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Expert Teachers' Interactive Cognition: an Analysis of Stimulated Recall Interviews

Abstract

The presented study focuses on the interactive cognition of expert teachers during their teaching. 16 foreign language teachers' lessons were videotaped and the teachers were asked to reveal their interactive cognition through a stimulated recall interview. The verbal protocols were then analyzed in the light of argumentation analysis and the claims were subject to content analysis. The results showed that individual teachers varied greatly as regards their percentages of stimulated recall as well as other aspects of their interactive cognition, which supports the prototypical view of teacher expertise.

Keywords: *interactive cognition, stimulated recall, pedagogical content knowledge, foreign language teaching*

Introduction

In this paper we focus on the issue of expert teachers' interactive cognition while teaching. The data were elicited from 16 expert teachers of foreign languages (English and German) at Czech lower-secondary schools using stimulated recall and analyzed in the light of argumentation analysis. Subsequently, content analysis was conducted, focusing mainly on pedagogical content knowledge.

The analyses were carried out within the research project "Expert teacher: the nature of expertise and determinants of professional development (in FLT perspective)", whose aims include a theoretical and empirical investigation into the nature of expert foreign language teachers (Píšová et al., in preparation). As regards this

particular study, the method and the results of the pilot study have been briefly introduced elsewhere (Janíková, Tůma, & Najvar, 2013). In the presented study we focus on one part of the research, whose aim was to capture some characteristics of teachers' interactive cognition during their teaching.

1. Interactive cognition and pedagogical content knowledge

In the context of this study, we see interactive cognition, in line with Schepens, Aelterman and van Keer (2007) and others, as a part of teachers' practical knowledge. We understand interactive cognition as the teacher's thoughts while teaching, which are directly unavailable to researchers, since trying to address them in-action would result in disturbing of the natural dynamics of the observed phenomena. Researchers are therefore left to rely on indirect approaches. In our study we relied on stimulated recall, which we introduce and discuss in the methodological section.

As regards research into teacher expertise, interactive cognition seems to be a promising focus. Cognitive research shows that experts, by definition, are able to think more effectively about problems. Glaser and Chi (1988) define expertise as the possession of an organised body of conceptual and procedural knowledge that is readily accessible and can be used with superior metacognitive skills. In teaching, a highly influential framework for teacher knowledge base was proposed by Shulman (1986, 1987). Its critical constitutive element, and thus the criterion defining feature of expertise in teaching, is pedagogical content knowledge (PCK), i.e. knowledge that guides teachers´ actions and reasoning concerning content to be taught in highly contextualised classroom settings.

Shulman (1986, 1987) described PCK as including subject matter knowledge, knowledge of potential student learning difficulties and students' prior knowledge of specific concepts, as well as the most effective models, analogies, illustrations, explanations, and considerations to make the content understandable for students. Later on, Shulman's framework was elaborated on by numerous researchers, e.g. Grossman (1990), Magnusson et al. (1999), who attempted to further conceptualise PCK to identify its components. A significant contribution to theoretical development, analytical clarification as well as empirical testing of the concept was made by Ball, Thames and Phelps (2008; content knowledge for teaching), who focused specifically on teachers of mathematics. For the purposes of this study PCK represents the core of teachers' interactive cognition.

2. Methodology

The aim of our study was to analyze the interactive cognition of expert teachers. Our main research question was: What was the nature of the teachers' interactive cognition? Access to interactive cognition can only be gained through language. In this study, argumentation analysis of stimulated recall and subsequently content analysis were deployed.

2.1. Argumentation and argumentation analysis

Modern argumentation theory builds on logic and philosophy as well as on pragmatics, psychology and sociology (Toulmin, 2003). The layout of an argument has been outlined by Toulmin (2003, pp. 87–134). The two main components of an argument are claim and data. Whereas the claim (C) is the conclusion of an argument, the data (D) is a foundation for the claim (Toulmin, 2003, p. 90). The most typical forms of arguments are "C, because D" or "D, so C" (Toulmin, 2003, p. 99).

