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Students’ experiences of their knowledge formation in a one-to-one computer initiative

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ABSTRACT
The research on one-to-one computer learning settings shows what students do while using computers and how much they use them. It is believed that students are highly motivated by having computers of their own and show improved grades, but few studies can confirm this belief. This study investigated the experience of knowledge formation amongst pupils in upper secondary school in Sweden during a one-to-one computer-based task. The theoretical and methodological framework stems from Interpretative Phenomenological Analysis, IPA. The analysis generated eight categories of statements, grouped into two themes: “Experience of processing the knowledge formation” and “Experiences of tool-handling”. The article concludes with a proposal for how to expand on the students’ experiences, allowing for deeper learning from one-to-one computer-based paradigms.

KEYWORDS
One-to-one; learning experience; IPA; knowledge formation

Introduction
International research on one-to-one computer initiatives shows that although computers are a considerable intervention in the learning context with promising possibilities, the results in school do not improve despite the fact that motivation seem to increase. The Swedish context resonates with these international research experiences. Consequently, we need a deeper understanding of the experience of the knowledge formation process, providing clues to the possibilities and pitfalls of one-to-one computers from the students’ perspective in order to adjust the educational use of computers to gain better effects. Therefore this article aims to describe students’ experiences of their knowledge formation when performing a knowledge task in a one-to-one computer learning setting in upper secondary school.

Literature review
Development of skills
Previous research illustrates increased skills through a one-to-one computer learning setting, particularly skills such as information-seeking (Warschauer, 2006). However, the degree to which information-seeking skills develop beyond Google and Wikipedia is highly dependent on training programs, involving both teachers and students. The students are reported to
improve their use of ordinary presentation and production software such as the Microsoft Office suite or Open Office. Again, development beyond the basic use is dependent upon well-designed educational plans and/or teachers with specific interests (Oliver & Corn, 2008). Research on one-to-one computer learning settings also reported increased skill in electronic communication and in organising study material (Dunleavy, Dexter, & Heinecke, 2007; Grimes & Warschauer, 2008; Lei & Zhao, 2008; Oliver & Corn, 2008).

Motivated but no effects on grades

Research also indicate higher engagement and motivation due to computers as well as positive effects on self efficacy (Keengwe, Schnellert & Mills, 2012) and cognitive performance (Hansen et al., 2012). In terms of improvement in grades, the literature shows almost no reliable results in terms of broad studies (Fleischer, 2012; Gulek & Demirtas, 2005), but there are some smaller indicative studies showing positive results (Islam & Grönlund, 2016). However, there is a lack of rigor and scale in most of those studies (ibid.).

Swedish research

The trend of implementing one-to-one computers in Swedish schools started on a broad scale around 2007, although the very first attempt was conducted as early as 1996 (Naeslund, 2001). At present, 75 per cent of all students in upper secondary school have a one-to-one laptop or iPad (Skolverket, 2016).

The event that started the wave of one-to-one computer projects in Sweden occurred in 2007 in a municipality with two elementary schools. One of the main goals in this one-to-one computer project was to increase the students’ motivation to learn (Tallvid, 2010). Even in this project, the motivation to learn increased as a result of one-to-one computers to a degree of 76 per cent (answered very much or much on question about increased motivation in the questionnaire).

The most current broad Swedish study on learning in one-to-one computer setting stems from a research project following 24 schools in eleven municipalities during 2010-2013 (Unos Uno, 2013). Of the students, 86 per cent assert that school has changed for the better with one-to-one computers (Grönlund et al., 2011). Students stated that learning is easier and more fun and that the computer makes them more effective. They also state that they have become better at organising material, seeking information and communicating with their peers. However, the students also experience the computer as a distraction, both during and outside lessons, mainly because of social media use, listening to music and playing games. Amongst the elementary school students, 65 per cent claim that they learn in other ways with the computer, compared to 44 per cent of the students in upper secondary school. This change is related to searching for information on the Internet and to the fact that the computer makes the schoolwork easier and more fun in general. As to whether the computer influences their learning outcomes, 53 per cent of the students asserted that their learning has improved due to the computer. However, when comparing merit-ratings in the elementary schools within the municipalities, six of them are decreasing, four are increasing and three are equal compared to 2010. The research (Grönlund et al. 2011) claims that it is
absolutely clear that the computers do not have a distinct and immediate positive effect visible in the grades, a result which is in line with international research.

