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Technology in Preschool: from Idea to Product

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Abstract

Teaching pre-service preschool teachers in technology is a challenge. Technology is a fairly new subject in school, students lack experiences and are not aware of the aim of the subject. In addition technology also include the consequences of technological choices for individuals, society and environment. The curriculum for pre-school in Sweden emphasize development of children´s knowledge in science, technology and their ability to identify technology in everyday life. The education of pre-service teachers involves visualization of their own tacit knowledge and experiences to be used in the teaching of technology. Here a course during a three weeks period with 55 pre-service teacher students is presented. They worked in groups with construction exercises, museum visit and outdoor technology walk. The students wrote summaries of the processes together with critical reflections. The written exams on the identification of technology in everyday life were analysed by using the quality markers 4R's of Doll's and compared with marks on their examination tasks. Our results show that many students could describe the processes of construction with high quality showing several perspectives of understanding, e.g., the advantage of group activity, their own development of understanding and how to teach children in preschool.

1. Introduction

Teaching pre-service preschool teachers in technology is a challenge. Technology is a fairly new subject in school, students lack experiences and are not aware of the aim of the subject. In addition technology is not a subject belonging only to the science subject but also include the consequences of different technological choices for the individual, society and the environment. The curriculum for pre-school in Sweden emphasize development of children´s knowledge in science and technology.

Children should

> *develop their ability to identify technology in everyday life, and explore how simple technology works* [1].

They should also be

> *stimulated and challenged to develop their interest in science and technology* [1].

The preschool teachers should

> *challenge the curiosity of children and their growing understanding of language and communication, mathematics, as well as science and technology.* [1]

2. Skills in teaching technology in preschool

The education of pre-service teachers involves visualization of their own tacit knowledge, experiences and technological literacy. They have to train to consciously use these in the teaching of technology in preschool. Courses should be developed in the way that the experiences of the students are deepened and envisaged. It is also important to provide the teacher with tools to develop their knowledge and skills in a similar way as they have to do together with children in preschool.

3. Course description

The technology course here presented, was roughly the three last weeks during a ten week course in science (biology, chemistry, physics) and technology with 55 pre-service teacher students. After the activities and at the end of the course the students wrote summaries with description of the processes and with critical reflections. There also were two examination tasks, one on the identification of technology in everyday life in which three tools based on silhouette pictures should be identified and

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described (Figure 1). This task was assessed with a rubric (Table 1). The other was to design pedagogic technological activities in preschool. (Rubric, one full page, not included here).

Figure 1. Question for the written examination task: Identify three (3) examples of technology in everyday life in the picture (draw circles). Use the rubric below as support for answering the question. (Only a part of the original picture is reproduced here.)

Table 1. Assessment rubric for the examination task.

	Good	Better
Identification	Correct	Explanation of the function
Artefact	Described	Special characteristics of construction
Context	When is it used?	Part in a larger system
Benefits of the tool	Explains	Compares without the tool
Reflection	Own experiences..	..in a wide context.

4. Pedagogic design of technology teaching

All activities were performed in working groups created by the teachers with 4–5 students. For an overview see Table 2.

Table 2. Overview of the technology course (as a part of a 10 week science and technology course).

Week of course	Subject or content	Type of activity	Report
8	Technology; sailing	Construction	Reflection
8	Outdoor technology walk	Observation	Group text
8	Technology; Rube Goldberg Machine	Construction	Reflection
9	Ancient ship Vasa museum	Observation	Reflection
9	Mobile	Experiment	AELP
9	Technology; Jumping Jack	Construction	Reflection
10	Written examination; technology	Assessment	Text
10	Exhibition	Presentation	AELP
11	Overall technology report	Text	Reflection

4.1 Constructions

Three construction exercises were included (Figure 2). At the end of each exercise the students wrote a reflection including solving problems and ideas they had during the work, but also the process of interaction in the group. After the exercises they wrote a summary of the general processes.

