. The *SPA* model was used by Good (1988) and developed further within his *Design Challenge* series of books (1999-2000), extending the scope and range of exemplar material. The use of strategies to promote design thinking is of course not unusual. A range of these have been used to enhance the creative and innovative activities of children based on models of problem-solving processes in technology (Kimbell, 2004, Layton, 1993; Sparkes, 1993).

Most primary schools in England follow the Qualifications and Curriculum Authority (QCA) (1998) scheme where the outcomes in a class are directed to have the same purpose, for example, the children are told to design a photograph frame or a pair of slippers. This situation is mirrored in Finland, which has a long tradition of handicraft education where pupils have traditionally made artefacts almost by recipe. However, during the recent revision of Finnish compulsory school framework curriculum, teaching technology was introduced as a cross-curricular theme called "Humans and Technology". One aim of the theme is to encourage children to develop technological ideas and be taught to evaluate them as they work. The new framework curriculum requires teaching technology across the curriculum.

The Starting Point Approach (SPA)

The Starting Point Approach, SPA, used in this study, is based on the model of technological problem-solving processes mentioned previously. However, it has specific features that distinguish it from other approaches which are characterised by outcomes with a common purpose (Suvillan, 2005).

In the *SPA* children are first introduced to specific technology and encouraged to explore the context in which it is used, how it is relevant to them, and how it can be applied in the wider world. They are then guided in making their own working example of the starting point that they were initially introduced to; in the process they gain knowledge, skills, understanding. This would include what English teachers would recognize as *focused practical tasks* and in the *SPA*, provides the starting point for their designing. Helped by brainstorming led by the teacher, children then develop a wide variety of different projects of their choice. Unlike the usual approaches in the UK and Finland, in the *SPA* children can, within reason, design "what they like". The starting point can be developed out of a need identified by the children themselves, reflecting their own experiences and interests or the needs of others around them. Typically many more ideas are proposed than it is feasible for the children to make in the time available. They have to select their favourite idea to actually make and evaluate in use. Sometimes two or more ideas are combined to make a new idea. The teacher may offer guidance regarding the child's choice. Some ideas might be less suitable than others when the available materials are considered, or there may even be safety or ethical issues! Even "unrealistic" ideas are not treated as "bad" or "stupid". Adult designers also work with constraints, and they usually have to narrow their ideas down to one that will be taken to the working prototype stage.

The *SPA* seems to reconcile the often conflicting demands of teaching specific skills and knowledge with encouraging individuals to be as creative as possible. The common starting point is intended to make this feasible.

Purpose of the Study

The purpose of the study was to examine whether the children could do what the approach required in particular and whether it promoted their innovative thinking in technology education. Moreover, it was hoped that an examination would bring aspects being done intuitively by the teacher/researchers to a conscious level. This would facilitate an analysis of the process and inform future teaching. The research also had the potential to identify ways to maximize the effectiveness of the *SPA* and give an insight into what happens when children generate ideas in this way. The analysis is ongoing, but some fundamental questions about the *SPA* are considered in this paper. Essentially, the authors asked whether the children could do what the approach asked of them and if it helped them to develop projects with different purposes within the group.

Methods of Inquiry

The theoretical framework of the study was qualitative in nature and based on interpretative skills and inductive analysis, whereby the researchers continually explored the relationship between data and emergent findings (Ritchie & Hampson, 1996). The study employed an open search for children's emerging ideas for ways to turn a pressure pad on. This is a pressure sensitive switch made in this case from three pieces of card and some aluminum kitchen foil (see

Figure 1). Even more important, the researchers wanted to see whether the children could apply this starting point in innovative and creative ways in their own living environment. The children's ideas were thereafter interpreted from the viewpoint of the research problems (Patton, 1990).

Figure 1. The Pressure Pad switch (Good, 2003, p. 12)

The UK children were from urban schools taking part in the Children's University at the University of Greenwich, Avery Hill Campus. There were 16 children in the group, ages 11-12. The Finnish children were from Karhukangas Primary School, a small rural school in Haapavesi Township. The head teacher Markus Tornberg, helped to set up and carry out the Finnish part of the study. All 11 children from classes 5-6 (11 –12 year olds) participated in the study. Cultural differences between the UK and Finnish sample were not considered to be significant in relation to the research.

