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Published in:
International Journal of Mobile and Blended Learning

DOI:
10.4018/ijmbl.2014040104

Published: 01/01/2014

Document Version
Final published version

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Link to publication

Please cite the original version:
Wiklund-Engblom, A., Hiltunen, K., Hartvik, J., Porko-Hudd, M., & Johansson, M. (2014). 'Talking Tools': Sloyd Processes Become Multimodal Stories with Smartphone Documentation. *International Journal of Mobile and Blended Learning*, *6*(2), 41–57. https://doi.org/10.4018/ijmbl.2014040104

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‘Talking Tools’: Sloyd Processes Become Multimodal Stories with Smartphone Documentation

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ABSTRACT

The study presented is part of a work-in-progress project of developing a mobile application for smartphones, Talking Tools (TT). The first context TT is developed for and tested in is sloyd education [Swedish: slöjd], a compulsory subject taught in Finnish schools. In sloyd learners design and manufacture unique artifacts in various materials (textiles, wood, metal, and electronics). The process-based work flow of sloyd lends itself well to this kind of educational tool, which aids multimodal documentation, communication, and instruction. The empirical study targets what student teachers (N=11) microblogged about and the character of the blog posts during a sloyd project. A sociocultural perspective of appropriating new tools for learning is used as a theoretical frame, as well as views on multimodality and transmedia. Their sloyd process is discussed in terms of transmedia storybuilding, as learners build their own story as a flow of content through their documentation and interactions.

Keywords: *Documentation, Learning Process, Mobile Learning, Multimodal, Slöjd, Sloyd, Transmedia Storybuilding*

INTRODUCTION

Smartphones are found in the pocket of nearly every learner in Finland today. This is an untapped educational resource that could be exploited for the purpose of learning and teaching (Ilomäki, 2012). The business model of the telecom industry in Finland further allows for affordable smartphone data plans, which is critical for schools to be able to justify the use of mobile phones from a democratic perspective, but also having the financial possibility to supply phones to those who cannot afford it themselves.

This article presents a pilot study on a mobile application for smartphones, Talking Tools (TT), which aims at utilizing the above mentioned untapped resource by turning smartphones into learning tools with an explicit educational purpose. Developing TT is a collaborative

DOI: 10.4018/ijmbl.2014040104

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project between sloyd education researchers, transmedia developers, user experience experts, and educational technology researchers at Åbo Akademi University, Finland, as well as software developers and coding experts at UpCode Ltd., a software company specialized in developing reading and scanning solutions for smartphones.

The pilot study of the application targets student teachers' documentation using TT. The aim is to explore *what* they chose to document in this multimodal environment. Multimodal documentation can enable transmedia storybuilding, in which the flow of dynamic content facilitates learning and allows for participation. It supports both independent and collaborative learning and allows for flexible information access, communication, and documentation (cf. Naidu, 2008). Being a learner in a multimodal blended learning environment entails both consuming and creating one's own content using a number of media sources and tools (Kress, 2003, 2010; Kress & van Leeuwen, 1996/2006; Säljö, 2012). Kress and van Leeuwen (1996/2006) have established a theory of multimodality offering concepts to analyse and understand the interplay between culture, situation and multimodality. The research aims and questions of the present study are discussed within a sociocultural framework of learning (Säljö, 2005; Vygotsky, 1978, 1986) including perspectives on multimodality and transmedia learning.

CONTEXT

In the Nordic countries, sloyd is a common free time activity in society, as well as an activity in educational contexts (Johansson & Lindfors, 2008; Nygren-Landgärds, 2003). The word sloyd etymologically stems from the old Swedish word *slöghþ*, which stands for shrewdness, diligence, skilfulness and smartness, and the word *slögher*, denoting characteristics such as being handy, being deft, having professional skills, being skilful, experienced, and resourceful (Svenska Akademins ordbok, 1981). Kojonkoski-Rännäli (1995) discusses the phenomenon of sloyd through analysing the words 'hand' and 'work' that form the Finnish word for sloyd, *käsityö*. The word 'hand' shows that the materials used in sloyd are concrete and tangible. In working the material, you use your hands, body and various tools. The concept of 'work' shows that the actor is a human being and that the work that is realized is a result of planning and modelling.

Sloyd as a core subject was established in Finland in connection with the introduction of Folk schools in the 1860s (Nurmi, 1979). Educational sloyd was, from the outset, tasked with objectives that resided outside the concrete making and practice of everyday sloyd (Peltonen, 1998). The sloyd class is learner-centred and allows everyone to work from their own ability and motivation in creating artefacts within a predefined educational and curricular frame.

The sloyd educational theory of learners' sloyd process emphasizes the learner's ability to carry out a 'whole' sloyd process from idea to finished product. The process involves phases of *planning*, *planning of manufacturing*, and *manufacturing and evaluation* (Lindfors, 1991). Learners are given the opportunity to define their idea, plan their work and carry out their plans, observe the consequences of their activities and evaluate the different stages of the work as a whole (Pöllänen & Kröger, 2006). Making a sloyd artefact takes time and the work usually stretches over several lessons. Lindström (2009) describes educational sloyd as a subject in which the learner learns *about*, *in*, *with* and *through* sloyd. The objectives of the activity can be dealing with materials and techniques (*about*), experimenting to achieve a certain effect or mood (*in*), supporting knowledge in other subjects (*with*), or risk-taking or patience (*through*). The individual process that leads to the tangible sloyd product is as important as the product itself (Lindfors, 1991). Studies have shown that learning in the sloyd classroom includes both material and immaterial dimensions in interaction with others and in interaction with mental and physical tools (Illum & Johansson, 2012; Johansson, 2002, 2006). Through the practical sloyd process the learners may access the wide spectrum of

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learning that the process enables beyond the practical realm.

