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Analysis of Lessons using Interactive Whiteboard focused on Pedagogical Interaction and Communication

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Abstract

The pedagogical communication and interaction can be viewed from different sides. The paper is focused on the exploration of communication and interaction between teacher and pupils by means of FIAS methods. The aim of interest are lessons of science to elementary schools where a teacher is using an interactive whiteboard at the classroom.

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Key words: Interactive whiteboard, ICT, Pedagogical Interaction and Communication

1. Introduction

In fulfilling the basic aims of primary education, it is vital that pupils are taught skills that will be useful to them throughout their lives. Teachers should be able to react to changing methods of fulfilling these basic aims and be able to adapt their teaching and communication styles accordingly. When developing a new approach to teaching, one avenue that can be explored further is the use of information and communication technology, at all levels of education and in a wide variety of learning and interpersonal contexts.

Social changes increasingly require a redefinition of the role and function of teachers, resulting in a shift from their role as transmitters of existing, pre-ordained knowledge to one as facilitators in a learning environment. As well as coping with this changing role, teachers need to expand their own knowledge and skills if they are to maintain their professional role. The two most frequently mentioned areas for development tend to be their ability to use a second language and to work effectively with ICT.
(Zukerstein, Novotný, 2009). It is in the effective use of ICT applications that there exists hidden potential for developing the intellectual abilities of teachers, which will inevitably lead to more successful teaching and learning.

If teachers are to achieve mastery of ICT, they must begin with a positive attitude towards it and the conviction that it is, in the right circumstances, an effective means of teaching and interacting with learners.

2. The Project

We aimed this research project at discovering a connection between the use of a single tool (the interactive whiteboard) and the expected outcome i.e. a change in the interaction between teachers and pupils. It is clear from our experience that using the interactive whiteboard alone is an extremely effective way of using ICT to accelerate the learning process.

2.1. Aims and methodology of research

Our fundamental task was to discover how the use of an interactive board at the first level of primary education influences educational communication and interaction between teachers and pupils. We devised specific research questions to explore the problem:

• What were the various characteristics of interaction in lessons when we examined the different activities being pursued?
• What were the various characteristics of interaction in lessons involving the use of ICT?
• What were the various characteristics of interaction in lessons where ICT was not involved?
• How did the use of an interactive whiteboard influence interaction between teachers and pupils?
• What teaching functions did the interactive whiteboard serve, and how did it influence their behavior?
• What were the individual and overall features of interaction in the lessons we analysed?

We chose a standard method of observation as our basic research model. Since we were observing and evaluating interaction in class, we chose one in particular: Flanders’ system of interaction analysis (Flanders, 1970). We preferred it to A. A. Bellack’s system, which uses symbols to record different processes with considerable precision, recording what is done by both teachers and pupils, but which is a somewhat complicated method. The observer must constantly follow and record 54 different processes, derived from the dividing of teaching and learning activity into a number of separate categories (Chráska, 2007).

Flanders’ approach derives from the idea that teaching takes place in a series of repeated communication acts by both teachers and pupils, and their mutual cooperation tells us what interaction is taking place. These ‘acts’ could be described as particular features of behaviour, relating to specific activities which can then be clearly observed and identified (Svatoš, Doležalová, 2011).

Flanders (1970) suggested a total of ten different communication acts (Tab. 1).
Tab. 1 Categories of behavior according to Flanders (Svatoš, Doležalová, 2011):

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Pupil</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. accepts pupil’s feelings, shows sympathy in constructive way</td>
<td>8. answers teacher, but after contact has been initiated</td>
</tr>
<tr>
<td>2. praises, encourages, jokes, approves of what pupil is doing</td>
<td>9. begins dialogue, is active, initiates contact</td>
</tr>
<tr>
<td>3. uses, accepts, clarifies and expands pupil’s ideas</td>
<td>10. is silent or confused, communicates indistinctly</td>
</tr>
<tr>
<td>4. asks questions (non-rhetorical), stimulates pupil</td>
<td></td>
</tr>
<tr>
<td>5. explains, tells, gives lecture, introduces own opinion</td>
<td></td>
</tr>
<tr>
<td>6. gives directives or instructions, organizes</td>
<td></td>
</tr>
<tr>
<td>7. criticises, enforces authority, tries to change pupil’s unsuitable behaviour or actions</td>
<td></td>
</tr>
</tbody>
</table>

