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PLEASE SCROLL DOWN FOR ARTICLE
Disparity in practice: diverse strategies among teachers implementing interactive whiteboards into teaching practice in two Swedish primary schools

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This paper reports on a project aimed at identifying and exploring the development and implementation processes of teaching practices with interactive whiteboards (IWBs) in two Swedish K-6 schools. The purpose of the project was to generate results and insights of value when preparing student teachers for professional use of IWBs and to give school leaders guidelines when implementing IWBs. A range of methods were used to collect rich and varied empirical materials in this exploratory project. Judging from our data, it was obvious that the implementation process of IWBs, just like other information and communication technology initiatives, is very technology-oriented, but also dependent on attitudes. Over the course of time in the project, different strategies emerged among the teachers regarding whether and how they used the IWBs in their lectures. It also became increasingly clear during the study that there is a distinction between technical interactivity and pedagogical interactivity. Our results further suggest that training is needed when introducing these boards for future users. This training should include both technical instructions and pedagogical discussions.

**Keywords:** interactive whiteboards; primary teaching; ICT; implementation process

Introduction

**The Swedish context**

In Sweden, the occurrence of interactive whiteboards (IWBs) in schools is growing fast as strong claims are made for their pedagogical value by manufacturers and teachers. The number of schools supplied with IWBs today is hard to estimate, but an indication of the spread is that boards of the brand ‘Smart Board’ alone are present already in more than 12,000 classrooms distributed over 1200 schools (according to http://www.smartboard.se/, retrieved April...
13, 2011). Dividing the number of Swedish students (886,487 in 2010/2011, http://www.skolverket.se/sb/d/1638) by 25 (the average number of students in one class) gives the estimation that roughly 25–30% of all Swedish classrooms have a board of this brand only.

In spite of the growing number of IWBs in Swedish schools, there is, however, so far nothing published on the effects these boards have on the pedagogical practice in a Swedish school context. According to a recent review, most studies have been performed in the UK (DiGregorio and Sobel-Lojeski 2010), thus calling for an expansion of studies in different contexts to broaden our understanding of how the use of IWBs might influence teachers’ practice in classroom settings also in other countries.

A central assignment for Swedish schools has traditionally been to offer equivalent education. According to the portal paragraphs of the Swedish Education Act, education at all levels should aim to promote maximal development of all children, compensate for the variations in their prerequisites for learning and provide children with equal access to education regardless of their geographical and socioeconomic background. Education should also be of equal standard regardless of kind and localization (SFS 1985:1100; SFS 2010:800). The task of ‘communication of knowledge’ is thus, in Swedish schools, broadened into including ‘character training’. In conjunction with this, the curricula and syllabi of the Swedish schools as well as other governmental policy documents state that implementing information and communication technology (ICT) in Swedish schools is a democratic issue – a right for all students irrespective of gender, class, ethnicity and geographical location to become familiar with ICT in school. Other important reasons for introducing computers/ICT in the Swedish schools relate to the preparation for working life, improving learning, change involving school development and the internationalization of education (Jedeskog 2005).

At the same time, decentralization of the Swedish schools in 1991 has resulted in a shift from national to local responsibility for school curricula and resources. The municipalities are thus free to decide what resources are required and how schools are to be organized to reach the goals (Swedish National Agency for Education [NAE] 2010a; for more information, see Wahlström 2008). The degree of ICT implementation among Swedish schools thereby varies substantially. This is in sharp contrast to the broad influx of IWBs into all schools supported by government funding, as has been done, for example, in the UK. In contrast, recent reports show that the ICT investments in Swedish schools generally have been both low and unequal (NAE 2010b). According to this report, technical support for both teachers and students is lacking, and only 1% of the teachers at K-6 level use ICT daily to support teaching. In Swedish schools, a tension between vision and practice concerning ICT implementation thus prevails, as the democratic outcome that requires ICT implementation in all schools by teachers in all
subjects is not yet fulfilled. The introduction of IWBs might be an icebreaker in this context, judging by the fast implementation rate all over Sweden.