**Theoretical framework**

The theoretical basis for this article is founded in Interpretative Phenomenological Analysis (IPA). Although the name signals that it is primarily a question of methods, there are strong theoretical foundations, mainly in phenomenology and hermeneutics which come into play in analysing and interpreting the results.

**Phenomenology**

Phenomenology is a philosophical approach to the role of experience, founded by Edmund Husserl as a reaction towards the research ideal at the time laying in psychology (Smith, Flowers, & Larkin, 2009). To Husserl, the basic idea was to investigate the experiential content of consciousness, expressed as going “back to the things themselves”. The thing to go back to is the phenomenon, that is, the way something reveals itself to us (ibid). To do that, according to Husserl, one must leave the natural attitude and go into the phenomenological attitude, which is a reflective mode, directing the gaze inwards rather than at the object being studied. Consciousness, in Husserlian terms, is not something that resides within the subject, but rather between the subject and the object. Heidegger (1962) expands on this, coining the term being-in-world, illustrating that we are always making sense of the world in one way or another, mostly in a circumspective way. Because the consciousness is always directed towards something and is affected by that thing, the consciousness is never to be found within the person. This is emphasised by the term Dasein (Dreyfus, 1991; Heidegger, 1962), translated to being-there. According to Heidegger, we are thrown out into the world, thus always in the process of understanding it, within the lived, unreflected experience, affected by the past and the future in a situated way (Heidegger, 1962). The phenomenological tasks is to question and reflect upon this natural attitude (ibid.) and question the revelations of the world in front of us with its objects being ready-at-hand. The things around us, being ready-at-hand, are never understood as separate instances of the world. Rather, everything is organised in nexuses of meaning (Dreyfus, 1991). In this study, the sense-making of the computer in the classroom is connected to and affected by, for example, the lived experience of computers at home, which is related to the house being lived in, which is related to the city being lived in, and so on.

In this study, the phenomenological foundation means that the focus is on the students’ sense making of their knowledge formation in a one-to-one computer learning setting interpreted as an intentional act. It also acknowledges and accentuates the knowledge formation in the one-to-one learning setting as embedded and immersed in a world of other objects, cultural codes, languages and concerns, that is, in a meaningful nexus.

**Hermeneutics**

The hermeneutic task is foremost to create bridges of understanding between different worlds (Palmer, 1969). In Greek mythology, Hermes was a herald, making messages
from the gods understandable to human beings. Hermeneutics has a long history, including many different subjects. Palmer (1969) states:

The field of hermeneutics has been interpreted (in roughly chronological order) as: (1) the theory of biblical exegesis; (2) general philosophical methodology; (3) the science of all linguistic understanding; (4) the methodological foundation of Geisteswissenschaften; (5) phenomenology of existence and of existential understanding; and (6) the system of interpretation, both recollective and iconoclastic, used by man to reach the meaning behind myths and symbols (p. 33).

In this article, hermeneutics is used in the fifth and sixth senses. Because humans are doomed to meaningfulness, we are always, as said above, in the process of understanding the world. According to Heidegger (1962), this understanding is always underpinned by fore-conceptions:

Whenever something is interpreted as something, the interpretation will be founded essentially upon [...] the fore-conception. An interpretation is never a pre-suppositionless apprehending of something presented to us (pp. 191-192). Heidegger notes that the fore-structure could potentially be an obstacle to the interpretation of the object, and he therefore calls for priority to the new object, and not to the fore-conceptions. A proper interpretation should work its way from the thing to the fore-structure. In this IPA-based analysis, this notion has methodological consequences as described in the section on data analysis.

The hermeneutic circle is the most resonant idea in hermeneutic theory (Smith et al., 2009). The basic premise of the hermeneutic circle is best expressed like this (ibid.):

It is concerned with the dynamic relationship between the part and the whole, at a series of levels. To understand any given part, you look to the whole; to understand the whole, you look to the parts [...] it describes the processes of interpretation very effectively and speaks to a dynamic, non-linear, style of thinking (p. 28).

The primary contribution of the hermeneutic circle in this article relates to the methodological attempt to operate at a number of levels within the data.