4.1.1 Construction of a sailing boat

The groups constructed sailing boats out of the following material; half a disposable aluminium foil lunch box (for hull), a straw (mast), plastic tape, paper, and aluminium foil. The boat should manage to sail with crosswind (hair dryer) over a washing-up bowl, load some cargo and return, with wind from the same direction (but from the other side of the boat).

4.1.2 Preparing a Rube Goldberg machine

This application started with an exercise doing a human Rube Goldberg machine, with 20 students, based on written instructions to each student how to behave when someone did something specific.

Then each member of a work group built a small Rube Goldberg machine including three different moving parts. These small machines were connected in order to create a larger functional machine.

4.1.3 Creating a jumping jack toy

This individual exercise in creating jumping jacks started with students in groups constructing simple machines with levers in order to understand the possibility to create movements in different directions.

4.2 Creating a mobile

Under the supervision of an aesthetic teacher the students created mobiles in groups based on a very short description of the relation between levers, balance and the centre of gravity. The results were presented in an exhibition at the end of the course (Figure 2).

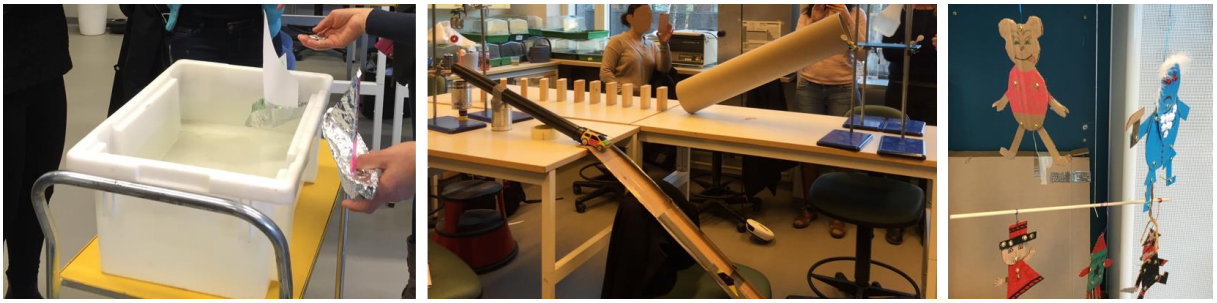

Figure 2 Pictures of the exercises. Sailing boat, Rube Goldberg machine and Jumping Jack as mobile (left to right).

4.3 Outdoor technology walk

The students should, in groups, identify and describe different examples of five simple machines (lever, wheel, inclined plane, wedge, screw) outdoors. They should not include wheels on vehicles.

4.4 The Vasa museum

The museum contains the ancient ship (17th century) and a large number of small exhibitions. The students visited several of the exhibitions and selected together one of these for individually written reflections with technological perspectives. They also included what they learned and what they thought a child could learn from the exhibition. [2]

5. Methods of evaluation

The first task (Figure 1) of the written examination was assessed by using a rubric (Table 1). The reflections of the general processes in the construction exercises were analysed by using quality markers, the 4R's of Doll's [3] (Table 3). Associations between these indicators of quality and the marks on the final examination were analysed with clustering and ordination techniques using the R statistical program [4]. Earlier we have showed that open questions promote answers based on the students own experiences, reflecting a deeper understanding compared to more closed questions [5]. In order to achieve this, the assessment questions were constructed to give the opportunity for the students to choose tools to describe and the context of these tools. Earlier we had found poor correlation between marks based on rubrics compared to other quality markers [6]. Thus, the quality of the tasks also was analysed using the 4R's of Doll's [3] in order to reveal the students' technological literacy (Table 3).

6. Results

In the written examination (n=55) only one student failed on question 1 and 4 on question 2, 28 resp. 25 passed and 26 resp. 26 got the higher mark. In their technology report many students showed high quality showing several perspectives of understanding. Our results show that students describing relations and technology outside the context (*rigor*) in their technology report had less probability to get high marks on the written examination question 1 but higher marks on question 2. The different character of questions is also obvious since students describing relation in question 1 are more likely to have high marks on question 1 (Figure 3).