**Interactive whiteboards**

The special feature of IWBs is the large touch-sensitive screen, linked to the classroom computer. It can be used by teachers and students to interact with still images, moving images and sounds, providing a multimodal portal visible to a whole class, enabling whole-class interaction and shared experiences. One of the main pedagogical gains claimed for IWBs is the possibility of a dialogic teaching climate, highly desired in schools today (Beauchamp and Kenwell 2010; Hennessy et al. 2007; Smith et al. 2005). In a Swedish context, a dialogic teaching climate fits well with the fundamental values of the national school system, where democratic working methods are emphasized in the curriculum (NAE 2010a). IWBs are also reported to provide a particularly interesting educational setting and to attract pupils’ attention, which helps to increase their concentration and also motivation as a result of the multimedia resources offered (Moss et al. 2007). The increased interaction of students in educational settings has also been reported with IWB use (Smith et al. 2005). Moreover, the IWB has been shown to provide a flexible and adaptable means for teachers to produce their own interactive educational material, matching specific needs of different groups and different subject areas (Gillen et al. 2007a; Moss et al. 2007). Accordingly, a range of potential educational advantages of IWB in teaching contexts has been published. There are, however, also skeptical reports of the boards. When it comes to the effect on actual learning outcome, for instance, the debate is still active. Teachers using IWBs are reported to believe that especially the interactive features of IWBs enhance children’s learning (Moss et al. 2007). Some research also reports on IWBs as the key factor for progress (Lewin, Somekh, and Steadman 2008). Concerns have also been raised that the IWBs might cement a teaching practice where students remain passive (Higgins, Beauchamp, and Miller 2007; Moss et al. 2007; Smith et al. 2005).

Moreover, there are misgivings about the danger of information overload when using the IWB. For example, Schmid (2008) reports on both students feeling bombarded with too much information and those feeling they were being spoon-fed, concluding that both groups faced the same kind of problem – they did not actively process the multimodal information. In this context, pedagogical change through IWB use may be interpreted in a less positive way, rather raising many challenging questions. According to the review made by DiGregorio and Sobel-Lojeski (2010) regarding the effect of IWBs on student achievement and attainment, however, this information is ambiguous and hard to interpret. A major challenge here, according to the review, is how to sort out the effect of the IWB from effects related to contextual factors such as teacher training, teacher confidence, school culture, technical support, lesson
preparation and practice time. One key issue here is the danger of introducing this rather expensive equipment into schools in a traditional top-down process that is also ‘technology-led’ rather than ‘education-led’. Most often this has been the case with earlier ICT initiatives in schools (Dawes 2000; Jedeskog 2007), in spite of the knowledge that difficulties of implementing these are frequently due to social conditions and that the involvement of teachers in the implementation process is a key factor for anchorage, accomplishment and survival of ICT implementations. Previous reports show that schools very often fall into the trap of acquiring IWBs without also building an education-led school culture that supports teacher training, time to practice and technical support (DiGregorio and Sobel-Lojeski 2010; Moss et al. 2007).

The project
There have been two aims with the present project. The first was to identify and explore the development of teaching practices with IWB in Swedish K-6 schools (age 6–12 years). The second aim was to gain insights into the implementation process itself, as it previously has been shown to be an inseparable part of the development of a professional use of the IWBs in school settings. Attention was paid to teachers’ attitudes toward using digital tools in the classroom, to their epistemology, to whether the teachers were using the multimodality features of the IWBs and to how the use of IWB affected interactivity in the classroom. Our expectations were that the results of the project would supply the research team with a range of examples of practices with IWBs in primary teaching, which might serve as a basis for a pedagogical discussion about IWB use in Swedish primary classrooms when preparing Swedish student teachers for the use of the IWBs which they probably are about to meet in their future practice. In addition, since no other published studies in a Swedish context are available, another expectation was that the information gained could be valuable for school administrations as guidelines when implementing IWBs in Swedish school settings. As pointed out in a recent review of research related to IWB implementations, the contextual factors of school cultures are important for researchers to consider when studying how IWBs are used in schools (DiGregorio and Sobel-Lojeski 2010).