The sloyd educational practice is an ongoing process where the learner, the group of learners and the teacher are involved and interrelate with each other when practicing sloyd (Lindfors, 1999). The learners are involved in cycles of activity (Uljens, 1997). Learners' former experiences form the basis for a new cycle of activity. The teacher creates different intentions for the activity. These are transformed into actions that provide new experiences for the learners. The experience takes its final form when the experienced activities become objects for reflection. In teacher education students practice whole sloyd processes, similar to the processes that learners carry out in school, in order to prepare student teachers for planning, carrying out and evaluating sloyd educational practice. During these processes student teachers learn knowledge about sloyd as well as knowledge in, with and through sloyd. Thus, sloyd teacher education needs to raise students' awareness of several levels of knowledge, including technical skills, instructional design of sloyd educational practices, and ideological subject values.

The artefacts made during sloyd lessons can be seen as a type of communication and storytelling (Mäkelä, 2011). Although the artefact in itself is a materialised documentation, the process cannot be detected from it and, hence, remains hidden (Johansson, 2002, 2006). The sloyd process can in a similar way be regarded as the carrier of a valuable story. Regardless of who the learner in sloyd is, there is an educational value in the story surrounding the creative process. Until now there have been no effective tools for a smooth capturing of the ongoing process in sloyd. One purpose of TT is therefore to allow learners to describe, visualize and discuss their story connected to their own creative process (Johansson & Porko-Hudd, 2013). Learners are, thus, encouraged to capture the essence of the why, how and what within the creative sloyd process.

The purpose of TT is to encourage microblogging about work processes using text, images and short video clips. These chronological blog entries are automatically saved in individual blogs. Peers can share their blog entries and comment on each other's processes. The teacher can monitor the documentation, provide feedback and share learning objects, in order to support the learners' work. Hence, opportunities for learners, peers and teachers to reflect are provided by the transparency that is achieved through the visualisation of the work process afforded by TT. According to Gao, Luo and Zhang (2012), the learning content is not solely limited to information provided by the teacher, when learners are connected via microblogging; everyone, both teachers and learners, in the virtual learning community can serve as information providers, information consumers and knowledge constructors. The objective of the multimodal documentation tools are to stimulate learners in multiple ways; learning by watching/listening, doing, sharing, collaborating, and reflecting on one's process as a whole, as well as learning by being exposed to variations of processes through other learners' stories.

MULTIMODALITY AND MULTILITERACY

Multimodality refers to multiple modes of representation, such as text, audio, images, and moving images (Kress, 2003, 2010; Kress & van Leeuwen, 1996/2006; Säljö, 2012). The concept of multiliteracy is discussed in terms of how we are able to use multimodal communication in the ever-changing landscape of media tools and multimodal output. We have to be able to both create and interpret communication that is much more than what it used to be in a text-based, single-mode format (The London Group, 1996).

Multiliteracy in the context of TT can be defined as the ability to use the mobile application as a tool for learning how to, e.g., write about the creative sloyd process, in which multimodal affordances are used as options for complementing the text with photos, videos,

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drawings, etc. One aspect of this multiliteracy is also to learn how to reflect on other learners' written texts, photos, drawings etc. of their creative work process, i.e., it is not only about creating your own multimodal texts, but understanding and reflecting on other learners' achievements and being part of a conversation (Johansson & Porko-Hudd, 2013).

TRANSMEDIA STORYBUILDING

The term transmedia is usually referred to in the context of storytelling for entertainment purposes, in which the story is designed to flow between various media sources and platforms. The end-users are often engaged as participators in the transmedia storyworld (Jenkins, 2006). The concept of transmedia has also entered the learning stage. In this context it is referred to as a blended and dynamic content method to facilitate learning (Teske & Horstman, 2012). However, the storytelling feature is usually still the essential characteristic, whether it is used as a teaching method or solely for entertainment purposes.

We would like to take this a step further by introducing a new term, transmedia storybuilding, which can be defined as the learning process where the learner creates his/her own story with the help of various media tools and multimodal texts and sign systems, e.g., written texts, sketches, photos, and video (cf. Kress, 2010; Säljö, 2012). In this particular context, there is not necessarily a predetermined storyworld. Rather, the learners build their own, be it factual or fictional. Parallels can also be drawn to the concepts of transmediation (Siegel, 1995) and its synonym transduction (Kress, 2010), which both refer to the process of translating meaning from one sign system to another. However, here we emphasize the continuous flow of the storybuilding process rather than a translation.

The current case of TT implementation serves as an example of how the concept of transmedia storybuilding can be used in sloyd education. The aim is that the learning process will flow between the design and manufacturing of tangible artefacts and a number of converging media tools and multimodal learning objects. The learning process is the learner's own story created through the transmedia learning experience enabled through the resources available. The convergence of the old and the new in this case involves the old ways of mediating sloyd tools and processes with new educational technology such as the Talking Tools application. This kind of instructional method, thus, combines the sloyd subject with multimodal literacy practice.