Relations	1. Describes relations between persons or objects and context.
	2. Emphasizes the importance of interactions.
	3. Describes the process.
Recursion	1. Refers to previous experience
	2. Refers to learning out of previous experience.
	3. Consistently use of recursion.
Richness	1. Rich vocabulary and varied language use.
	2. Writing in own words, indicating acquired knowledge.
	3. Use of several approaches (perspectives, dimensions).
Rigor	1. Unexpected change of subject within the context
	2. Unexpected change of subject outside the context
	3. Courage to leave the framework totally and enter new contexts.

Table 3. Assessment rubric for the assessment of the 4 R's of the examination task.

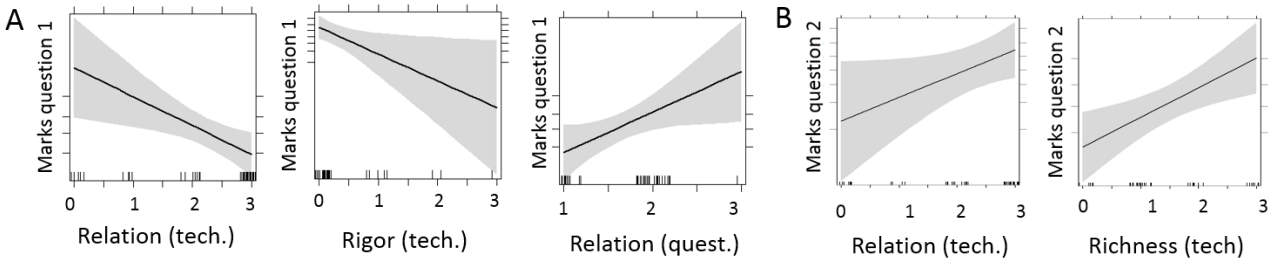

Figure 3. The effect of using of the 4R's on the marks of the questions. A. Question 1; *Relations* p=0.0004224***, *Rigor* p=0.008589** in the descriptions of the constructions and *Relations* p=0.007905** in question 1. B. Question 2; *Relations* p=0.03535* and *Richness* p=0.000869*** in the description of the construction.

The analysis of the 4 R's in the overall technology report and the examination tasks show fairly high quality (Table 4).

	Level	Relations	Recursion	Richness	Rigor
Overall technology report	0	0	4	5	27
	1	22	24	11	17
	2	32	27	28	9
	3	1	0	11	2
	Average	2,15	1,98	1,36	0,26
Examination question 1	0	7	3	11	39
	1	4	7	18	5
	2	11	25	8	2
	3	25	12	10	1
	Average	1,62	1,42	1,82	0,75
Examination question 2	0	9	13	17	30
	1	18	22	14	16
	2	13	15	16	8
	3	15	5	8	1
	Average	1,62	1,22	1,27	0,64

Table 4. Number of students at each quality level of the 4 R's in the technology report and the examination tasks.

The reflections on the museum visit and the outdoor technology walk showed how these activities visualized the understanding of the importance of the five simple machines in everyday life. The description of the building of the ancient ship at the museum promoted understanding of differences in modern and older technology but the students also recognized resemblances over time in ageless craftsmanship when constructing ships.

7. Discussion

The reflection texts of the students were of high quality and indicated fairly high technology literacy. One reason for this was the use of open questions, experiments and construction tasks which promoted better understanding of what technology may be and widened their technological literacy. The most important factor was probably the training during earlier parts of the course with reports based on identification and descriptions of processes.

The 4R´s of the written technology report and the 4R's of assessments show how students use the R's differently when answering open tasks compared to more closed questions. In open tasks the students emphasized the importance of group and personal experiences. In closed questions the students also refer to relations but between objects.

Variation of activities with different aspects of technology promotes a deeper knowledge. However, it is important to construct different tasks when assessing the student's knowledge and to be careful when creating the assessment rubrics.

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