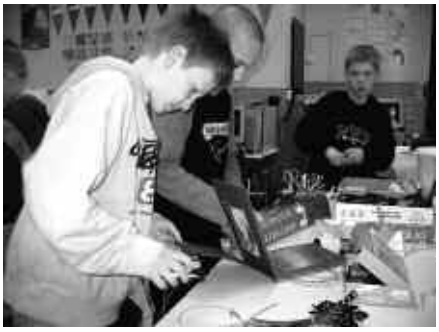
Studies in UK and Finland were conducted following an agreed "script" that was believed to epitomize the *SPA*. The exemplar *starting point* for designing was a pressure pad switch, made from card and foil. Before starting, the children were given an overview of the session. It was seen as important that they knew from the outset that they would be asked for ideas for using the pressure pad. This was so that subsequent activities could be used as stimulus and to give maximum time for ideas to emerge.

Phase 1 - The basic concept of a switch was discussed. This was revision (i.e., review) for the Greenwich children who had covered this as part of their National Curriculum Science. The children were told that they would be shown a type of switch called a *pressure pad*, and they would be shown how to make one.

Phase 2- The children were shown a large pressure pad and how it worked. It was big enough for the entire class to see. The characteristics of pressure pads were discussed, for example that they are thin, take up little room and are tough. It was hoped that focusing on the special qualities might lead to ideas that were provoked by them. All of the children then followed instructions to make their own pressure pads. The children were given a copy of the basic pressure pad instructions from Keith Good's Zap It! book (English edition: Exciting Electrics, pp.12-13). The Finnish children were given a translated version. All the materials needed to make a working pressure pad and a circuit for it to control were provided.

Phase 3- The children were asked to think of where pressure pads were used in everyday life, and their ideas were recorded on a flip chart. This was intended to consolidate the concept of a pressure pad and allow one idea to provoke others. The teacher researchers then encouraged the children to brainstorm as many ways as possible to keep the pressure pad switch on (i.e., complete the circuit).

Figure 2. Children making pressure pads in Karhukangas Primary School, Finland



Phase 4 – During the final brainstorming session, the children were encouraged to generate many new ideas for using a pressure pad. Again, the flipchart was used for recording purposes. These ideas were intended to lead them to design and make projects of their own choice. The research was focused on the following questions:

1. Could children identify the existing uses of pressure pads in the world around them?

2. Could children generate ways to turn pressure pads on in different ways?

3. Could children find possible uses for their pressure pads?

It was assumed that multiple qualitative data collection would provide enough information relative to the research problems. Moreover this procedure was believed to enhance the motivation and relaxation of the pupils and thus to support their innovative and divergent thinking process. In this way the children did not need to be constrained by the traditional school evaluation practices (Duffy,. Fishman and Honebein 1992: 89 and Patton, 1990: 132;). The researchers assumed the role of participant observer. This procedure enabled them to be "inside" the study, true to the nature of qualitative research (Erickson, 1986).

Data were collected by various ways: brainstorming recorded on flip chart, video recordings, children's written notes and drawings, and photographs of the children's final outcomes. The children's responses were documented on a flip chart (in black pen). The researcher's input to the discussion was documented on the flip chart in green pen (to distinguish it from the pupil's input).

Video recordings from the brainstorming sessions can be regarded as a primary data source. Secondary data sources, such as the children's notes and drawings and photographs of the final outcomes also provided valuable information. They were used to supplement information in the search for emergent patterns in the data. To ensure validity and credibility of the research, multiple data collecting sources and strategies were employed, applying the concept of triangulation (Miles & Hubermann, 1994).

Analysis and Results

Verbatim transcriptions were derived from the video recordings. During the analysis process, irrelevant data were excluded. Care was taken to ensure that individual children could not be identified, thus pseudonyms were used. Parental and caregiver's agreements were also secured. All the collected data, both primary and secondary data sources, formulated a body of data, which was submitted for analysis.