The idea behind using multimodal content is to make the learning situation flexible and make use of tools that can enhance and visualize materials in multiple ways. Therefore, the multimodal affordances provided by a blended learning environment may assist a transmedia storybuilding process. In this transmedia flow, learners can add their own 'voices' through their active participation, such as voices of co-creation in the sloyd conversation. The intention is to put the learner through a constructive act, not merely transmit content. The story created in this transmedia content flow is ultimately the learner's, although to some extent structured according to a specific instructional design by the teacher. Thus, the learners become more like 'directors' of their learning experiences.

One can argue that humans are by default transmedia storybuilders based on our multichannel sensory system and multimodal brain. This is similar to Stein's (2008, p. 874) claim that "all learning is multimodal". Our perceptual and sensory systems are the source of our conscious experience (Fauconnier & Turner, 2002). Sight, hearing, touch, smell, and taste are our bodies' 'tools' to experience various perceptions from a variety of perspectives, and this is particularly evident in sloyd education (Illum & Johansson, 2012). Media tools function as extensions of our bodies, McLuhan argued (1964) and, hence, educational media tools can be described as extensions of our bodies and senses to assist transformation of experiences into knowledge. It can be argued that the method of using multimodal media tools is thus similar to combining multiple features of our bodies' sensory system for interpreting our experiences.

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SOCIOCULTURAL PERSPECTIVE

ICT (Information and Communications Technology) and access to the Internet have in many ways changed how Western people communicate, behave, socialize and manage their everyday lives. One of the latest additions, the smartphone, has made information online more independent of time and space. The phone is becoming a powerful tool for learning as it has rapidly developed into a pocket-size computer supporting Internet-based applications in which users can create, share, and exchange information and ideas in virtual communities.

A sociocultural perspective, in which learning is seen as based on the relation between the collective and the individual (Säljö, 2005; Wertsch, 2002), is relevant in the design of educational technology where social media often is an important ingredient. This theoretical approach sees our learning in relation to the context we live in, the tools we work with, and the social context we are a part of (Säljö & Linderoth, 2002). The external memory field is expanding, and is continuously being created. This fact is also having an impact on educational settings (Säljö, 2012). Social learning theorists would argue that learning could even be constrained by the lack of social presence as development of knowledge is a social process (Naidu, 2008). Therefore, it is seen as essential that TT supports both individual and peer learning (Johansson & Porko-Hudd, 2013).

When technological tools change, it changes how we interact with the world around us, but also the way we learn and acquire knowledge (Säljö & Linderoth, 2002). It has long been argued that the characteristics of the medium itself will affect society (McLuhan, 1964). ICT allows for new strategies of solving problems and provides an atmosphere of trial-and-error testing for learning. This gives permission for error-making, which then is seen as a step in the process of learning instead of being judged as being right or wrong as an end-result (Säljö & Linderoth, 2002). Mistakes made during a creative process are often crucial steps in order to reach an optimal solution (Beard & Wilson, 2002). This approach towards error-making is of significance for how we learn, and learn to learn in new ways with the help of ICT. It is a sociocultural perspective for understanding how human learning functions in terms of appropriating new tools in our environment (Lave & Wenger, 1991; Säljö & Linderoth, 2002).

One such new learning tool is the smartphone. Two significant factors for understanding mobile learning and its implication for education are conversation and context. Sharples, Taylor and Vavoula (2007, p. 225) propose a tentative definition of mobile learning as "the processes of coming to know through conversations across multiple contexts among people and personal interactive technologies". They "claim that conversation is the driving process of learning" (ibid, p. 225), and that "all activity is performed in context /.../ learning not only occurs in a context, it also creates context through continual interaction" (ibid, p. 230). One affordance of TT is microblogging. This provides opportunities for creating conversations around learning tasks, such as the sloyd assignment in the present study. We want to emphasize this, since the long-term research regarding the TT application is framed by these perspectives; investigating the learning process while using new technological tools and learning objects as a means for learning – from both a learner and a teacher perspective.

RESEARCH AIMS AND QUESTIONS

The aim of the empirical study presented in this article is to find out what teacher students are documenting, in order to explore their patterns of using the multimodal microblogging tool of the Talking Tools (TT) smartphone application. Learners' understanding and actions are always part of a context, which they help to create and recreate (Lave & Wenger, 1991). In this study, the interest is not on the materials and techniques taught in sloyd, but on how learners use the TT application for documenting, reflecting, and

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communicating, in order for us to understand how this new tool influences their learning activities, both individually and socially, and how it can support the creative process. Finding out what learners are documenting will support the ambition of developing guidelines for teachers on how to apply TT in educational situations. The long-term objective is to explore how to maximize the added value of TT in various contexts and for different types of didactical models. Namely, how can learning activities be enhanced, facilitated, and supported by the use of TT for both formal and informal learning in different subjects?

EMPIRICAL STUDY

Background and Data Collection

The Talking Tools (TT) mobile application was piloted on eleven student teachers taking part in a compulsory sloyd course at Åbo Akademi University in Finland. During the course the students were working on an assignment called 'The Battery Guzzler'. In this assignment, the students were challenged to solve a storage problem for batteries. They were instructed to design and manufacture a product that would function as a storage place for batteries with the purpose of keeping track of empty batteries.