Methodology
The setting and participants
The project started in August 2008 and ended in December 2009 (for a schematic overview, see Figure 1). It was designed as a participatory process, and based on workshops involving researchers from the university and teachers of two K-6 schools (age 6–12 years) of a middle-size town in the county of Värmland, Sweden. Both schools were municipally run, which is the most
common type of compulsory comprehensive schools in Sweden. Both schools were also typical in respect to the overall picture of ICT use in Swedish K-6 schools. Twenty-three teachers (all teachers of both schools) and two fifth grade classes from the schools were involved in the project. Both schools were administrated by the same headmaster, who also had taken the initiative of implementing the IWBs in the schools, mainly to inspire the teachers to renew science teaching. The start of this process thus followed the ordinary top-down feature of new inventions to be found in most Swedish schools (Jedeskog 2005).

The research group was invited into the process at a very early stage, before the first board was delivered to the schools. The strategy of the university team was from the beginning only to facilitate the implementation by holding workshops driven by the teachers’ own questions, not to give them ready-made solutions with particular theoretical or conceptual models.

**Methods and analyses**

The design of the study was based on the underlying assumption that the use of IWBs in learning situations is a process that requires time. Previous research has repeatedly indicated that it is not enough to have access to a particular technology for educational purposes; the issue is far more complex than that. In evaluations of UK schools’ use of IWBs, 2 years were needed in order to reach a stage where the teachers skillfully could extend or transform their established pedagogical practices into IWB use (Lewin, Somekh, and Steadman 2008). In order to grasp this complexity, as well as to acknowledge teaching practice as a dynamic process rather than a rigid snapshot event, the study was designed as an explorative study with an overtime approach. To match the broad purpose of the study, we used a multi-method approach, combining observations, interviews, focus group interviews and questionnaires. By using various approaches, method triangulation was possible where the combinations of methods gave
potential to cover for the shortcomings that each method individually inevitably contained (Flick 2009).

**Introductory meeting and workshops**

The workshops were held in successive cycles at the two schools involved (Figure 1). Each workshop was designed based on the results of the earlier ones, resulting in workshops with a larger emphasis on the teachers’ own experiences as time went by.

Our first meeting with the teachers (August 2008) was an introductory half-day where both hardware and software, as well as some pedagogical aspects of the IWB, were presented. This meeting was very much influenced by the teachers’ own questions and suggestions, and the enthusiasm was high among most teachers. After 4 months, the introduction was followed up with a hands-on workshop (December 2008) where the teachers tried out different basic IWB applications, such as ‘drag and drop’ or ‘hide and reveal’. By then, only two IWBs were installed, and access was therefore limited. The enthusiasm was still high among the teachers, though, and the opportunity was taken to share ideas and experiences. After yet another 4-month period, another workshop was held (March 2009). At this workshop, it was quite evident that there was a split among the teachers. Some were already producing their own educational material while others, for several different reasons, had not used the boards at all in their teaching. Ideas and experiences were shared, but discussions repeatedly got stuck around technical and structural issues (see Results for details). The differences in experiences made it difficult to attend to different needs and discussions at different levels. Therefore the research team prepared three options for the next workshop (May 2009), matching different needs expressed within the teacher group. One workshop was quite similar to the first one, enabling a basic introduction to the software and hardware of the board. The other two provided different levels of hands-on activities, one technology-oriented and one pedagogically oriented.

All workshops were documented, either with notes taken by an observer or with video recordings. All the videotaped material was transcribed, focusing on verbal utterances as well as behavior among the participants during the workshops. The transcriptions were then categorized according to the different themes emerging from the material itself – such as epistemological views, concerns about IWB use, skepticism about the added value of using IWB and need for further training (see Strauss and Corbin 1990 for a grounded analytical approach). After this, yet another round of analysis was made where special attention was given to whether the focus of practices and/or verbal statements was on (a) technology only, or (b) revealing a teaching design idea where the IWB was one component. The material was then analyzed to reveal whether categories and foci of practices and/or verbal statements were changed over time.
Group interviews

After the third workshop, the teachers’ thinking was further explored with audiorecorded group interviews held afterwards. Here open-ended questions related to teachers’ experiences and IWB use guided the discussions. Analyses were made with special attention to positive or negative comments on the technology as such, whether and how the IWBs were implemented so far and perceived values of the IWB in their teaching.