Method

The study site

The study site for this investigation is an upper secondary school in one of the larger cities in western Sweden. At the time of the study, the school had provided computers to all students and teachers for half a year. The school includes 1,300 students from a mixture of socio-economical statuses. The central school board of the chosen city asked the teachers for participants within suitable topics (in which the students worked freely with their computers). The students of the chosen class were informed about the research and the aim of the study in advance, as well as that participation would be voluntary.

Data collection

The research project was performed within the framework of one specific topic, namely making budgets in private economy in social sciences. The class chosen was in the first
grade in upper secondary school, meaning that they were 16 years old. The specific task for the students was to engage with a case study about private economy in which the knowledge task was to answer four questions by writing reflective answers in a proposal. The students worked in self-chosen groups of two or three persons. In total, 20 students completed the task, and 15 of those were interviewed. The interviews have been translated from Swedish to English. The remaining students declined or were absent at the time of the interviews. The students were assigned the task during lesson time and were given supporting material such as links to websites, but the teacher challenged the students to work as independently as possible. The work was completed within four weeks. Short lectures were given twice a week during that time. During the rest of the time the students were allowed to work in the classroom or elsewhere.

The task at hand revolved around private economy within social science, split into four parts. In the first part the students made a budget for a case family. The second part dealt with the relationship between welfare and private economy with two sub-questions: a) How is the family affected by the welfare society? And b) How is the family affected when the economy is stressed, due to external factors such as becoming unemployed? The teacher expected the students to discuss economics from a social perspective in the third part of the task, in which the students discussed the following question: What socio-economic status does the family have, and what signs of it can you see? The fourth part revolved around power, and the students were to engage in a discussion on what type of power the family has and how to use it in the private economy.

Interviews were collected three weeks after the knowledge task ended. The interviews were conducted and recorded at the school. The 15 interviews were conducted in a semi-structured way, following the recommendations for interviews in Patton (2002), evolving around what meaning the computer had for the interpretation of the knowledge task and the students’ knowledge formation.

In total, there were five hours and six minutes of interviews transcribed verbatim, with a focus on the content of the participants’ account rather than on the prosodic aspects of the interview.

Data analysis

The interviews have been analysed via an Interpretative Phenomenological Approach (IPA) (Smith et al., 2009) with assistance from the qualitative analysis computer program MaxQDA (MaxQDA, 2013). However, IPA is sometimes regarded as un-hermeneutic (Smith et al., 2009) in the sense that understanding is a free and flexible process and cannot be guided stepwise. Therefore, in the following analysis, the steps outlined in IPA have been used; nevertheless, flexibility has been preserved in terms of transferring, grouping and merging categories and themes. MaxQDA is a program for recording code notes and sorting them as the researcher instructs. It does not do any analysis of its own. MaxQDA was the appropriate software because it allowed the researcher to work as flexibly as if the analysis was performed manually but included the possibility to let the computer sort and find quotations quickly.

The analysis process consisted of seven steps. The analysis started (1) with an acquaintance with the overall material, reading the transcripts several times on paper.
After that (2), initial coding took place by assigning memos, notes and keywords to units of meaning in the transcript by assigning new codes in MaxQDA. Examples of this are illustrated in the table below.

In accordance with IPA, those notes were assigned to categories indicating whether they indicated something of interest and whether they provoked associations or reflections. This was followed by (3) a preliminary categorisation of the initial codes within the transcription, laying out a basic but not static system of categories. In the following analysis of further interviews, those categories were not simply recreated but questioned, changed and fine-tuned, meaning that code notes were transferred between categories. The table below illustrates how two separate code notes were assigned to a preliminary category.

The next (4) step was to relate the categories to each other, expanding them through polarisation, generalisation and contextualisation. This was done by looking for overlapping categories, as well as categories appearing near each other within the transcript, as exemplified in Table 3.

After this, a summary (5) was formed about the transcript under review in an attempt to grasp the full understanding and interpretation of the interview transcript, forming an overall note about the main content of the interview.