Altogether eleven teacher students participated in the course; seven male and four female students. Three of them were first-year students and eight were second-year students. Blogs 1 through 10 and 13 were made by individual students as part of the assignment. Blogs 11 and 12 were made by groups of students. The 'Battery Guzzler' assignment documented in the TT application continued during six teacher-led lessons, each consisting of 3 x 45 minutes. At the beginning of the course, the students were informed about the study and asked to participate in it. All ethical measures were adhered to, in accordance with proper code of conduct. Since the mobile solution at this time only supported Android devices, some of the students could use their own devices, whereas seven students were supplied with a device. At the time of the study, only a limited number of the planned features of TT were available. Therefore, this study was limited to the documentation features.

The students were encouraged to document their work process within the course; from the first ideas to the finished artefact. They were asked to take pictures and write short texts, comments, as well as reflect and describe their work, either during or after the sloyd lesson. In addition, the students were encouraged to follow and comment on each other's blogs by giving feedback and observing each other's work process. The objective was for the students to create their own story of their learning process. The teacher students documented their sloyd processes in 13 different blogs by creating photos and text entries (Figure 1). There were 478 entries (273 photos and 205 texts) varying between 7 and 85 entries per blog with an average of 37 entries consisting of 21 photos (57%) and 16 text entries (43%).

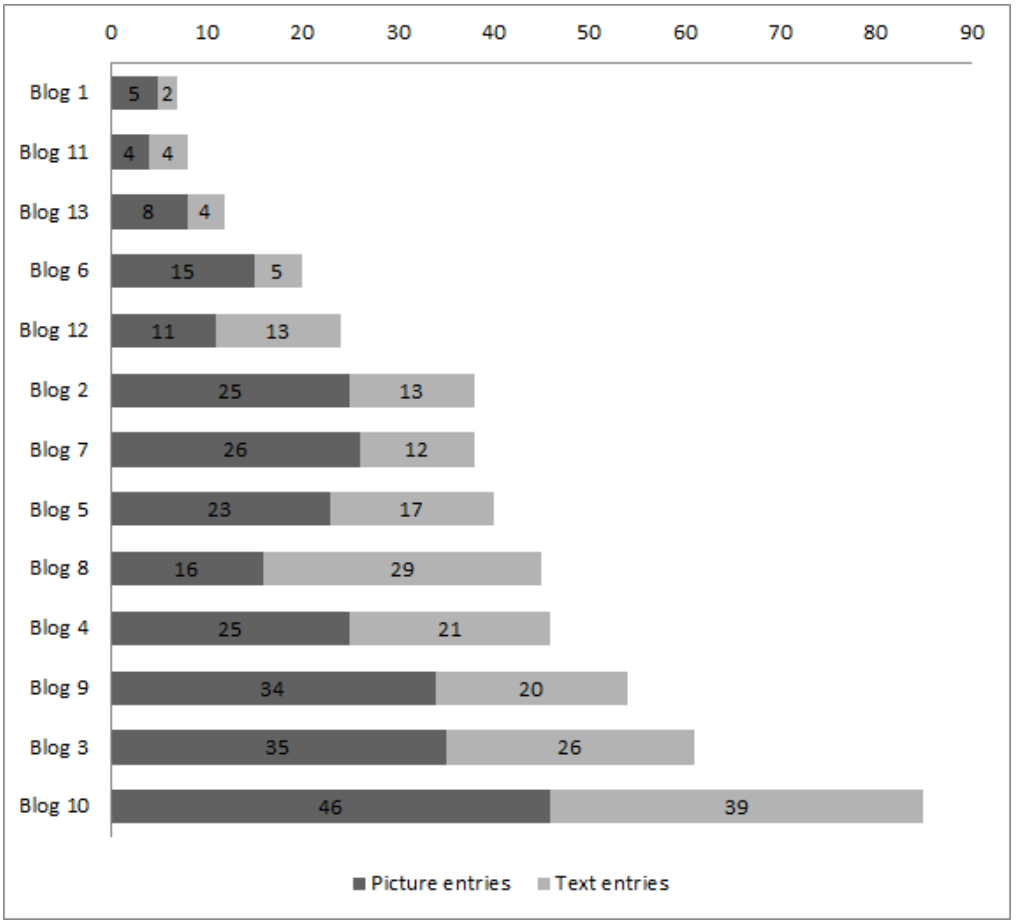
Analysis and Results

Content analysis was used in order to systematically identify categories of documentation practices in the multimodal blog data. As a reliability measure, all thirteen blogs were read and analysed separately by three researchers of sloyd education (one PhD and two PhD students). Their preunderstanding of the sloyd subject was useful for interpreting the blog data, and, especially, in analyzing the visual images. The analysing software NVivo (by QSR International) was used for the content analysis. NVivo allows for flexible switching between entries in blogs and between blogs. This flexibility in manipulation of qualitative data gives an overview that makes it easier to see patterns of interest.

At first, during the process of analysis, the researchers read the material repeatedly. Secondly, the content was organized into units of meaning in an open coding process, in order to identify qualitative categories of activities. Thirdly, the units were categorized further, by analysing and interpreting the essence of the units of meaning. When the data had been analysed independently by all three research-

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Figure 1. Number of entries in the blogs



ers, the interpretations and categories were synchronized. The researchers then jointly analysed the consistency of the categories found. A consensus was reached and resulted in a final number of seven categories of documentation activities made by the student teachers during the sloyd project.