Questionnaires

In combination with qualitative methods, we also distributed two questionnaires in order to collect detailed information about IWB use such as the extent of use, purpose of use, attitudes toward use and perceived effects on teaching and students’ interest. The first one was handed out after two semesters. It contained two open-ended questions concerning (1) perceived needs for getting started, or to move further with teaching using an IWB, and (2) perceived benefits of using the board. Of the 23 teachers, 14 answered this questionnaire. A more extensive questionnaire with 18 questions was then handed out at the end of the project, and answered by 15 of the 23 teachers. This included four five-level Likert items concerning attitudes toward ICT in general and to what extent they felt comfortable with using the IWBs. Multiple-choice questions (6) were used to explore in greater detail how the IWB was used, with questions like: ‘In which of following subjects have you implemented the IWB?’ and ‘Which of the following statements agrees with how you use the IWB?’. All the multiple-choice questions also gave opportunities to leave personal remarks. The questionnaire also included nine open-ended essay questions. These concerned attitudes toward teaching and technology, and practices and experiences using the IWB. The Likert scale items were analyzed by descriptive statistics, as the small number was not sufficient for statistical analyses. The open-ended questions were analyzed by categorizing the different themes emerging from the material itself, as described in more detail for transcribed material above.

Teacher observations and videotaped classroom practices

Four teachers from one of the schools were selected for observations since they represented different attitudes toward the implementation, as well as different extents of use according to workshop and questionnaire results. Two of the teachers were the only real regular users, defined by using the board about once a week. One teacher expressed lack of competence in her wording, but in practice was rather skillful, judging from the observations at the workshops. We also selected a teacher for whom access to an IWB had become a burden rather than a facilitator.
All of these teachers had between 10 and 30 years of experience. In this paper, we name them Teachers 1, 2, 3 and 4 for anonymity. The material for the teacher observations was gained from workshops, questionnaires and, on two occasions, videotaped classroom practices wound up with informal interviews at the end of the project time. The reason for videotaping only two of our four teachers was that only these two voluntarily invited us, after an open request addressed to all teachers.

When analyzing our material, special attention has been paid to four aspects, as mentioned earlier: (1) attitudes toward using digital tools in the classroom, (2) epistemological views, (3) use or no use of the possibility of interactivity and (4) multimodality of the IWBs. In order to explore and describe the use of IWBs to achieve interactive teaching in a deeper way, we used the analytical matrix of Mortimer and Scott (2003), thereby deviating from the grounded theory approach in this respect (Figure 2).

Judging by the categories emerging from our material and our research focus, this framework helped us to describe and compare our material with prior research addressing teacher–student interactions. The bases of the Mortimer and Scott analytical framework are five linked aspects: teaching purpose, content, communicative approach, patterns of discourse and teacher interventions. As we were primarily interested in the aspect of interactivity, the aspect of communicative approach was used as inspiration for our own analyses. Here, questions such as whether or not the teacher interacts with students (taking turns in the discourse) and whether the teacher takes account of students’ ideas as lessons proceed are highlighted. The talk between teacher and

<table>
<thead>
<tr>
<th>Interactive</th>
<th>Non-interactive</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dialogic</strong></td>
<td></td>
</tr>
<tr>
<td>a. Interactive/dialogic: teacher and students consider a range of ideas. If the level of interanimation is high, they pose genuine questions as they explore and work with different points of view. If the level of interanimation is low, the different ideas are simply made available.</td>
<td>b. Non-interactive/dialogic: teacher revisits and summarizes different points of view, either simply listing them (low interanimation) or exploring similarities and differences (high interanimation).</td>
</tr>
<tr>
<td><strong>Authoritative</strong></td>
<td></td>
</tr>
<tr>
<td>c. Interactive/authoritative: teacher focuses on one specific point of view and leads students through a question-and-answer routine with the aim of establishing and consolidating that point of view.</td>
<td>d. Non-interactive/authoritative: teacher presents a specific point of view.</td>
</tr>
</tbody>
</table>

Figure 2. Matrix for distinguishing types of communicative approaches in teacher-led talk. Inspired by Mortimer and Scott (2003).
students is thus defined along each of two dimensions: dialogic–authoritative and interactive–non-interactive (for more details, see Mortimer and Scott 2003, 33–40).