The categories for recording pupil activity in Flanders’ original system were fewer than those applied to the teacher during the same task. We therefore adopted a modified version of the FIAS method developed by T. Svatoš and J. Doležalová (2011) to observe pupil behaviour so that the parameters used were identical. The authors suggest (2011, p.11) that since there are seven categories of teacher behaviour, the number of pupil behaviour categories should be increased. As teamwork is, in our experience, frequent at this primary level we added a further category to the list. The different categories of teacher and pupil behaviour were identified as follows:

U1 – Teacher accepts pupil’s feelings and behaviour, tries to show sympathy in a constructive way
U2 – Teacher values pupil positively, expresses favourable opinion of work, answers, actions, characteristics or behaviour, is encouraging, makes jokes, generally values achievement
U3 – Teacher uses, elucidates, develops, or accepts what pupil suggests, repeats pupil’s statements in order to stress their value so others can remember them, paraphrases or modifies answers or comments on the task
U4 – Teacher summarises and makes responses more precise, compares pupil statements
U5 – Teacher asks questions about the task, method of working or organisation, expects answers rather than asking rhetorical questions, uses questions to stimulate pupil
U6 – Teacher explains, informs, introduces own opinion, acquaints pupil with own attitudes and values, elucidates or glosses subject matter (we include the use of video and sound recordings here, as it is the teacher who selects them)
U7 – Teacher gives instructions or orders, criticises outcomes, answers, actions or behaviour, gives reasons for own methods, explains why particular approaches or actions are necessary, establishes rules, enforces authority, tries to change pupil’s unsuitable behaviour or actions
Z1 – Pupil asks questions, seeks help and support from teacher
Z2 – Pupil asks questions, seeks help and support from other pupils
Z3 – Pupil states, explains and introduces own opinions when pressured or influenced by teacher, answers when called on to do so rather than raising hand first
Z4 – Pupil states, explains and introduces own opinions arising from own actions or motivation, raising hand when answering questions or spontaneously referring to own experience or opinion
Z5 – Pupil directs or modifies actions of others, offers them help (we include here any presentation by the pupil, such as use of the blackboard when ‘teaching’ other pupils)
Z6 – It communicates with other pupils during a team activity
Z7 – It participates in whole class discussion
Z8 – Pupils pursues individual learning activity without visible interaction
O1 – It is silent or confused, stops working, communicates indistinctly

Data obtained from systematic observation was evaluated in two different ways. In the first, we compiled a classic quantitative survey, in the form of tables and graphs. These showed the absolute and relative frequencies of how different categories of activity made up the whole. In this way, temporal cross-sections could be evaluated. Segments of teaching could be isolated which were of particular interest to us.

In the second, we grouped the different activities of teachers and pupils into activity strands which, after statistical elaboration, were expressed as distinct indices which helped us to describe the level of communication and interaction in the observed lessons. We employed the following combined and separate indices (Svatoš, Doležalová 2011, p. 11):

\[ I_i = \frac{A_z}{A_u} \]

Where:
- \( I_i \) - combined index of interaction;
- \( A_z \) - index of pupil activity (\( Z_0 + Z_3 + Z_4 + Z_8 \)/\( K \));
- \( A_u \) - index of teacher activity (\( U_1 + U_2 + U_3 \)/\( K \));
- \( K \) - total number of coding categories O1;
- \( Z_0 \) - index of pupil’s seeking of help and support (\( Z_1 + Z_2 \)/\( K \));
- \( Z_3 \) - index of pupil’s activity (\( Z_3 + Z_4 + Z_8 \)/\( K \));
- \( Z_5 \) - index of pupil moving towards teaching others (\( Z_5 + Z_6 + Z_7 \)/\( K \));
- \( U_1 \) - index of teacher’s acceptance of pupil (\( U_1 + U_2 + U_3 \)/\( K \));
- \( U_4 \) - index of teacher’s active teaching (\( U_4 + U_5 \)/\( K \));
- \( U_6 \) - index of teacher’s dominant role in teaching (\( U_6 + U_7 \)/\( K \)).