The categories consist of 1) *Concurrent Process Notes,* 2) *Retrospective Summary Notes,* 3) *Lecture Notes,* 4) *Notes of Peer Activities,* 5) *Communication with Peers,* 6) *Emotional* Comments, and 7) *Response to the Talking Tools App.* In the following, the categories are presented using illustrating excerpts. These excerpts have been translated from Swedish to English by the authors, and all names are fictive.

1. **Concurrent Process Notes**: The category *Concurrent Process Notes* consists of notes that the students have made during a work process. The notes can either be pictures of the sloyd product in progress or texts about the work process. The following excerpt exemplifies entries from a student's concurrent documentation during his sloyd process. The excerpt consists of two text entries and one picture entry (Figure 2).

Now follows an interesting experiment with the risk that the entire work is destroyed. The idea is to use a technique that my cousin Dani taught me, namely, sanding away the paper edges.

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Figure 2. Blog 3: Concurrent process notes



The sandpaper technique works surprisingly well. The most important thing was to always sand diagonally downwards. (Blog 13).

In the first text entry the student describes what he will do and shows his awareness about a critical phase for the work as a whole. The student exposes the fact that his work requires preparatory work in the form of information retrieval. Here, information is retrieved from a cousin who has experience of similar operations. The picture taken a few minutes later shows him using the technique. In addition, the student has engaged a fellow student to take a picture of him as he carries out the technique. The image adds value to the text since it visually shows how the technique is performed (diagonally). In the second text entry he evaluates how the method worked. Using text and image together he highlights the most effective work method. All three entries, made within 17 minutes, illustrate a demarcated moment of the manufacturing process.

2. **Retrospective Summary Notes:** Although the mobile device allows concurrent note-taking, some students chose to describe their activities after class, like a retrospective summary of what they had accomplished during the day. The following excerpt describes how one student summarizes what he/she has been working on. The entries within this category are generally longer than entries made during a manufacturing process. Entries also include descriptions of several different steps in the process. The excerpt below, in blog 13, includes descriptions related to all phases of *planning, planning of manufacturing,* and *manufacturing and evaluation* (Lindfors, 1991) of the artefact.

I started by sketching out what I wanted to do ... Finally, I came up with the idea of a cat with LED lights as eyes.

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After this I glued together pieces of wood that would be enough material to cobble together a box. Having planed boards, I would start with the box BUT the material cracked and I started from scratch with taking finished pieces of wood and screw and glue together into a box. After this I sawed out a cat face, paws and also cut out a piece of metal as a back plate for the cat. That is how far I have come at this point. [Blog 13]

The entry includes a description of different stages of the process from idea to ongoing manufacturing activities. The text is used as a retrospective description of different phases of the craft process. The student discloses that the work began with sketching, but mentions nothing about what the sketches contained. The selected idea is described briefly. After this, various manufacturing-related stages and events are summarized. Unlike the first category, entries in this category contain much information about the manufacturing process. In addition, the sequence of actions and phases are described in the written text, whereas pictures are more commonly used in entries in the first category. In this blog the social context is not documented, which may be perceived as an indication that the student was working alone.

3. **Lecture Notes:** Entries that describe things that the teacher taught during the lesson make up a third category. Many students made text notes of things that the teacher said during the lessons. The excerpt below describes a text note of critical steps in using the circular saw. In blog 10 the student stresses some of the critical safety aspects by using capital letters.

circular saw. NEVER use both the rip fence and the crosscut fence at the SAME TIME. Cut pieces with enough supporting surface. earmuffs and face shield should be used on all type of machines. [Blog 10]

Ten out of thirteen students chose to take pictures as the teacher demonstrates a new manufacturing technique or machine. The excerpt in Figure 3 is a picture in Blog 3 representing teacher 'J' demonstrating how to use the planer.

In this entry there are no written text comments related to the picture. The image is used as a memory aid for catching work posture, grip and generally handling of the material when using the planer. In this particular situation students were encouraged to take photos about how to safely and correctly use the machine.

4. **Notes of Peer Activities:** For the most part students described their own work processes. Nonetheless, some students made entries about fellow students' processes. The fourth category comprises posts about what others in the group are working on. The excerpt from Blog 4 below illustrates how a student describes what his/her peers are planning to do within the assignment.

Hahaaa! Managed to measure out my hexagon! Jonathan in the background [referring to a previous picture post]. He'll do a house. [Blog 4]

While the student's own success is mentioned in the blog, the student also comments on what his/her peer students are working on.

5. **Communication with Peers:** In contrast to category 4, *Notes of Peer Activities,* in which comments about other students' work are only mentioned, category 5 describes peers as active participants who in various ways influence how the sloyd process progresses. Although most entries were about documenting a student's own process, the microblogging tool was also used to communicate with fellow students. The excerpt in Figure 4, consisting of a picture and a text entry below from Blog 2, describes how a student thanks another student for helping with the planning during the lesson:

Here's my drawing. thanks Emma for helping with the calculation! [Blog 2]

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Figure 3. Blog 3: Teacher 'J' demonstration



Unlike previous categories, entries in this category show communication with classmates. In the excerpt above classmate Emma gets a thank you for her help with the planning. The image and the accompanying written text summarize a working stage in cooperation.