<table>
<thead>
<tr>
<th>Table 1. Example of code note.</th>
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<tbody>
<tr>
<td><strong>Transcription</strong></td>
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<tr>
<td>I: When did it become important to talk to the teacher?</td>
</tr>
<tr>
<td>S: We just wanted to speak openly with him, we kind of already knew the answer. However, we still wanted to reason a bit and check what he thought about it... So we spoke about how to do if the family didn’t get a job? Then he said that if you can’t... like, the unemployment office can pay for going to school, but not always... so we understood that if you take a loan, it will be harder later on.</td>
</tr>
<tr>
<td>I: So you wanted to check but also understand the situation?</td>
</tr>
<tr>
<td>S: Exactly</td>
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<tr>
<th>Table 2. Example of transferring of code notes into categories.</th>
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<tbody>
<tr>
<td><strong>Transcription</strong></td>
</tr>
<tr>
<td>In the end, we had to click away Facebook and such things. Then... you were under stress and thought: you have to prioritise. And then we did it... I know where to draw the line.</td>
</tr>
<tr>
<td>I: Talking about having goals... sometimes you just have to deal with stuff?</td>
</tr>
<tr>
<td>S: That’s the way with everything. Sometimes you are not just too tired. But you have to have a goal that you fight for</td>
</tr>
<tr>
<td>I: Is that a good way of thinking in school as well?</td>
</tr>
<tr>
<td>S: Yes... When you get tired of it, you think “I have to do it, I really have to do it. Then you have, like, it’s like a competition, you must make it. I really think so.</td>
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<th>Table 3. Example of transferring of code notes into categories.</th>
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<td><strong>Transcription</strong></td>
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This process is then (6) started again with the next interview transcript. When all of the interviews had undergone the initial analysis, a synthesis (7) was performed. In this process, a matrix was formed with the Code Matrix module in MaxQDA with all transcriptions and emergent categories. There was yet another fine-tuning of the categories, in which some codes were collapsed and transcripts were transferred between categories, and the categories that occurred in more than half of the cases were included in the results presented. From those categories, two main themes emerged: Experience of processing knowledge formation and Experiences of tool-handling.

The analysis of the 379 coded segments formed 10 categories, describing key aspects of the students’ sense-making of the knowledge formation process when answering a knowledge task in one-to-one computer learning setting. Two of the categories were applied to less than half of the students; these categories were left outside of the analysis because the aim of the study is to reveal the overall architecture of the students’ understanding. All of the remaining categories are present within all of the interviews, but they express different strategies within the frame of the category.

In the following illustration of the findings from the interview, the students are marked with numbers. Students 1, 6, 8, 9, 12, 14, 15 were girls, and students 2, 3, 4, 5, 7, 10, 11, 13 were boys.
Results

Below the results are presented within the two main themes.

Experiences of processing knowledge formation

Starting point

Common to all of the students is that the students assert that to solve the knowledge task with the aid of the computer, they need a known starting point. They make sense of the knowledge formation with one-to-one computers as somewhat ‘wider’, in the sense that there are more opportunities to gain information, which is valuable, but it simultaneously provides more opportunities to lose themselves in the depth of information.

In the interviews, students express that they understand the knowledge task at hand as both a task in which information gathering is important, as well as a task in which they are supposed to reflect upon their knowledge formation. The students express strong needs to depart from what is already known. However, the starting strategies described differ. Some of the students prefer to begin from a recommended source on the Internet, such as one given by the teacher. This helps them quickly get into the material: "We were given Internet pages by our teacher that he recommended. So, it was a big help, instead of looking in the book and writing it down" (11). Another strategy is to start with the easiest parts, the part that could be performed more mechanically, such as creating a table of contents and other necessary elements of the product: "We started out by reading the task . . . I did the table of contents and such smaller things. Fixed the front page. After that, I started to search for information" (8). The view on knowledge formation in this type of reasoning with this strategy is interpreted as the student understanding the importance of getting a sense of the totality of the product before delving into the unknown details of the final product. A related strategy for managing the totality before delving into new material is to define central terms from which the students then thread-search the Internet. This related strategy is also used for getting along and for the students to have the same definitions for terms such as ‘private economy’. In this case, they understand that they should be careful to define key terms at the beginning of the work because working with an Internet search could be far too broad: "For example ‘private economy’. At first, I just searched what it was, and then I continued to search on the topic I got" (6). Yet another starting strategy among the students was to work from practical aspects with which they had personal experience. As an illustration, in the case of making a budget, they discussed how much they spend on clothes, make-up, cell phones and sports, and started out solving the task that way. Other students benefitted from the fact that one student in the group owned an apartment, and that could be used as a starting point: "he has the same apartment as the one we should use. So it was . . . we got much help out of that" (15).