During the first round of analysis, the researchers began to form an idea of the emergent phenomena relative to the theme of this study. In subsequent rounds of analysis, the data indicated that the children were creating ideas for their own projects. This prompted the researchers to further review of the data in order to specify those emerging features.

During the analysis process, the researchers were continually open to re-exploring the relationship between data and emergent findings and making corresponding revisions. They discussed and shared observations during a series of meetings in Finland and the UK. Data examples presented in this article were analyzed by both researchers individually and also in the collaborative discussion in which the final interpretations were developed (see Ritchie & Hampson, 1996). Finally, the researchers reached the stage where they considered that they had investigated the whole body of data sufficiently from the viewpoint of the research problem. From this point of "saturation" the researchers proceeded to present results.

The inductive interpretative analysis process used in this study enabled the results to be presented as empirical assertions, with supportive data (Erickson, 1986). Examples are referred to within the commentary in order to clarify the interpretative analysis process (see Järvinen & Twyford, 2000).

Empirical Assertion 1: The children were able to find existing uses for pressure pads in world around them

The Finnish children came up with the following examples:

1. Scales (weighing fruit, etc., in the supermarket)
2. Car radios
3. Cash register

4. Control panel for milking machine and feeding control in barn
5. Motor workshop –used to control engine hoist
6. Digital cameras
7. Cash point machines

The English children came up with these examples:

1. Cash machines
2. Light switch
3. Mobile phone
4. TV remote

Commentary

The above examples present the input of different (individual) children They demonstrate that the contributing children are able to find existing uses for pressure pads in the world around them. This is evident for example in the supermarket scales, mobile phone, and TV remote. These children are obviously familiar with these user interfaces which have become common in our everyday lives. They were able to transfer the concept and function of a cardboard pressure pad to real world pressure pad applications. This suggests that the basic idea of pressure pad was understood. However, not all the examples mentioned are used by the children themselves, like cash point machines and shop tills [American synonym?]. Interestingly, the child who refers to control panels of milking and feeding devices (example 4) has identified quite recent applications of pressure pads used in modern barns (his parents are farmers). The same child also refers to a pressure pad used in a control panel to control an engine hoist in the motor workshop of their farm. The child who identified the pressure pads in the family barn and motor workshop could see the importance of the technology he was being asked to design.. His understanding of the technology in his surroundings can also be said to have increased. Black box technologies of control panels, weighing scales and other everyday devices have become more understandable to the responding children, at least to some extent.

Empirical Assertion 2: The children were able to generate a wide range of ideas for turning the pressure pad on in different ways.

When asked to think of different ways to turn the pressure pad switch on, the Finnish children came up with the following ideas:

1. Turn it over
2. Step on it
3. Lean on it
4. Knock on it
5. Put something on it
6. Throw at it
7. Somersault on it
8. Blow on it
9. Drop something on it
10. Drive over it
11. Put a can on it, when rains fills it to a certain extent- the switch goes on
12. Put it between pages of a book

The English children came up with the following ideas:

1. Step on it
2. Sit on it
3. Squeeze it
4. Pinch it
5. Head butt it
6. Put some weight on it
7. Belly flop on it
8. Elbow it
9. Punch it
10. Touch it with your tongue
11. Expel gas on it
12. Flick it
13. Kneel on it
14. Kick it
15. Throw the pressure pad against the wall
16. Blow on it
17. Stamp on it
18. Drop something on it
19. Put some water on it (meaning squirt water on it)
20. Slap it
21. Run over it
22. Tiptoe on it
23. Close the window on it
24. Lay on it

These were added to the flip chart and acted out by the teacher researchers to repeat and reinforce the suggestions.