Kopperschmidt (1985, p. 161) defines argumentation analysis as a method that reconstructs the specific and logical structure of argumentative discourse. This method has been used in a number of studies, predominantly in the field of science education (cf., e.g., Kelly, Druker, & Chen, 1998; Kerlin, McDonald, & Kelly, 2010). For the purposes of this study, argumentation analysis was used for segmenting the teachers' utterances into units, some of which were subject to subsequent content analysis. We introduce the procedure in section 2.4.

2.2. Stimulated recall

In order to access cognitive processes, introspective process tracing methodology is most frequently utilised based on the tested assumption that a respondent can verbalise them at some level (Ericsson & Simon, 1999). Out of a number of methods available, stimulated recall is considered relevant to this study. A stimulated recall interview requires participants to report what they were thinking and/or feeling during a past activity.

Without a visual, aural or written artefact reminder, stimulated recall would be open to charges of non-reliability and non-validity (Ericsson & Simon, 1999). In response, Henderson and Tallman (2006) proposed six issues that need consideration in order to strengthen reliability and validity: (1) timing of the stimulated recall interview, (2) capturing the data, (3) conduct of the interview, (4) interviewer training, (5) interviewee and interviewer fatigue, and (6) coding and categorizing the data. In our research we paid special attention to these issues in order to

maximise the reliability and validity of our data. For details cf., Píšová et al. (in preparation).

2.3. Data collection

Lessons of 16 expert teachers[1] of foreign languages (English and German) at Czech lower-secondary schools were video recorded. Immediately after each lesson, the teacher was asked to comment on a 20-minute part of the video. The teachers were asked to stop the video every time they recalled what they had been thinking about. The instructions by the researchers included an explicit statement that the purpose of the session was to recall what the teacher had been thinking about at the moment depicted in the video (interactive cognition), not at the moment of seeing the video (reflection). The researcher only listened and could ask questions in order to guide the teacher towards stimulated recalling (e.g., "Is this what you are thinking about now or what you were thinking at that moment during your teaching?").

The session lasted approximately 45 minutes and its audio recording was subsequently transcribed. The transcription included contextualization cues (Gumperz, 1992) captured in the recording, mainly paralinguistic features (e.g., laughter, pause, hesitation). The average length of a transcript was 2904 words. The transcripts of each session were subject to subsequent analysis.

2.4. Data analysis

The analysis was guided by the main research question: What was the nature of the teachers' interactive cognition?, which was broken down into the following subquestions: What was the proportion of claims related to thinking while teaching?, What was the proportion of justifications of these claims?, What was the proportion of recalled claims related to thinking about teaching?, and In what categories (PCK components) were the claims related to thinking in teaching distributed?

The transcripts of the stimulated recall interviews were analyzed with regard to each teacher's way of stimulated recall (e.g., most teachers used the past tense for recalled claims, whereas some used the present tense). The identification of claims recalled by each teacher also included (1) the character of the utterance (a typical claim was relatively short and related to one action in the video recording), (2) contextualization cues (Gumperz, 1992) and (3) a complex understanding of the

[1] These 16 expert teachers constituted the sample for the second phase of the research project within which stimulated recall was carried out. The sampling at the initial stage was purposive and out of the 30 teachers, 16 teachers were selected for the second phase on the basis of their classroom performance data. Cf., Píšová et al. (in preparation) for details.

teachers' utterances. A similar way of identifying argument structure was used by other researchers (e.g., Kelly et al., 1998).

The analysis comprised two steps. First, the teachers' discourse was segmented in the light of the argumentation analysis. Second, the claims were subject to quantitative content analysis.

During the segmentation, we first identified the core of a recalled utterance, i.e., the recalled claim which was related to the teacher's interactive cognition. Second, we identified the supporting data, which we marked as justification of the claim. Next, the utterances related to the teachers' reflection were coded accordingly. Other utterances were excluded from the analysis.