6. **Emotional Comments:** Some of the entries show how emotionally engaged the students are throughout their work process. Entries reveal anticipations for the task, the joy after a successful work step and disappointments when the final outcome was not as planned. The excerpt from Blog 3 below describes the anticipation and anxiety after a critical point in the work:

Oh no... hard to know how it will be. Doubt that the glue will hold. Hope I get rid of air bubbles ... [Blog 3]

In the excerpt below, from Blog 4, the student is in the phase of *manufacturing*. He/she points out that a certain stage of the overall work is successfully finished (in this case sawing) and it is time to go on to the next stage. Documentation that explicitly marks an ending of a phase in the work process as a whole emerges frequently in the students' blogs.

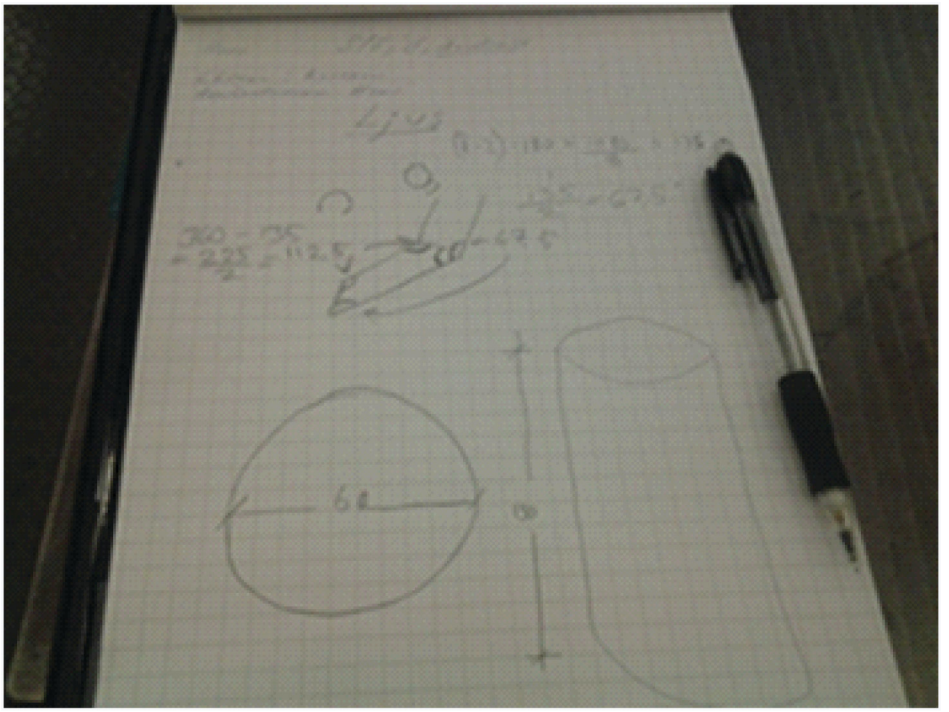
Yes, sawing check! [Blog 4]

The thumbs-up is used to reinforce the message of the text (Figure 5). In addition to writing about the successful sawing, the student has placed out the material in the background of the photo to emphasize the expression of the 'like' imagery.

7. **Response to the Talking Tools App:** The seventh category consists of posts and comments on the Talking Tools app. Students

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Figure 4. Blog 2



commented the application's ease of use in particular and also provided suggestions for technical improvement. The excerpt below, from Blog 4, describes a student's suggestion on how the usability of the microblogging tool could be improved.

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A delete function for individual blog posts would be surely nice, considering my previous post. In addition, an opportunity to write titles on posts would help structure. [Blog 4]

He/she proposes developing a function that would allow deleting entries. He/she also suggests that each post could be marked with a title.