Importance of reflection

All of the students express that there is need for reflection to gain knowledge to solve the task. When making sense of their knowledge formation and of the task given, they also realise how important it is to reflect upon the answers given. One strategy
expressed is that they have to agree in regard to the questions whose answer is not a simple fact, grabbed from the Internet: "...Because everyone must agree about the content, so they think it is good" (6). The students experience that the proper way to form deep knowledge is to discuss and reflect on the form of the knowledge. The students express a strategy developed without the computer: "...Analyse and thinking. When it comes to those deep questions" (14). In those strategies, the best way to solve the questions at hand is to take a step back and meet face-to-face to discuss and reflect. Many students also experience their knowledge formation in the one-to-one computer learning setting as a bit stressful, and they state that the quality of discussion and reflection could be negatively affected if they do not take a step back. Illustrated in this interview excerpt is a student, realising that the lack of discussion amongst his peers has negatively affected the overall quality: "We should have discussed the questions more ... I think it would have been better, actually. Because then all in the group will come to a conclusion" (5). As an extension of this, those students sometimes also want to engage the teacher: "We just wanted to talk a bit more openly with him (the teacher), although we did know the answer. But we wanted to reason a bit to see what he thought about the topic" (12).

**Importance of Analogue Reading**

Though the students make sense of the one-to-one computer as a rational tool saving time, all but one of the students disliked it for reading. They express that reading quality is negatively affected because they feel that it is harder to concentrate: "I cannot concentrate. I can’t. I can’t read on a computer. I need to have what I read on paper or in a book" (2). They assert that this reading experience leads to a shallower understanding of the text, due to physical tensions while reading: "I think that it is really hard to read that many pages on the computer...You get tired and you can’t comprehend everything. It becomes shallower" (12). Another stated reason to get away from the computer whilst reading is the different sensation of holding a book or a paper in comparison to reading on screen; they lack the opportunity to read comfortably in bed or to make notes properly. Therefore, they actively asked the teacher for printed versions of the texts, even if accessible by computer: "I used to print it and use it that way, so that I have kind of a booklet. The teacher used to do that for us as well. It’s easier if you are to take notes and so on in the text, you can’t do that on screen" (5). Many students primarily use reading on the computer in the task as skimming, finding proper information to process further. This leads to a pendulum motion while working, finding some information, processing it, and then returning to find more info and quickly reading it: “First you get some information, and then you type in the information found, and then you find something else, and then you type that in" (1).

**Information Source Evaluation**

The students also make sense of knowledge formed with material found on the Internet as a source that needs to be corroborated with other facts. At times they use friends and relatives, and at other times they use the teacher as a control station: “We do check with the teacher. Absolutely. Then he might say some things. So maybe one of the answers was not correct” (11).
A large part of the time used to solve the task involves searching on the Internet. All of the students understand the task as including dealing with the ability to evaluate information and handling the evaluation differently, and the one-to-one computer is experienced as giving them access to information to reflect upon. The simplest way experienced was to use the top-most link in the Google search, even though it was not experienced as always reliable: “I used to click on the top-most first. But then... Internet, you can’t always trust the Internet” (9). Because of this the students use diverse strategies, including avoiding uncertain web pages, such as forums, where ‘ordinary’ people are writing, in favour of more official sources: “You might want to use a bit safer pages, maybe... like The Swedish Social Insurance Agency and stuff like that” (11). Comparing sources was another strategy to address the uncertainty of the one-to-one computer in terms of gaining information. The students use skim-Googling, finding three or more sources of information to reflect upon when drawing their conclusions: “You have to find something trustworthy... then you find another that sounds as good, but that differs. Then you don’t know which to choose, so you have to take in a third source to see who is most correct” (1). Most of the students also state that the information on the Internet could be outperformed by other sources, such as by speaking with personal contacts, teachers (as mentioned earlier) and books. However, some of the students experience hesitation towards books. On the one hand, when asked whether to choose book or internet to rely on if forced they state: “I think I would choose the book, because it’s a schoolbook. It is pretty safe” (6). On the other hand, fresh information is experienced as an important contribution from the one-to-one computer learning setting: “The books are quite old. Like 10-20 years old. And it is a bit hard to get the proper information” (1).

