PRIMAPODCAST –
A TOOL FOR VOCAL REPRESENTATION

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PriMaPodcasts are audio-podcasts of mathematical contents, which are made by primary school children. The application of the tool, its special setting of production and an empirical example are depicted in this paper. Furthermore our interest of investigation concerning the use of PriMaPodcasts in bilingual mathematical classes is briefly described.

MOTIVATION

Our special interest in vocal representations of mathematical contents aroused from the investigation of written and graphical-based communication in the project 'Math-Chat' (Schreiber 2013). It was about the genesis of 'mathematical inscriptions' (Latour & Woolgar 1986) in primary education: In the experimental situation of an internet-chat setting, the communication between pupils solving together given word-problems depended on the use of written and graphical representations. This setting offered insights into the learning of mathematics because the discipline depends on written forms of communication (Pimm 1987).

PriMaPodcasts focus on the opposite: vocal forms of communication are investigated. By recording audio-podcasts the use of written and graphical elements is not possible and this kind of representation must be 'replaced' in some way by the pupils. Three different aims of production are crucial:

- The children's mathematical learning can be fostered because of the requirement of not using any written or graphical representation but only vocal representation for the description of mathematical contents.

- The level of the pupils' skills can be identified. Their utterances and mathematical expressions both spontaneous and planned are analysed during and after the production.

- This is very promising for the purpose of investigation because it is possible to see what is used to replace the written and graphical representation when vocal representations have priority.

Not only the final version of the PriMaPodcast, but the entire development is of interest. There are seven different steps in which vocal and written representations are interwoven permanently.

PRODUCTION OF PRIMAPODCAST

According to the latest conception (Schreiber in press) there are seven steps of producing a 'PriMaPodcast' (see Fig. 1):

1. Spontaneous Recording: The pupils have to answer a question or to react to a stimulus about a mathematical term or topic. Their first spontaneous reaction is recorded with a voice recorder. This is comparable to a brainstorming about a mathematical content. It can be used in the further process because it is recorded and therefore available for the pupils.

2. Manuscript I: The pupils have to plan an audio-podcast, which is to explain this content to an audience. For this they can and they should now take some notes and make a kind of manuscript for their recording. They are free to make it more or less detailed, to decide who is saying which part or to make more or less a rough draft.

Fig. 1: Steps to produce
a PriMaPodcast

3. Audio-podcast: The recorded audio-podcast should begin with the same question or stimulus as in the first step. It will be recorded based on the pupils' manuscript. Depending on this manuscript it can be read out or the pupils speak freely.

4. Editorial Meeting: Two different groups come together with the teacher to give to one another feedback to the created audio-podcasts. The feedback can be about the content, formal aspects or the choreography of the entire audio-podcast. These two groups decide with the help of the teacher if the created audio-podcasts are ready to be published or if there are changes to be needed.

5. Manuscript II: In connection with the editorial meeting the manuscript has to be revised. This way, the final version is initiated.

6. PriMaPodcast: The pupils take a final recording of their audio-podcast. Afterwards, it is ready to be published.

7. Publication: After the release of the PriMaPodcasts, an administrator publishes them in a blog on the Internet. The advantage of the publication in a blog is the categorising of several podcasts in main-theme and sub-theme categories, which facilitates the management for a group of researchers.

EMPIRICAL EXAMPLE

A couple of PriMaPodcasts have been made in a bilingual Maths class. The English examples are available in this blog: http://blog.studiumdigitale.uni-frankfurt.de/primapodcast-en. Further PriMaPodcasts in Spanish and in German languages are also available in blogs [1].

The PriMaPodcast, which is presented here, deals with the topic 'symmetry'. It was produced by three boys in grade four. First the transcript of the spontaneous recording is given [2]. After that the manuscript is depicted, which is written by one of the pupils as agreed with the others. Then the audio-podcast, which is based on this manuscript, is exhibited as transcript. A second manuscript follows. The improved recording, the PriMaPodcast, is also documented as a transcript. It conforms to the second manuscript. All citations of the transcript are marked in squared brackets <like this>.