Results

Here we are using our different sources of data to create a composite illustration of the implementation process at the two schools. Results from empirical observations of the teachers’ strategies are used to illustrate different personal aspects of the process of implementation and teaching strategies. Results from workshop observations, group interviews and questionnaires are then presented to picture the context of these examples.

Four teacher observations

Teacher 1

Teacher 1 felt very comfortable with technical tools and had a personal interest in computers. She attended three workshops, and started to use the first IWB very soon after installation, even though it was not installed in her own classroom. During the last semester of the study, she voluntarily attended a course given by the IWB-providing company to be a licensed IWB educator, and she is now responsible for future IWB education of school staff. One year after the first board was installed, she received a board in her own classroom. After this, she used it as an integrated part of her teaching practice. Teacher 1 used the material obtained from the internet and the IWB software and made her own interactive applications.

Teacher 1 had a clear intention of creating a dialogic teaching climate, following Mortimer and Scott (2003). When asked about her underlying thoughts while designing her own IWB material, she mentioned two main ideas. The first was to make the subject taught interesting by designing applications where students were involved, by clicking on different words or pictures on the IWB to find new facts behind them. The second was to match lesson contents with students’ different abilities and needs. About tailor-making the lessons, Teacher 1 said:

You can be on an advanced level when designing a presentation, but then you show it on a lower level.

To further adjust her teaching to match specific needs, she made sure the students had access to the applications used during lessons after class. Here, her intention was to let students explore the applications at their own pace and guided by their own interests. The intention to involve all students, and to make an interesting educational setting, was also the underlying thought of the observed lesson about Africa. The tailor-made set-up began with a big
map of Africa on the IWB. Teacher 1 opened the lesson by explaining to the students (fifth grade) that this map was somewhat special:

If you click on a picture or a word, new pictures will appear.

The students were then encouraged to come up to the IWB to click on a word or picture. Sometimes Teacher 1 specified what should be clicked and sometimes the students got to click something by their own choice. The students were further involved by the teacher’s questions relating to what was shown on the board. During the lesson, the confidence of Teacher 1 with the IWB was quite apparent in the seamless movement through different screens and the incorporation of a variety of the IWB’s functionalities. Judging from the amounts of raised hands, the students seemed very interested and eager to be chosen to come up to the IWB for the activity, even though some started to show signs of distraction after 15 min.

The classroom observation confirms the ambition of Teacher 1 to involve the students and to meet individual needs by tailor-making her own materials. The observation from this single lesson nevertheless also reflects a design with strong control by the teacher, thus providing a teaching practice that shares similarities with what Mortimer and Scott refer to as interactive/authoritative. Teacher 1 uses most of the IWB facilities (interactivity and multimedia resources from both the internet and notebook). The teaching is, however, teacher-centered and the content delivery-based.

Teacher 2
Teacher 2 described himself as not very comfortable with technical tools or computers. This teacher was among the first to receive an IWB in the classroom, but did not use it for teaching during the time of the study. Teacher 2 attended all workshops, but these were not enough to make him feel confident enough to start using the board in his teaching practice. The strong reluctance against using the board he describes as follows:

I’m not at all ready to begin. I would very much like to get started [but] I want to know I can load this picture without making a fool of myself [in front of the children].

During workshops, Teacher 2 was also very reluctant to be active, but when occasionally active and supported by colleagues he showed quite good competence in handling a computer. From our material, it is hard to analyze the epistemological views of Teacher 2. Clips from workshop discussions and questionnaire answers mainly reveal concerns about technical issues, and requests for more education. And as Teacher 2 did not use the IWB in lectures during the study, of course, no observations were made regarding how the teacher used the technology with the students.
Teacher 3