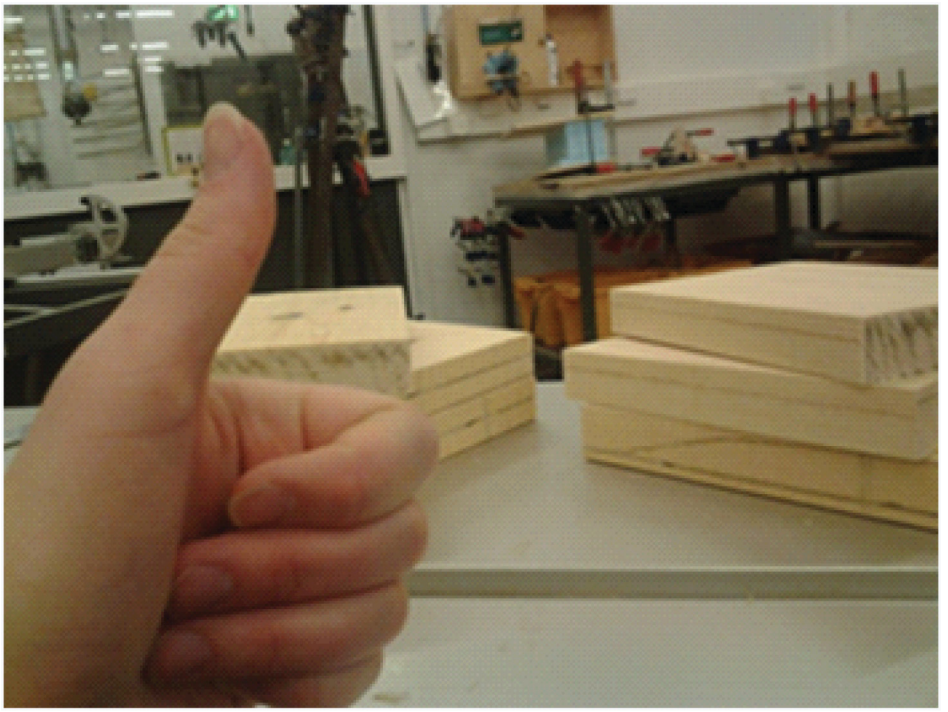
Summary of Categories

The results show that many of the notes were made after the completion of a critical step of the work process, and before the next step or phase was begun (category 1). The students took a break for documenting one phase before starting a new one. The microblogging was also used for diary-like descriptions of what had happened during the day (category 2). This second category, *Retrospective Summary Notes*, contrasted with the first category with regards to both length of notes and the time of the documentation.

TT was often used for note-taking during the teacher's demonstrations (category 3). Thus, TT substituted regular note-taking methods, such as using pen and paper. The work process of sloyd education takes place in a social context where we are influenced by each other. Students found it relevant to write what other students were doing (category 4). Written text and photos show how students help each other during their work process (category 5). Students used emotional comments to reinforce their emotions related to their work process, e.g., happiness about successful operations, and anxiety

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Figure 5. Blog 4: Sawing check



about uncertainty of the outcome of operations in the work process (category 6). Finally, some technology-related reflections were described in the students' documentations (category 7).

CONCLUSION

The research interest in the development and implementation of the Talking Tools (TT) centres on how learners' learning and reflection are facilitated. We will summarize what the students' documentation showed us about the possibilities and challenges of using this smartphone application. We discuss the findings in relation to the specific conditions of sloyd education, while using perspectives of multimodality, socio-cultural learning, and transmedia.

Phases of the Sloyd Process

In sloyd education, it is desirable for learners to take notes of information that is relevant to their own work. However, creating meaning in the documentation may also include aspects that are not directly connected to sloyd. One aspect that is meaningful to one learner may not have the same value for another learner, or for the teacher (Säljö & Linderoth, 2002; Porko-Hudd, 2011). However, both the first and second category of the blog analysis (*Concurrent Process Notes* and *Retrospective Summary Notes*) show evidence of the Lindfors' (1991) system theory of phases and steps in the learner's sloyd process.

The theory conceptualizes the sloyd activity as an ongoing, holistic human process where the actor (learner, teacher and peers) is acting within the sloyd activity itself. The learner's sloyd process is a slowly progressing process of structural change, divided into three phases: the *planning phase*, the phase of *planning of manufacturing* and the phase of *manufacturing*. These steps will naturally overlap and be iterative, as the process will most likely occasionally go backward and then forward again (Lindfors, 1999). The blogs' contents easily fit into the three sloyd process phases as most entries somehow

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describe moments within the work process. Without going into further detail of Lindfors' theory, we conclude that the steps of the sloyd process were represented in the blogs subjected to study. It also made us aware that the phase of *manufacturing* could be further developed as the blogs clearly made visible how the phase in fact consists of several reiterative moments of planning, executing and evaluating.

Multimodal Documentation

In the social context of sloyd, multimodal documentation offers a broader picture of how teaching has shaped the learners' work (cf. situated learning, Lave & Wenger, 1991). Many students used both written text and photos in their blogs. A photo of a calculation (as documented in Blog 2) may be used as a memory aid. But it also provides possibilities for both classmates and teachers to observe and learn how the reasoned solution was developed. Similarly to a written text, a photo mediates meaning for both the photographer and the viewer of the documented information. The photo becomes a mediating resource for meaning-making (Kress & van Leeuwen, 1996/2006; Säljö, 2012; Wertsch, 2002).

Entries in categories 1 and 2 (*Concurrent Process Notes* and *Retrospective Summary Notes)* show that the written language is important in order to make reflections. As Vygotsky (1986) states, the written word is crucial to convey thinking. However, a reader with prior experience in sloyd can perhaps follow the text-based documentation of this type, while a non-experienced novice would likely benefit from additional images. The results further indicate that retrospective summaries are useful, also when modern smartphones are used as tools for documentation. This method of writing in a diary form has lately been used by students teachers at university level, as well as by learners in sloyd education in elementary school, in order to describe their sloyd processes, and to raise awareness about their work process (e.g., Johansson, 2002, 2011).

Prior research has shown that sloyd is a subject that easily touches learners emotionally, which is confirmed by category 6 (*Emotional Comments*). These emotional experiences may even be carried for a long time (Porko-Hudd, 2011). The results in this study show that multimodal documentation was used for expressing emotions, using both text and nonverbal signs through photos (see blog 4). Using the thumbs-up sign to communicate positive emotions non-verbally in a photo is perhaps representative of the multiliteracy-skilled net generation. However, this type of innovative multimodal communication may also be seen as part of the appropriating process of using TT as a new tool for learning.

The students' documentation clearly shows how smartphones enable multimodal texts, which contributes to a rich documentation of thoughts and actions. Video as a note-taking feature was not available in the early version of TT that was piloted, but it would no doubt add richness to the documentation. Moving images might provide opportunities to document complicated processes, which are difficult to reproduce in written text. Examples of such processes could be ergonomics, technology, and handgrip (Goodwin, LeBaron & Streeck, 2011). Although multimodal documentation enables sensory experiences to be described, some experiences (for instance how soft a material ought to be) need to be experienced in real life (Illum & Johansson, 2012). However, for people with these prior sensory experiences of processing materials, the documentation with TT facilitates describing and sharing such experiences through the multimodal documentation. Although no smartphone can replace sensory experiences TT can be used as a complementary resource to document the perceptions and appearance.