Another strategy of information handling is illustrated by the fact that the students experience the task as easier to solve if they find websites containing much information, for addressing many questions at once: “There was this site that was very helpful, it contained information on food, clothes, how much you use annually and so on. It was very helpful” (8). That the information could be gathered on the Internet instead of spread over other physical spaces was appreciated: “There are forums, Wikipedia, lots of different sources. And it is also much faster” (9)! They also experience the computer as a tool to aid knowledge formation by downloading information, thereby keeping it in one place: “We save all the sources and stuff in a word-document. And then we read it and take the information we need” (9). They make sense of information handling also as a good way to collect their own notes: “If you repeat important stuff that the test will deal with, then it is great to have everything collected ... instead of hunting for a paper that you lost like a maniac” (13).

Experiences of tool-handling in knowledge formation

Rational Time-Saver

The computer in the one-to-one computer learning setting is described as an effective tool that saves time. The students particularly experience that the computer saved time in terms of writing and editing text. They often experience the task as impossible to conduct with paper and pencil, both in terms of how long it takes to write and in the time and extra effort of editing texts on paper instead of on the computer: “Of course, it
is comfortable to write in word, it is absolutely faster than writing by hand” (15). This is not only the case when the students write their essays but also while taking notes during lectures: “For example, when the teacher lectures... when he speaks, you have the time to write it down. It is different when writing by hand. It is not as fast” (7). The students also experience the one-to-one computers as time-savers in terms of gathering information, compared to other sources. Often, they believe that it would be theoretically possible to conduct the task with only non-computer sources but that such an approach would be prohibitively slow: “The computer played a major role because we needed to gather all information in a quick way. As in the first part, we wouldn’t have made it without the computer in such short time” (9). Most of the students also consider the computer to affect the way they work, and it puts a focus on the appearance of the work: “The outcome of the task becomes different when you have the computer. Everything becomes much more good-looking and much easier to access” (5).

**Flexibility**

The students appreciate that the computer gives them freedom and flexibility due to the transparency of the technology. Whether they do the same things at home as in school or other school related things differs, but they all sense that the one-to-one computer affects their knowledge formation: “If we wouldn’t have the computer in school, and if we had to do it at home individually, then it would be more difficult” (12). Not only was the information collected in this way, but the computers were also understood as facilitating task completion: “But the positive is that you have access to everything. You can type on it, search, you have helping applications, everything in one place. It is very...easy” (4). This is interpreted such as that the students experience the one-to-one computer as giving them freedom in space. “I use it all day and night ... With this computer, I can sit in the sofa, the bed...watching TV and stuff like that [while working, authors note]” (3).

**Social media use**

The students express sense making of certain patterns in their knowledge formation when addressing whether they should be working in groups or individually with each task. When in a hurry or if the tasks are understood as being easy, they prefer to search for answers alone to one question each and then merge those answers together: “We worked on different parts, and then we merged it all together. We wrote some text each” (4). However, some students sense that, if there is time, the quality of knowledge formation rises when they work together, all searching for answers for the same question, to reflect and discuss it jointly to fully agree: “You want to feel that you are a part of it. Every task” (11). According to the students, this type of oscillating motion, between working alone and working in groups, calls for leadership. The type of leadership called for differs between students, with some of them preferring shared leadership and others preferring a more outspoken leadership, granted by the person who takes charge at the time, in practice being a bit more active than the others: “I took command. So I said: ‘You check the household and you check what the family got, what they buy and do with the money, then I check what they pay in taxes’. So we did” (3).

While working in different locations, all students experience the social aspect of asking questions of each other via computer as quite natural. The tool used does not seem to matter; the main idea was that the one-to-one computer let them work socially
Despite being separated in space: “I use it to talk to different people ... it can be through Facebook or anything else” (2). Most of them also experience it as a rational way to work jointly on texts with the aid of social media. “Facebook can be used, you write messages to each other. Send over schoolwork and different texts” (4). However, those social media is not used to contact strangers. Unknown people are regarded with suspicion and do not seem to have anything to do with their schoolwork: when asked whether social media was used to enlarge the pool of information sources, a student answered, ”I do know the people I need to talk to, so why should I?” (1).