It can be generally stated that if the index of interaction is equal to a value of 1, then there is a balance between teacher and pupil activity. If the index is greater than 1, it suggests that pupils are more active; if it is less than 1, it suggests that the teacher is dominating the process of communication and interaction.

The authors would also point out that these indices of interaction can be used when analysing temporal cross-sections, so that comparisons can be made when the intention is to track changes in interaction eg. during separate phases of the teaching process.

A special CodeNet program developed at the Department of Education and Psychology, Faculty of Education, University of Hradec Králové (authors T. Svatoš and V. Žák) was used to obtain data and provide basic quantitative elaboration (frequency tables for separate activity categories, graphical cross-sections of teaching units according to separate categories, time recording of separate categories). This program makes it possible to define 20 different observed categories of activity, and to set code intervals. Last but not least, it enables the creation of different temporal segments - separate sets corresponding to
selected initial and end codes from the total set. The results can be archived and exported to Excel (Svatoš, Doležalová, 2011).

Despite the use of quantitative elaboration of the data obtained, the FIAS method described above always records actual lessons taught. It is therefore not possible to generalise or to identify permanent effects. As the authors quoted above discovered, we realised that some teachers involved, aware that they were being observed and that their teaching was being evaluated, did not behave as usual and consequently were teaching lessons that were different from normal.

We used an adaptation of the FIAS method for coding video recordings and for direct coding of the lessons observed.

2.2. Research sample

The sources of research data to which we applied the FIAS method were video recordings of taught lessons, recorded without mediation, as well as actual lessons at which we were present.

We made a total of ten recordings of lessons in which the teacher explored the possibilities of the interactive whiteboard. Throughout the process, the lessons took place in the third grade of a primary school. The recordings were made during November and December 2011 in different types of schools (one with small classes, one in a village and three in towns), and involved five teachers. In addition, we observed lessons in five other schools (one in a village, one on the outskirts of a town, two in a city and one in a small town which was a natural centre for surrounding villages). Two lessons were observed with each teacher. Once again, we concentrated on third grade primary teaching.

2.3. Research results

Our research took place from November 2011 to January 2012. Video recording began in November and at the same time, questionnaires were distributed to the selected schools. In January, interviews with focus groups took place. We analysed a total of 20 lessons (ten from video recordings, ten at which we were present) and we recorded activity features at intervals of 3 seconds. We achieved a total of 674 codings per lesson, with a standard deviation of 46.4. However, rather than work with summary data, we concentrated on individual lessons. A key aim was to compare data from ‘classic’ lessons taught without ICT with those where the teacher and pupils worked with an interactive whiteboard.

In the first phase of our analysis, we focused our attention on the separate individual characteristics of all the observed lessons, examining the occurrence of the activity features we were tracking, and then on the varying nature of the lessons as a whole (a) with the use of an interactive whiteboard, (b) without the use of an interactive whiteboard, observing the same interactive features. This part of our analysis is visualised in graphs 1 and 2. On the horizontal axis are the separate categories used (U1-U7, Z1-Z8, O); on the vertical axis are the frequencies of the given categories. The key explains our abbreviations for the different lessons (codes for the schools involved, and the number of the lessons).
Lessons taught without an interactive whiteboard usually followed a similar course. After announcing the lesson topic, the teacher introduced prepared subject matter using a variety of different methods (dialogue, independent work etc.). We think it important to mention that we tried to observe similar lessons - not only according to the age of pupils and the subject, but also according to the content and structure of the lessons. We asked teachers for a current lesson, not one which repeated or summarised one already taught.

After the motivational phase, the new subject matter was explained and work followed involving encyclopedias, descriptions of an experiment or a class discussion of a given problem. Pupils then worked independently or in groups, and the lesson concluded with a review of the subject matter or an evaluation of the pupils' work.

Lessons involving interactive whiteboards resembled one another in the pupil activity features observed (category Z5): pupils were more likely to direct and modify other pupil's actions, and to give one another help (Fig. 2).
We discovered statistically important differences in two categories: U6 (directives and organisation), at $\alpha=0.05$, $t=3.286$, $pt=0.007$, $Z=3.067$, $pz=0.002$; and Z5 (pupil directs or modifies the actions of others), at $\alpha=0.05$, $t=2.463$, $pt=0.024$, $Z=3.264$, $pz=0.001$. It is clear that in the observed lessons, teacher behaviour changed due to the use of an interactive whiteboard (the teacher was more organised), as did pupil behaviour (they were able to move towards teaching other pupils).