Teacher 3 attended all workshops. She described herself as only ‘fairly comfortable’ with technical tools as well as computers – and still, Teacher 3 was a rather regular user of the IWB after one and a half years. Teacher 3 did not voluntarily invite the research team to observe her IWB classroom practice, though. The material regarding Teacher 3 is therefore based on workshops and questionnaire results. During one workshop, Teacher 3 started her description of her IWB use with ‘I only use it as a screen’. But when describing her activities in more detail, and showing examples using the IWB, a well-planned music lesson based on carefully chosen links to YouTube mixed with ‘ordinary’ teaching methods was revealed. Teacher 3 expresses, just like Teacher 1, a strong wish to meet the students where they are, and to see each student’s special needs. Her approach to do so was by presenting the learning content – instruments of a symphonic orchestra – through YouTube clips of Metallica playing with the San Francisco Symphonic Orchestra. However, there was no particular use of the special interactive features of the IWB such as ‘drag and drop’, ‘hide and reveal’ or manipulating the board by using the touch-sensitive screen.

Teacher 3 thus mainly uses the IWB for easy access to the internet multimedia resources, and describes a use with low interactivity where the students are not involved in handling the board, explaining this with:

Because I’m not ready for that yet.

Upon a direct question, however, she describes how she, together with the students, finds short movies to illustrate specific aspects of subjects taught. She also feels comfortable with asking students for help if something does not work out with the technology. The IWB use described by Teacher 3 reflected an intention to have a dialogic climate in the classroom. This way of talking about her teaching practice shared similarities with Mortimer and Scott’s interactive/dialogic description, but since there were no observations of actual classroom practice, this interpretation is based solely on the teacher’s own words. Her description of herself as IWB user is, however, somewhat different compared with Teachers 1 and 4 (below), who express more confidence and comfort with the board.

Teacher 4

Teacher 4 was one of the first to actively incorporate the use of IWB with the students and their learning situation. She had, from the beginning of the implementation, a relaxed attitude to the IWB and very soon expressed a comfort with using it. She attended all workshops and during these she also early distinguished herself by trying to turn technology-centered workshop discussions into teaching design dimensions. Here, a main theme was the
possibility to use the board to involve the students and make them active. She also expressed a relaxed attitude toward not always being the ‘digital expert’. Teacher 4, just like Teacher 1, already in an early stage noticed the benefits of using the board to support unmotivated children, and also refers to the IWB as a ‘modern tool’.

The classroom observation showed a structured lesson, with a clear intention of involving the students. First the students (fifth grade) were asked to recall what they remembered about the planetary system from third grade. Based on their recollections, they were then asked to draw the planets positioned in relation to the sun and the earth on a sheet of paper. After this, the attention was turned to the IWB where an interactive planetary system, fetched from the internet (http://www.webbmagistern.se/planeter08.html), was shown. This particular application was a drag-and-drop activity, where the planets were shown, placed in order from the Sun, but the names were missing. These were shown at the bottom of the page and could be dragged to positions indicated beside each planet. A correction button could be pressed to correct suggested answers. If some answers were wrong, there was a possibility to move the names again and make a new correction. The students were now encouraged to walk to the IWB and drag a name to a planet. Here no right and wrong answers were told by the teacher. Instead, the students discussed freely among themselves about the specific location of each planet. If a student was unsure, he or she was still encouraged by the teacher to go up and make a guess. Suggestions of corrections were also allowed, which meant that some students moved other students’ suggested names from one planet to another. When all students finally agreed upon a possible set of matched planets and planetary names, one student was asked to press the correction button. Upon realizing that some planets were misnamed, the class took another round with the naming. This time they got it all right, and the lesson ended with comparisons with their drawings from the beginning of the lesson. From the classroom observation, comments on the questionnaire and workshop activities, Teacher 4 shows a clear intention to interact with the students in a dialogic classroom climate, sharing similarities with what Mortimer and Scott (2003) refer to as interactive/dialogic communication style. She also expresses a concern for designing her teaching to match different capabilities and personalities among the students. These clear intentions are also visible in the lesson observed where all students were encouraged to interact with the IWB. One student refused to go up to the front several times; this was permitted although she was gently encouraged to change her mind. Finally, when it was time to press the correction button, she changed her mind, went to the front and pressed it.