**Mental challenges**

The students in the study sense that the one-to-one computer learning setting in itself provide mental challenges while working with knowledge tasks. They all sense that working with this task in a one-to-one tools environment lead to a time pressure: “We were really late. So, we finished in the last minute” (14). The students state again that working freely in a one-to-one computer-learning setting demand that they establish a good starting point. This has been mentioned in the first category, as a prerequisite for the knowledge formation, but it is also understood as a demand for motivation. A good start give the students a steady pace through the task: “I think we came right on track” It was ... it could be fun, and we got into it, so to speak” (4). The ways to get this important starting point differ, as described above, but it is understood as important. To manage stress, the students experience the need to develop a strategy for handling the many distractions such as loud noise, students calling for attention while looking at a YouTube clip, Facebook and other social media: “In the end, we had to click Facebook away ... you must prioritise” (8). One strategy expressed is establishing a starting point, another is to just ‘decide’ to shut things down, and yet another is to use headphones with music to reduce distractions. The students also acknowledge that the one-to-one computer paradigm affects the classroom climate: ”I think it is really bad, because you don’t speak that much when you use the computer. It is more using headphones and your computer. I think that is really bad” (6).

**Discussion**

The eight key aspects of the students’ sense making of their knowledge formation show an awareness of that the technology leads to specific behaviours. In terms of reflection, the students signalled a need for meetings face-to-face, if possible, to deepen their knowledge as much as possible. From one theoretical standpoint, this could be interpreted as the students finding it easier to combine their horizons of understanding better in face-to-face meetings than through computers. This calls for the role of the corporal aspect in deep learning, in which it is admitted that the risk-taking of meeting face-to-face (Dreyfus, 2008) is experienced as necessary by the students. Although the students’ use of the computers is relatively transparent, they sense that it deprives them of the possibility of full reflection. They also avoid the computer for reading long texts, sensing that analogue reading provides deeper quality in creating understanding when solving the task. Thus, according to the students, the computer calls for an experience of the world not compatible with activities associated with deeper learning. While they do experience this, it is of course with their fore-conception of reading as a basis. This
may, in the long run, change once children start reading electronically from early ages. It is also consistent with Rose (2011), discussing how the experience of reading is changing on screen, making electronic reading shallower.

The students understand that they need a firm starting point for their knowledge formation, suggesting that too much freedom might not be the most fruitful way of introducing a topic. This contrasts with the positive research result reporting that freedom stimulated motivation (Grönlund et al., 2011; Naeslund, 2001; Tallvid, 2010) and creativity (Dunleavy et al., 2007). This should be investigated further in terms of what types of fore-conception and expectations of the learning setting create a balance between autonomy and guiding on starting points.

A crucial part of forming knowledge with the one-to-one computer paradigm is information handling. The students in the study were quite aware of the need to critically evaluate the sources; however, their strategies for this task were rather naïve. To develop useful strategies, the school must adopt a well-designed plan allowing both students and teachers to develop strategies. The students in the study stressed the mental challenges of the one-to-one computer learning setting, such as the handling of distractions. At the same time, the students experienced the computer to be a rational tool and a time-saver, much in line with previous research on how to work with computers as a transparent tool (Dunleavy et al., 2007; Grimes & Warschauer, 2008; Oliver & Corn, 2008; Tallvid, 2010), using standard tools effortlessly. They also admit that the computer is ubiquitous in terms of being flexible in time and space and that it allows collaboration via social media. This is also in line with recent research (Ben-David Kolikant, 2012) claiming that students use the technology effortlessly in regard to standard tasks.

Further research on the consequences of one-to-one computer initiatives in terms of students’ experiences is needed since computers change the learning environment dramatically. Besides research on the outcome of one-to-one laptop initiatives, we need to further investigate how computers on one-to-one basis affect students’ relationship to both the learning context and the learning content in various kinds of computer use. That kind of insights does not tell how the outcomes are affected but rather why.

**Notes on contributor**

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**References**