Spontaneous Recording:

At first pupil 1 reads out the given task 'Explain – what is symmetry?' Due to the fact that nobody else gives an answer, pupil 1 makes a first statement. He talks about unspecific things that are the same. That these things are the **same** is emphasized <sp02>. Pupil 1 reformulates this utterance at once, by saying that something is same on both sides. It is difficult to analyse which conception of symmetry he has got in mind because his explanations remain superficial. At this early stage he seems to be uncertain about the topic, which is signalized by the fillers (mh, l i k e) and the pauses <sp01/02>. Pupil 2 thinks of two things which 'both' are the same. In his answering he refers to pupil 1 by stating: 'It's the same.' In between he mumbles something. So his ideas remain unspecific for the audience, too <sp03/04>. Pupil 3 speaks boldly, he confirms that he does not know what symmetry is. Either he is really in the dark about it or he is confused by the other's explications. Another reason might be that it is too difficult for him to formulate his concept of symmetry in English <sp05>. After this short interruption, pupil 2 makes another attempt by giving an example. The unknown 'things' are replaced by two houses, which are neighboured. He underlines again that both houses look the same. It is astonishing that he refers to three-dimensional objects when talking about symmetry. Instead, he could also mean two-dimensional drawings of houses. Then he makes a restriction: 'Not everything can be symmetry' <sp07/08>. He could look for a good example to prove the opposite. One might assume that he means 'symmetric' instead of 'symmetry' in this context <sp06-08>. Then pupil 1 thinks of an approach to line symmetry: the mirroring. He tries to describe this procedure, by naming two parts of construction, 'drawing a picture' and 'having a mirror'. He suggests when having both components, it would look symmetric. Even though one will understand what he means to express, this description is incomplete <sp09/10>. Then pupil 2 makes a statement that makes pupil 3 laugh. His utterance 'symmetry is symmetry' <sp11> expresses his despair: symmetry can only be explained and defined by itself. This is depicted by his consideration of how he can say that. Instead of taking up pupil 1's ideas, he looks for another example. Then he talks from a blue anything in particular from the same market <sp11/12>. This aspect might indicate a translation movement. Pupil 3 seems to know what his classmate thinks of and puts emphasis on the same colour <sp14>. At this point the recording ends.

sp	min.sec		
01 02	00.02	p1	Explain what is symmetry … ehm symmetry is w h e n . things are . mh l i k e . mh **the same** looks like the same on both sides
03 04	00.21	p2	Symmetry is ehm l i k e w h e n . it´s eh s o m e when it´s both the same *(he mumbles)* be that´s what . Kilian said it´s . **the same**
05	00.37	p3	*(he speaks low)* I don´t know what symmetry is\ *(he breathes out)*
06 07 08	00.40	p2	Yes a symmetry is would be like ehm . a **h o u s e** and the neighbour has also a house that looks . the same . just the same .. b u t ehm not everything can be symmetry ..
09 10	01.01	p1	When you draw a **picture** and . and you wa and you m have a .. **mirror** it looks symmetric
11 12 13	01.13	p2	Yes like e h m .. m h h how I can say that . symmetry is symmetry *(S3 laughs)* . like e h like **this** . like eh a blue order from the same market ehm . yes#
14	01.33	p3	the same colour