Commentary

The rich variety of ways generated to turn the pressure pad on suggests that the children felt relaxed and free to brainstorm in these sessions. These ideas did not rely on previous

knowledge or experience since this was a new situation for the children. They were already being creative as they came up with plenty of ways to close the circuit with the pressure pad. This is important as it gives a fertile basis for generating ideas for using the pressure pad later. Through this brainstorming session the children were establishing a basis for a wide variety of uses of pressure pads, including possibly novel and innovative ones. Some unusual or less obvious ideas came up, for example the Finnish child's: "*put a can on it, when rains fills it to a certain extent- the switch goes on*" and the English child's "*throw the actual pressure pad against the wall*," which show an interesting reversal of the normal pressing or throwing things onto the switch. The last child [Author's note- NOT *BOTH* CHILDREN]seems to have stumbled across a recognized strategy for generating innovative ideas. Michalko (2001) devoted an entire chapter to reversal in his text on idea generation.

Empirical Assertion 3: The children are able to find possible uses for the pressure pad switch in their own environment.

Due to the large amount of transcribed data from videotaped brainstorming session, Empirical Assertion 3 is not supported by presenting the whole data, but rather by using exemplars from the transcripts.

When asked to think of as many uses as possible for the pressure pad switch, the Finnish children came up with the following ideas:

(Extracts from the video transcript)

1. Doorbell
2. Burglar alarm
3. It could be used in a game – thrown at on a wall
4. Under bicycle tire (e.g., to warn of theft)
5. It could tell you it was raining, even if you were reading
6. A kind of wind meter
7. Put by the side of the bed to tell when you have fallen out
8. Could tell you when something was full
9. Put pressure pad in door handle (to warn of sleepwalking)
10. Knocking doorbell
11. Used inside the mailbox to tell when newspaper has arrived- indicates inside the house
12. Put pressure pad on bird feeder to tell when birds come
13. Warns that a car is at your gate and you need to go and open it or in the road (in rural Finland, often small roads off the main one lead to houses).
14. To control a torch

The English children came up with the following ideas:

15. Control a remote control car
16. Under the door mat to turn on a tape recorder to scare people at Halloween
17. Stand a glass on the pressure pad to keep a night light on if you're scared in the dark. You could easily find your drink and you could use it as a light to help you read
18. An automatic door bell that no one would need to ring it and you'd know people were there - hide it under the mat
19. Put a weight on it and it'd give you light to work in the garden at night, use the light as a signal, they used it in the war and out at sea
20. A car goes over it and the bulb come on instead of speed cameras
21. Use it to tell which model car has won as they roll down a slope
22. A game for children like a play mat
23. When they stop a lorry (truck), they might want the light on. When the car goes quiet.
24. If the driver was really tired there could be a buzzer to wake him when he drops off
25. A different burglar alarm so that if he comes in the window and the window shuts the buzzer would go on
26. When burglars put their hand in the mailbox and try and push the door then when the letter box shut the thing would go off
27. Detecting when a dog gets out of its basket when it has been told to stay in

Commentary

The above list of 27 examples seem to show that some of the children were able to combine the function/concept of a pressure pad and various ways to close the circuit to produce innova-

tive product ideas. Most important, the children's ideas can be regarded as innovative and novel applications of the pressure pad concept. This is in accordance with the definition of technology as "human innovation in action" (ITEA, 2000). It is important to notice also that many of the children's ideas are actually feasible and could be a basis for their realprojects in design and technology education. This was the purpose of the SPA from the start. Infrequently, ideas were discussed that could probably not be made to work, at least at first sight. This was often because the essential nature of the pressure pad had been forgotten. Other children quickly reminded the speaker that pressure was needed and an idea based on sound (for example) would not be practical. In such cases was needed careful handling to preserve the enthusiasm of the idea giver.

Making an apparently impractical idea feasible, was another chance for the adults and children to use their creativity. The children were encouraged not to dismiss ideas too readily. It must be realized that each idea listed could be the starting point for very many different designs.

The children went on to explore these through drawings, modeling, and discussion, which resulted in some of the ideas being made into finished artefacts.