Using a quantitative evaluation of observed lessons, we aimed to discover if there would be a difference between different activity features in lessons with and without the use of an interactive whiteboard.

We came up with a null hypothesis H02: The different kinds of interaction did not depend on the use of an interactive whiteboard.

For the selected level of significance, $\alpha=0.05$ and five degrees of latitude, we found a value of $\chi^2 = 110$. P- value was less than 0.0001. With a 0.05 level of significance (and at 0.01), we cannot support a hypothesis of independence. The use of an interactive whiteboard had an influence on the different indicators of interaction, and influenced communication between teachers and pupils. The Cramer coefficient was 0.95.

We also tested how far the total interaction of teachers and pupils depended on whether or not an interactive whiteboard was used. H03: The total amount of interaction between teachers and pupils did not depend on the use of an interactive whiteboard in lessons.

In this case, the null hypothesis was not confirmed ($\alpha=0.05$, 1 degree of latitude, $\chi^2=26.971$, $p=0.0083$, Cramer coefficient $C = 0.41$). We concluded that the use of an interactive white board in teaching had an influence on the total interaction and communication between teachers and pupils; several changes in interaction and communication took place as a result of the introduction of a new teaching method. However, we are aware that this conclusion cannot be applied on a wider scale due to the small size of the sample.

We also wonder whether the introduction of an interactive whiteboard may have had an influence on both teacher and pupil behaviour.

We have summarised the total indicators of interaction in all the observed lessons (Tab.2, Tab.3).

**Tab. 2 Interaction indicators in lessons without interactive whiteboards**

<table>
<thead>
<tr>
<th></th>
<th>PL_1</th>
<th>SV_1</th>
<th>Jir_1</th>
<th>SV_2</th>
<th>PL_2</th>
<th>GO_1</th>
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<th>Jir_2</th>
<th>NM_1</th>
<th>NM_2</th>
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<td>0.12</td>
<td>0.16</td>
<td>0.12</td>
<td>0.15</td>
<td>0.12</td>
<td>0.09</td>
<td>0.16</td>
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<td>0.12</td>
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<td>0.23</td>
<td>0.27</td>
<td>0.16</td>
<td>0.13</td>
<td>0.17</td>
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<td>0.17</td>
<td>0.17</td>
<td>0.22</td>
<td>0.17</td>
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<tr>
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<td>0.60</td>
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<td>0.03</td>
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<td>0.18</td>
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<td>0.18</td>
<td>0.46</td>
<td>0.23</td>
<td>0.08</td>
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<tr>
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Tab. 3 Interaction indicators in lessons using interactive whiteboards

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<th>PR_1</th>
<th>PR_2</th>
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<th>BZ_2</th>
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</table>

2.4. Summary

We observed 16 separate activity features, using an adaptation of Flanders' method. In the first phase, we aimed to produce a quantitative elaboration of the data we obtained. We can conclude that some of the observed categories (teacher accepts pupil's feelings and behaviour, shows sympathy in a constructive way, criticises, enforces authority, tries to change pupil's unsuitable behaviour or actions; pupil asks questions, seeks help and support from other pupils) appeared with minimal frequency (the mean frequency of occurrence varied from 1 to 4). This means that teachers did not exert their power and authority by force, and pupils addressed their questions to teachers rather than fellow pupils. The question may be posed, however, as to whether they learned to address their questions to teachers in order not to disturb other pupils and consequently, the teaching process. On the part of the teachers, there was a predominance of directives and organisation of the teaching process, together with explanations and information about their own views. On the part of the pupils, there was a predominance of active communication, explanation, answering and participation in whole class discussion, with group and independent work occurring relatively often as a shift away from teaching at the front took place.

The various kinds of classroom interaction were the same whether or not interactive whiteboards (henceforth IT) were used, but we did observe a difference in several categories of pupil interaction (directing or modifying the actions of others, giving them support). We found no evidence in our research of this happening in lessons where there was no use of IT, but it was the predominant feature of pupil activity throughout one of the IT lessons.