Even though some statements remain incomplete and doubtful, the boys seem to reach an agreement on it in the end. At any rate, they do not contradict. In terms of language, important facts seem to be unsaid. The boys might have trouble doing the formulating. There are some problems concerning grammar (e.g. the use of if-clauses <sp01> + <sp03>) and style (e.g. 'yes' instead of 'well' at the starts of record <sp06> + <sp11>). However, it is evident that they have at least an image of what symmetry is. Nevertheless, they need more information to complete.
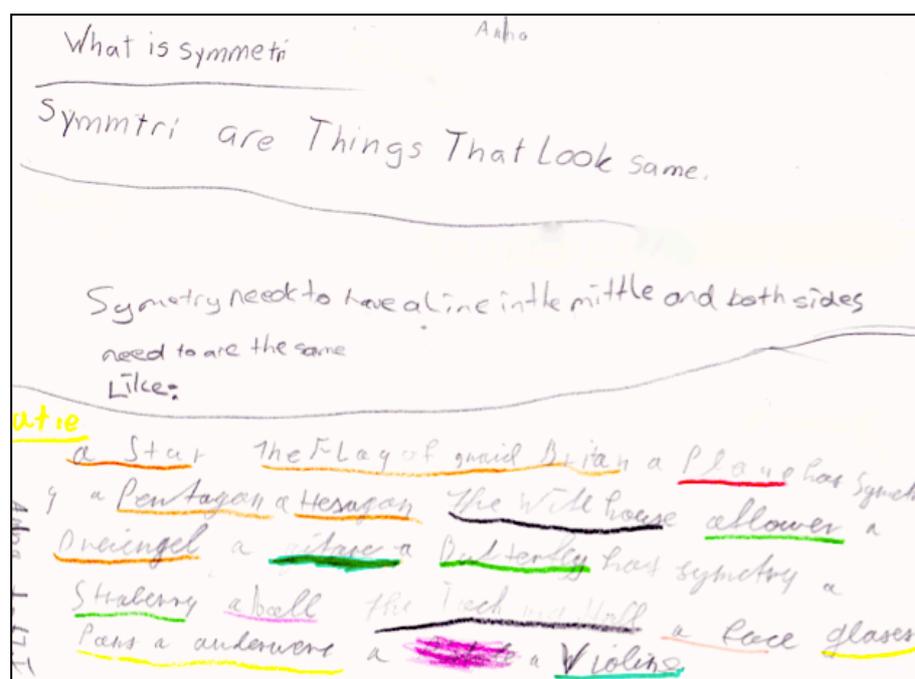
Manuscript 1:

Fig. 2: Manuscript of the Audio-Podcast; original in A4, coloured

In order to produce an audio-podcast, the boys look for more information on the Internet. They also use their school books and further printed material to make their manuscript. After about half an hour, they finish their search and begin making their notes. Then they assign the different parts to be read out among them.

Audio-Podcast:

In this version pupil 1 starts with a general statement towards symmetry, which is comparable to the first utterances of the spontaneous recording. The emphasis is again on the sameness of things <a01>. Pupil 2 seizes the idea of having 'a line in the middle' which generates two equal sides. This is evocative of a certain symmetric aspect: the line symmetry <a02/03>. In the following statements, pupil 3 presents many examples concerning line symmetry <a04-08>. Apparently he forgets to mention one example, which is added by pupil 1 <a09>. Pupil 3 affirms this, repeats the word and names another example <a10>.

a	min.sec		
01	00.01	p1	Symmetry are things l that look same
02 03	00.04	p2	Symmetry means you have a line in the middle and both sides need to are the same like /
04 05 06 07 08	00.11	p3	A **star** has a symmetry . the flag of Great Britain has a symmetry a plane has symmetry - a **pentagon** a **hexagon** the White House has symmetry a flower a triangle a guitar a butterfly . ehm . symmetry has also a strawberry a ball . ehm . then underwears has symmetry and p a n t s and the f a c e #
09	00.42	p1	And Scarfs
10	00.43	p3	Yes . scarfs and glasses has symmetry .. *(spricht leise)* That's it.

In contrast to the spontaneous recording, the utterances are well-conceived and more structured. Yet, the beginning and the end are not well considered. The boys forget to mention their topic in the beginning and they end their recording rather informally.

Manuscript 2

In the editorial meeting the peers especially praises the boys' chosen examples. However, it is decided that the manuscript should be revised in terms of content, style and language. The structure and the tenor of the second manuscript are similar to the first one but the boys add more explications and details, which is commented in the analysis of the final version.