The recalled claims, i.e., utterances related to the teachers' interactive cognition, were further investigated by means of content analysis. Each claim was, in line with a synthesis of the conceptualizations and models of PCK (cf., section 1), coded into one of the following core categories: processes, content and aims. Within each of these categories a distinction was made between claims oriented to learners or subject matter as suggested by Janík et al. (2009), Píšová et al. (2011). Having piloted the procedure (Janíková et al., 2013), we realized that although the majority of claims fitted the category system for PCK, there was a group of claims which were related to the teachers' emotions during their teaching. The emergence of emotions in cognitively oriented research in a way supports the validity of the analysis: it is generally acknowledged that cognition is shaped by emotions. Moreover, teaching has been recognized as an inherently emotional enterprise both in the classroom and outside (for reviews, cf., Hargreaves, 1998; Sutton & Wheatley, 2003). Therefore, we added another dimension to our category system. The final version of the category system accompanied by examples[2] can be found in Table 1. The italics in the examples indicate the recalled claim, whereas the rest of each utterance is the justification of the claim.

Table 1. Category system for content analysis of recalled claims

	Main category	Orientation	Example
Cognitive dimension	PCK – processes (the how of teaching – strategies, techniques, methods, tasks, etc.)	Pupils	"*Here I intentionally chose Jana,* because she is the weakest … in order to check whether she knew this."
		Subject matter	*"Here I realized that it would be beneficial to go back to the task*, because there was a lot of new vocabulary."

[2] The examples were translated from Czech.

	Main category	Orientation	Example
Cognitive dimension	PCK – content (the what of teaching)	Pupils	"*Here I used the word 'blush' and I thought that the majority of them would not know the word, so I put the word to a sentence*, so that those who are ready to remember the word could link it with the meaning."
		Subject matter	"*Here I must admit that the word 'trolley' slipped my memory*, but usually before I get to the board I recall the word, or I have a dictionary at hand."
	PCK – aims (the why of teaching)	Pupils	"*Here I intentionally said 'morning' in Czech*, so that they [the learners] could compare the meaning in Czech and English."
		Subject matter	*"Here I thought that it was more important for the activity in that moment that they discuss it with each other* [no matter in what language – Czech or English] *and that it will be sufficient if they formulate their conclusions in English."*
Affective dimension	Expressing emotions or mood	-	[after not being able to start a video on an interactive board] "*I was angry*, because the kids were waiting and nothing was going on."

4. Results

Having piloted and adjusted the category system (for details cf., Janíková et al., 2013) we reached a relatively satisfactory direct agreement among three researchers (76% on identifying claims, 82% on identifying justification, 93% on identifying reflection and 60% on the content analysis). Evidently, some aspects were relatively straightforward to code, whereas some utterances required discussion in the team. Therefore, each of the transcripts was coded by one researcher and the areas of difficulty, especially coding according to the category system, were subsequently discussed by the group of three coders. Furthermore, to assure consistency in coding, each transcript was checked by another researcher who had not coded it.

From our theoretical positions and the description of the category system for content analysis (Table 1) it follows that some categories were complementary to others (stimulated recall – reflection, orientation toward learners – orientation

to subject matter), whereas some categories (affect, justification of claims) were autonomous. In order to answer the research questions stated above, the following variables were defined. All of the variables were computed separately for each teacher.

The percentage of recalled claims was defined as the ratio of the number of recalled claims to the sum of numbers of recalled claims and utterances coded as reflection.

The percentage of reflection was defined as the opposite of the percentage of recalled claims – it is the proportion of the number of utterances marked as reflection to the sum of recalled claims and utterances marked as reflection.

The percentage of justification of claims was defined as the ratio of the number of justifications to the total number of recalled claims.

The percentage of affect was defined as the proportion of claims classified as affective to the total number of recalled claims.

The orientation toward learners (or subject matter) was defined as the proportion of the sum of the recalled claims classified as oriented to learners (or subject matter) to the total number of recalled claims. Like the other variables, these two variables were expressed in percentage.

The analysis revealed striking differences between individual teachers as regards the numbers of recalled claims and utterances classified as reflection. As regards the distribution of recalled claims, out of the total of 247 recalled claims, the vast majority were classified as PCK – processes (184 claims), relatively fewer were classified as PCK – aims (11 claims) and as PCK – content (11 claims). 41 claims were classified as related to affect. The results for individual teachers are shown in Table 2.