To sum up, Teachers 1, 3 and 4 all had clear intentions of creating a dialogic classroom climate. They also all expressed a wish to meet the students and to see them as individuals with different needs. It is interesting to note, though, that these intentions were expressed in three completely different IWB
practices. Teacher 1 used tailor-made lessons, exploring most of the boards’ functions. Teacher 2 used internet resources carefully chosen to meet the students’ worldview, and Teacher 4 used an interactive ‘drag-and-drop’ application in combination with a dialogic procedure. These three teachers thereby together exploited about all the main properties claimed for IWBs: interactive applications, multimedia resources offered on the internet and the possibility to produce one’s own (interactive) educational material.

In spite of our limited amount of material, it is thus possible to see quite similar intentions manifested in three different teaching designs with IWBs. Using the interactivity matrix as a tool for analyzing interactivity, the two observed lessons also showed approaches matching different categories. In the case of Teacher 1, the teaching design could be interpreted as an authoritative–interactive teaching climate where the teacher led the students through a question-and-answer routine with the aim of delivering a particular content. In the case of Teacher 2, there was also a clear content to be taught, but using the same matrix, it was categorized as dialogic-interactive, since the teacher and students together consider a range of ideas, using the board as a tool to explore these different ideas.

The teacher observations in a broader context

When taking a closer look at the implementation process by analyzing themes dominating discussions during workshops, it was quite evident that the process quite rapidly ‘got stuck’ around technical issues (Figure 1). These issues initially concerned basic ICT skills and how to handle the specific IWB hard- and software (how to ‘drag and drop’, import material from internet sources, where to save planned lessons, how to fix errors, etc.). Another common theme during early implementation discussions was the limited access to the IWBs, as the assembly of some of these had been delayed due to the procedure of public procurement. As time went by, however, another theme became more prominent: a perceived feeling of being less accustomed to the digital world than the children. Some teachers felt very uncomfortable with this, while others saw it as a way to invite the students to become active.

All through the process, only a few of the teachers were involved in discussions concerning lesson design. About half a year into the implementation process, a split was thus evident between the teachers – some had started to use the board regularly, producing material matching the specific needs for their groups and subject areas, and others did not. One year later, this split was still obvious, even though the board was used occasionally by most teachers by then. In the final questionnaire, three teachers stated that they had used the board ‘6–10 times’ or ‘about once a week’ during the last semester (Table 1). These three were chosen to be included in the teacher observations. More commonly (8 out of 15 teachers), the IWB had been used between one and five times during the semester. Four teachers had not used it at all.
Among those who had used the board, the majority reported that they were sourcing their IWB resources from the internet. Applications supplied by the IWB software were used by one third. Only two reported that they had created their own resources to use on the IWB. Interactive resources, such as ‘drag and drop’ and ‘hide and reveal’, were dominant among resource types used. This was irrespective of where the resource was retrieved.

Discussion and further research

When now closing down this study, one of our key results is that the implementation process at this school was much more time-consuming and complex than we had expected at first. In fact, it was so time-consuming that our aim to explore developing teaching practices together with the teachers was not possible to achieve to the extent we initially intended.

From our material, it was also quite evident that the process rapidly became confined to technical issues and ‘technical stress’. This technical stress, expressed by Teacher 2 as well as other teachers of the staff, seems to be a recurrent issue when integrating ICT into classroom practice (Al Fudail and Harvey 2008). In our study, this was also manifested by teachers often expressing a need of more time for training and developing their skills. A typical questionnaire remark was:

I haven’t had time to practice. There has been so much else to do.

It may thus be tempting to connect the rather low IWB use among the teachers in this study directly with technical stress. However, in our questionnaire results, there was no connection between perceived feeling of comfort when using computers and actual IWB use. One teacher perceiving herself as ‘not comfortable’ with technical equipment in questionnaire 2 still had used the board between two and five times during the semester. Other teachers describing themselves as ‘fairly comfortable’ with computers had not used it at all. The decision whether or not to use the IWB thus cannot, in our study, be related to

<table>
<thead>
<tr>
<th>Frequency of use</th>
<th>Usage of IWB during the last semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once a week</td>
<td>2</td>
</tr>
<tr>
<td>6–10 times</td>
<td>1</td>
</tr>
<tr>
<td>1–5 times</td>
<td>8</td>
</tr>
<tr>
<td>Never</td>
<td>4</td>
</tr>
<tr>
<td>Did not answer</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>23</td>
</tr>
</tbody>
</table>