We can infer several things about the behaviour of teachers and pupils from our observation of the interactive characteristics of different lessons. In our opinion, there were no significant differences in the behaviour of teachers. They provided more information and organised the pupils more (they gave instructions and commands more frequently when using IT), which was in our opinion to be expected, given the kind of work involved.

Pupils were significantly more on task in IT lessons, whether working individually or in interactive pairs (for example, choosing an animal and placing it appropriately according to whether it hibernates during the winter, is fed indoors or migrates to warmer countries); they also were more likely to observe and check what other pupils were doing. We were particularly impressed by a lesson in which pupils had to prepare an interactive presentation (involving an animation set to music) during which they taught other pupils, using questions and semi-professional explanations. It was clear that this way of working was familiar to them, and that pupils are increasingly able not only to work with technology, but with
information which is not only absorbed but presented to others. Their presentations were successful, and driven by ideas.

We concluded that separate indicators of interaction, and interaction as a whole, depend on whether lessons are taught with or without the use of IT, on the basis of the results that we derived from our research. This is a data-based view and it is necessary to mention that the measure of dependence (tested by means of the Cramer index) was relatively high, especially in the separate interactions \((C = 0.95)\). If we look at individual lessons, it is clear that IT brought lessons to life, as the maximum interaction index \((1.61)\) occurred in a lesson where an interactive whiteboard was used. When teachers use technology such as interactive whiteboards to support constructive and innovative methods of teaching, pupils will be more active; in numerical terms, the resulting interaction index will be higher than 1, as shown by our results. On the other hand, we must keep in mind that a constructive approach to teaching and the inspiring of pupil activity depend not on technology, but primarily on the personality and competence of the teacher.

3. Conclusion

The interactive whiteboard allowed a more vivid perception of both new and previously studied subject matter in each of the classroom lessons we analysed, and it broadened the channels through which perception took place. We can conclude that the interactive whiteboard fulfilled several intellectual functions: it made pupils think as well as develop their powers of imagination and attention; and it had an epistemological function, as it made it possible to connect a concrete reality with its abstract expression.

Even if the interactive whiteboard is used simply as a projection surface, it performs an ergonomic function: it makes perception quicker, and therefore easier. We must add that its use can be demanding from an organisational point of view, and that it does not guarantee a reduction in the non-productive aspects of a lesson. On the contrary, teachers must think carefully when preparing an interactive whiteboard lesson; the fact that only one pupil at a time can work with it may be a major stumbling-block. In the lessons we observed, however, pupils were in reality called up very quickly one after the other, or exchanged a pen with one another, or were left by the teacher to work in pairs before returning to work together in class, checking each other's work afterwards. If teachers are negligent in their preparation and only one pupil is involved in the work, the rest of the class will be bored (Neumajer, 2008). In the lessons we observed this did not happen, although we must take into account that the teachers were expecting us to visit them.

As a result of working with a variety of materials (their own presentations, prepared exercises, short videos, interactive textbooks, educational websites etc.), pupils were able to develop their understanding of visual culture, aesthetic responses and techniques.

In our opinion, and after engaging in dialogue with respondents, we conclude that the most powerful effect of using the interactive whiteboard is the way it increases motivation. Brown and Duguid (2001), Černá and Poulková (2011) mentioned with reference to the implementation of ICT in education that more and more activities, both experimental and investigative, take place in the internet environment. It encompasses virtual simulations, virtual animations, virtual visualisations and virtual experiments. The younger generation learns to absorb information and experiment with ideas and phenomena by means such as these rather than by participating in courses or reading manuals. It is typical of this generation that among other things, they become acquainted with technology even before starting school (Rosen, 2010). This is also confirmed in international research, for example by the Pew Research Center (http://pewresearch.org/millennials/) and the Kaiser Family Foundation (http://www.kff.org/entmedia/index.cfm). The use of an interactive whiteboard in the classroom simply represents modern technology. Pupils like working with it. They look forward to this way of learning;
sometimes, their work was encouraged by using it as a reward (we heard one teacher promise 'When everyone's ready, we'll work on the whiteboard!'). In one class, another teacher christened the interactive whiteboard 'Abracadabra' for the magical way it can motivate children.

References