Table 2. Results for individual teachers

Teacher	The sum of recalled claims and utterances marked as reflection	Percentage of recalled claims [%]	Percentage of reflection [%]	Orientation to learners [%]	Orientation to subject matter [%]	Percentage of affect [%]	Percentage of justification [%]
T01	46	22	78	80	20	0	60
T02	22	86	14	74	11	16	74
T03	16	81	19	31	62	8	92
T04	33	79	21	54	19	27	62
T05	51	25	75	54	46	0	77

Teacher	The sum of recalled claims and utterances marked as reflection	Percentage of recalled claims [%]	Percentage of reflection [%]	Orientation to learners [%]	Orientation to subject matter [%]	Percentage of affect [%]	Percentage of justification [%]
T06	35	94	6	45	36	18	67
T07	48	8	92	25	50	25	75
T08	42	69	31	48	17	34	97
T09	33	55	45	78	11	11	89
T10	19	74	26	86	7	7	50
T11	22	82	18	61	11	28	50
T12	14	36	64	60	20	20	80
T13	35	31	69	64	27	9	27
T14	27	59	41	100	0	0	75
T15	28	32	68	67	11	22	44
T16	23	39	61	67	22	11	33

5. Discussion on results and conclusions

To address the main research question – What was the nature of the teachers' interactive cognition?- we can conclude that the teachers overall recalled mainly their cognition related to PCK – processes (184 out of 247 claims), which might be interpreted as a natural consequence of the elicitation. The teachers saw themselves teaching, and with regard to the nature of the task of recalling what they had been thinking about, the considerations behind their actions, teaching strategies, techniques and methods seemed to be the most accessible aspects of their performances. It may, however, document a more general feature of teachers' thinking, specifically the fact that teachers tend to focus more on the procedural aspects of their work as noted by Janík, Knecht, Najvar et al. (2010), or Janík, Janko, Knecht et al. (2010) in their research into curricular reform implementation in the Czech Republic.

However, the extent to which individual teachers revealed their interactive cognition varied greatly. As the results showed, there were teachers whose percentage of recalled claims was very high (e.g., T06 with 86%) and there were teachers who were, despite the researchers' prompts and questions, rather reflective (e.g. T07 whose percentage of reflection was 92). The results for the latter group, i.e.,

for the teachers whose utterances were mainly reflective, should be interpreted with caution, since the orientation to pupils or the subject matter is computed on the basis of their recalled claims. The data also revealed that the teachers differed from each other in the light of the other variables. It can be concluded that the group of 16 teachers did not seem to share a common feature in the light of the results. Instead, there seem to be certain areas of expertise which are developed to different extent in each individual or are displayed in response to the particular pedagogical situation. This seems to be compatible with the prototype view of expertise (Sternberg & Horvath, 1995).

It should be pointed out that the fact that some teachers did not reveal much of their interactive cognition through stimulated recall, and instead were rather reflective, does not mean that they were better or worse teachers. It follows from our previously collected data that all 16 teachers displayed some characteristics of expertise. One interpretation of the high percentage of reflection in some teachers (especially T07, T01 and T05) can be that they found it more difficult than others to verbalize their cognitive processes. Another interpretation can be that in the expert teachers such cognitive processes were routinized and automatized to such an extent that they were unable to verbalize them. This is in accord with the findings of cognitive psychology research on memory traces, more specifically on the distinction between memory traces in novices and experts (e.g., Ericsson & Simon, 1999).

The data were segmented by means of argumentation analysis and subsequently analyzed in the light of a category system based on PCK. The argumentation analysis seemed suitable for this type of data and allowed for quantifying the recalled claims and their justifications.

The presented study has its limitations. The way the data was elicited and analyzed might have limited the findings. Contrary to our initial aim to concentrate exclusively on interactive cognition, reflection-on-action occurred in many verbal protocols. Also, the generalizability of the findings is limited. The data obtained in the stimulated recall only relate to the lesson that the teachers had taught. The content of the lesson as well as the specific group of learners might have influenced the flow of the lesson, and thus the teacher's interactive cognition. Relatedly, it should be pointed out that our results are domain specific (teaching English or German) and the research was conducted in the cultural context of the Czech Republic.

The results presented here comprise one stage of a research project which was conducted as a multiple case study. For individual cases (teachers), multiple data sources were used, and a combination of data analysis techniques was applied.

Apart from the analysis presented here, cluster analysis was conducted and the transcripts were analyzed inductively in order to reveal other aspects of the stimulated recall (Píšová et al., in preparation).

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