Table 1. Reported usage of IWB in final questionnaire.
technical skills only. During workshops, the issue of where the board was placed occasionally also came up as a factor hindering use. In questionnaire answers, two thirds of the teachers thought it had an effect on how much they had used the board. For example, one of the teachers who did not use the board at all states in the final questionnaire:

It’s too time-consuming and awkward to book a time ahead and to move the children to the room where the board is mounted. The board is only a complement to the teaching and there’s too much hassle and time consumed to change room.

However, in our complimentary material, we cannot find that easy access to a board was a determining factor in IWB adoption. For example, among the teachers who were early users of the board, none had a board in their own classroom, whereas the teacher who received one of the first boards never did begin to use it.

In DiGregorio and Sobel Lojeski (2010), the most important contextual factor put forward for a successful implementation is a school culture where a ‘whole-school approach’ is used, in which all teachers have easy access to a board, receive the same software, on-going training, and are ‘led by a principal with an enthusiasm for technology and supports innovation’. The schools in our study were led by an enthusiastic principal, and all teachers were given the same training opportunities. All teachers did not have easy access to a board, but according to our material this was not a determining factor for adoption. Still, only a few real enthusiasts adopted the IWB in their teaching. Possibly, a combination of perceived digital competence and a willingness to both invest time and risk not being in control could better explain why some teachers chose not to use the IWB in their teaching. For example, Teachers 1, 3 and 4 all claimed that they felt very or fairly comfortable with computers. They all also very clearly expressed in one way or another that the students sometimes were better skilled in handling the digital world. This, however, was not seen as a problem, rather as an opportunity for interaction.

Judging from our data, it is thus obvious that the implementation process of IWBs, just like other ICT initiatives, is very technology-oriented, and also dependent on attitudes. The incorporation of IWBs into primary teaching practices requires both some basic computer skills and a willingness to invest time and risk some trouble in front of the students. In our study, these differences in competence and attitudes led to an obvious split between the teachers, where a few quickly incorporated the boards while many had difficulties getting started. This split also persisted, so that almost a third had not used the board at all 1.5 years after the introduction. Possibly, this split could have been less evident if the implementation process had included more training.
What also became increasingly clear during this study was the apparent distinction between technical interactivity and pedagogical interactivity. In spite of our limited amount of material, it was possible to see that quite similar intentions of a dialogic teaching climate were manifested in three different teaching designs with IWBs – teaching designs reflecting different categories of interactivity. Our finding in a Swedish context thus confirms reports from other contexts that, when integrating IWBs in classroom practices, it is important to distinguish between interactivity with the technology and interactivity between students and teachers in a classroom (Beauchamp and Kenwell 2008, 2010; Gillen et al. 2007b). In addition, our results support earlier findings that integration of IWBs does not necessarily change the focus of teaching and learning activities (Bennet and Lockyer 2008). Rather, just as has been found for other types of teaching settings, teaching practices with IWBs are more related to lesson content, learning objectives and teachers’ epistemological beliefs (Kang and Wallace 2005).

To conclude, one of the aims of this project was to supply teacher education with insights of value when preparing student teachers for the use of the IWBs they probably are about to meet in their future practice. Our results highlight the importance of attitudes of the teachers, as well as the need for prior training where technical skills are integrated with discussion of issues such as learning objectives, epistemological beliefs and the meaning of interactivity. In conjunction with this, further research is needed to explore the interactive utility of the technology for higher pedagogical purposes. In this context, we see a need to focus on the intertwined relationship between technical features and teachers’ part of the pedagogical applications. To focus on just one or the other will not provide a deeper understanding of the fast-growing phenomena of ICT and learning in general.

Notes on contributors

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Jörgen Stenlund, Master of Science, is a Lecturer at School of Science and Technology at Örebro University, Sweden. He previously worked as a teacher at upper secondary level for more than 20 years with a particular interest in the implementation of ICT in science education, e.g., the introduction and use of IWB.
References