Open Access for Classmates and Teacher

It can be concluded that the student teachers' blog posts give a good general picture of the activities in the sloyd class. One of the great advantages of this kind of documentation is that it makes the individual work process visible to others in the group. By having access to their own processes, as well as those of their peers,

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learners are given the possibility to become more aware of their own performance as they can compare it to others' work processes. The opportunity to take part of each other's documentation, or share documentation, can be seen as a resource for learning as it builds up collective memory (Säljö, 2005; Wertsch, 2002).

Prior research on learning in sloyd has shown the importance of providing opportunities for reflecting on the learning (Johansson, 2002, 2006). Especially in sloyd, learners are prone to focus on the practical doing rather than the more abstract notion of what they have learned from the work process itself. When documentation is available even after class hours, learners can continue their reflective process outside of school. It provides nearly limitless opportunities for classmates to learn and communicate, as well as to be present in each other's learning processes. Thus, they can both give and get new perspectives that they otherwise would not have received. The fact that learners can easily access the notes of classmates provides an advantage over notes made on paper as the time for reflection becomes more independent of time, place and pace.

Potential Challenges

It is important to point out that all entries do not necessarily describe the correct way to perform a task or work step, as wrong practices may just as easily be documented. This might reduce the informational value of the memory aid. For example, within category 3 (*Lecture Notes*), there was a photo of the teacher standing on the wrong side of the circular saw (blog 1), which might be dangerous. This fact was not reflected on in the blog. Hence, documentation without correct reflection may even be harmful, especially since it is so easy to take a photo in every kind of situation.

Simultaneous documentation might distract learners' attention from the teacher's teaching, as well as distract the teacher. There is also a risk that the microblogging about the task becomes more interesting and time consuming than the actual task that is being documented. Another challenge might be to develop an open and positive atmosphere where learners give each other constructive feedback. An ongoing creative process is often very personal and learners may be sensitive to criticism. The question is whether learners even want to share everything. The approach needs to be carefully described, and the class should agree on a common code of conduct.

The Transmedia Story

While looking at the teacher students' documentation activities from a transmedia storybuilding perspective, a few aspects need to be highlighted. First of all, it can be concluded that the documentation process does not necessarily become a story by default. Rather, the documentation process can metaphorically be compared to a path of knowledge building as described by Scardamalia and Bereiter (2006). Secondly, the storybuilding process has several parallel stories: 1) about the artefact development (Lindfors, 1991), 2) about the learning process related to the artefact development, and in the case of teacher students there is the story 3) about developing as a teacher (Uljens, 1997). These parallel story tracks are naturally intertwined, but need to be emphasized to facilitate reflection for each of them in the documentation process.

The difference between transmedia storybuilding and storytelling is another aspect that needs to be problematized. The documentation process using TT is naturally multimodal and flows between mediating tools, similar to a mediation process of using multiple sign systems (Kress, 2010) for communication and documentation. We interpret these as transmedia affordances enabling a transmedia storybuilding learning process. However, this is from the perspective of the learner. Whenever the goal is to 'broadcast' your story to a peer, or the teacher, or even a parent, it becomes a storytelling process, and then it is not necessarily transmedia, unless multiple means of transmitting are used.

From a sociocultural perspective, the process of co-creation is seen as ubiquitous (Lave

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& Wenger, 1991). This aspect is especially emphasized in the way TT is designed. Its purpose is to encourage learners to communicate, collaborate, teach and learn from each other's processes, and be involved in an ongoing co-creation process without boundaries. Thus, the two perspectives of storytelling and storybuilding are not easily discerned as separate entities. From a sociocultural perspective you cannot, perhaps, even separate them. The essential affordance we would like to highlight is the possibility it brings for reflection, and for this you can use either a specific storybuilding assignment for an internal reflection on the process, its successes, failures, and end results, or you can focus the assignment on reflections through storytelling, in which learners create a story for the purpose of an external audience.

Methodological Considerations

The results represent the authors' subjective interpretations of the blogs' content. However, from this interpretive research method the teacher students' subjective experiences cannot be fully understood. Differences can most likely be found between what the students document and what they actually did (cf. Johansson, 2002, 2006; Säljö, 2005). Also, the data often lacked descriptions of the context, which would help in understanding the activity, especially the social context.

Future Research

Research ambitions regarding the Talking Tools application and its implementation in various learning contexts are comprehensive, broad and long-term. The assumption is that learning resources allowing for multimodal learning and transmedia storybuilding in learning broaden the horizon of proximal development. There are at least three perspectives that will be covered: a sociocultural perspective of the learning experience, a contextual perspective of implementation in a variety of contexts, and a learning design perspective of how to increase the added value of TT by exploring various methods of implementation. There is no doubt that the multimodal documentation features of TT offer a new platform for reflection. However, a future challenge is how to make the documentation a resource for learners to reach a better awareness of their own learning. Future research within the project could therefore focus on what practices are needed to help learners analyse, reflect, evaluate or summarize their learning process.

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