Fig. 3: Manuscript of the PriMaPodcast; original in A4, coloured

PriMaPodcast:

Pupil 1 begins this PriMaPodcast by answering what symmetry is <pr01>. Pupil 2 gives a definition. He equals symmetry with 'things that look same on both sides'. Then he returns to the idea of mirroring which was originally uttered in the spontaneous recording. The procedure of using the mirror is better described than before. Moreover, the technical term 'line of symmetry' is used for the first time. In his explanations pupil 2 relates to general 'symmetric things' <pr02;03;04>. Before these things are further explained by giving lots of

examples, pupil 2 emphasizes that 'not all things are symmetric'. He names seven things, which are not symmetric. It is interesting that the boys again choose to present three-dimensional things like a radio and a door in this context. Why they use the three natural things 'an ocean', 'a sea' and 'a river' remains uncertain for the audience. Pupil 2 leads over to pupil 3 who reads out the examples of symmetry <pr05;06;07>. Some examples, which are presented in the audio-podcast, are not uttered here any more (e.g. the 'White House' or 'a scarf'). Another difference is that the examples are classified into categories like 'clothes', 'shapes' or 'music'. They are more structured. A new example of symmetry is highlighted in the end: Words like 'OTTO' can be symmetric, too.

pr	min.sec		
01	00.01	p1	What is symmetry
02 03 04	00.03	p2	Symmetry are things that look same on both sides . when you have a mirror and put it in the middle . of a symmetric thing and it looks same . on **both** sides it is symmetric ... A **mirror** is like a line o of symmetry
05 06 07	00.24	p1	These . there are **lots** of things . that are symmetric\ but not **all things** are symmetric\ **these** things are **not** symmetric\ a radio a door a piano a crane an ocean a sea a river\ these things are symmetric
08 09 10 11	00.45	p3	**Clothes** a tie glasses pants and underwears **shapes** a star the flag of Great Britain a triangle a hexagon a pentagon . **nature** for example butterflies flowers and strawberries\ . **music** a guitar/ a violin\. **electricity** a plane even **words** can be symmetric otto

Apart from the described content-related changes, modifications concerning style are also made. This is especially depicted by the beginning and the end and differs from the audio-podcast. In terms of language the German sounded expression 'it has symmetry' is changed into 'it is symmetric' <pr04>. Finally, the PriMaPodcast is ready to published in the blog on the Internet.

INTERESTS OF INVESTIGATION

Due to the fact that we are still at the beginning of this project, we only want to highlight one aspect of special interest towards investigation: The use of PriMaPodcasts in bilingual mathematical classes:

Although bilingual forms of teaching and learning are meanwhile common practice in Germany, they are more realized in secondary school forms than in primary education. Sociological subjects like History and Geography are mostly focused. Yet there are also bilingual concepts for scientific and artistic subjects as for example Biology or Music teaching. However, the usage of a second language in Mathematics lessons remains rather unconsidered in all fields of education (Hallet 2005, Lipski-Buchholz 2012, Rolka 2004).

There are unquestionably many reasons to use a second language as teaching and working language in Mathematical lessons: The support of intercultural and foreign language learning, the pupil's vocational preparation and the equalization

of gender differences. Moreover, especially Mathematics lessons in elementary school are characterized by the richness of illustrative material and media. This vividness invites and emboldens young learners to communicate in a foreign or second language (Rolka 2012).

As our chosen empirical example shows, already primary school children are able to deal with mathematical questions in a second language. The different steps of developing a PriMaPodcast enable them to conduct meaning. In order to analyse the mathematical conceptualization of bilingual school children, we still look for good analysis criteria and methods.

NOTES

[1] Blogs in Spanish: (http://blog.studiumdigitale.uni-frankfurt.de/primapodcast-es), and in German language (http://blog.studiumdigitale.uni-frankfurt.de/primapodcast) are available.

[2] The audio-files are available: http://blog.studiumdigitale.uni-frankfurt.de/primapodcast/

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