In idea 11 above, the pupil applies the idea of the pressure pad to the context of a mailbox and remote sensing. In Finland it is common for mailboxes to be at the boundary of a property. This idea is a system where a pressure pad would be placed to the bottom of the mailbox and when mail, such as newspaper, arrives, it presses the pad and the circuit closes. This idea was clearly related to her needs and she connected two existing products in an innovative, divergent way. This is an example of combinational creativity. Michalko (2001) devoted a chapter in his book on idea generating strategies to making novel combinations. It seems that the "mailbox" did this naturally.

Significantly, most of the above ideas seem to occur as a response to the children's own needs, interests, and purposes, true to the nature of design and technology as it should be. It is of course also valid for the children to design products that may be needed by others. Indeed the English National Curriculum for Design and Technology (Key Stage 2, 7-11 year olds) requires that they "generate ideas for products after thinking about who will use them". When examining existing products, they have to think about the views of the people who use them, not just themselves.

This mailbox idea also illustrates the importance of the "audience". In this case, the Finnish teacher/ researcher, knowing the context for the idea, was able to fully appreciate it. We may sometimes need to get children to explain the context for their ideas if we are to appreciate them. Ideas otherwise might be dismissed.

Discussion

In this study an effort was made to add to the children's understanding of the human made environment, (i.e., pressure pad technology). This is close philosophically to the goals of most school subjects in teaching knowledge and understanding about the world at large. The data indicated that some of the children were able to make meaningful connections to a pressure pad by identifying existing uses of it in the human made world around us. This in itself has value, demystifying the technology by having the children build their own example. When they were making the pressure pads, the children acquired information and skills on basic issues in electricity (open/closed circuit, conductor, etc.).

Moreover, the study aimed to give children opportunities to apply their new knowledge in designing projects based on their own ideas. It was evident from the data that some of the children were able, at least to some extent, to apply the pressure pads in a creative and innovative manner as a response to the problems they identified in their own living environment. Here it is important to notice that it was not known beforehand what applications of pressure pads would emerge from the children's creative minds. This can be seen as being in line with the philosophy of technology as well (Niiniluoto, 1984). In this way the technological process did not aim just at discovery (as in science), but rather and more essentially, at children's innovations in action. In this regard, many of the children who took part in the study acted in accordance with the idea put forward by Adams (1993, p..87): "Successful inventors that I know are extremely problem-sensitive. They are tuned to the little inconveniences or hardships in life that can be addressed by the technology they know."

It is important to recognize that is in accordance with how the made environment has developed and continues to develop through human activity. Ingenuity, innovation and problem solving are part of the basic essence of technology (e.g., Järvinen, 2001; Sparkes, 1993;). This could also be crystallized in the definition: "Technology is human innovation, in action" (ITEA, 2000). Consequently, teaching technology should not be mere study of how technology works, as children need to be given opportunities for creative and innovative action.

The *SPA* facilitates children's creativity in technology education to a greater extent than the approach where the purpose of the project is specified by teacher. However it is not so open that children have to search for a need or problem to solve without any support. The making stage of the SPA is close to focused practical tasks in the English National Curriculum but these usually lead to projects with the same purpose within a class.

The authors do not claim that using the *SPA* is the only manageable approach to technology teaching nor that the applied method is the only way to foster children's innovativeness. There are actually some concerns which should be taken into account when applying the SPA, for example, using SPA should not hinder the ability of children to have an open and sensitive mind to identify needs and problems without the support of a starting point.

However, it seems to the researchers that the *SPA* offers a compromise between what the teacher and student can manage, what needs to be done, and what the student would choose to do. By making the most of opportunities for students to create their own ideas, the SPA seems likely to increase their perception of technology education as it is relevant to them. This approach is primarily aimed at maximizing creativity, but it may well also help motivation and behavior in technology. Working from the teacher's starting point students can still end up with a project with a different purpose from their peers, one over which they have ownership. However, less experienced teachers may feel more secure if they know the purpose of the children's projects in advance.

The SPA seems to offer a way of allowing individual children to identify their own design problems and for outcomes with different purposes to be designed and made within a class. All this is done while maintaining the sanity of the teacher.

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