DEVELOPING BEGINNER TEACHERS' PROBLEM SOLVING SKILLS IN POST-LESSON REFLECTIONS

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Abstract

Although reflective practice has gained popularity world-wide in recent years, some argue that the 'reflective' research has focused too much on different conceptualisations of reflection and not enough on how teachers actually think when they reflect. This article addresses this issue of teacher cognition by examining one skill underpinning reflective thinking, problem solving. Specifically, this study compares the problem solving of six inexperienced and three experienced teachers of English. It emerged that the experienced teachers developed sophisticated reasoning skills to help themselves analyse problems in principled ways. This article identifies what principled reasoning actually consists of and how it may be developed in inexperienced teachers of English to help them solve teaching problems and so reflect more effectively.

Key words: reflection, cognitive skill psychology, expert-novice problem-solving, subject-specific pedagogy, generic pedagogy.

1. Introduction

During the last 40 years, reflective practice and learning to teach by critically examining one's practice, has received much support in teacher education. I do believe in the power of reflective thinking but have always found it a problematic skill to foster with the student teachers I work with in Hungary who describe rather than analyse their practice, experience difficulties with solving problems, evaluating their own and pupils' performance. A desire to understand why beginners experience difficulties and how they may be helped to reflect triggered the study described belowthat addresses these questions.

1. Do differences exist in the reflective thinking of nine Hungarian English teachers with differing levels of teaching experience?
2. What implications do any findings have?

This article focuses on just one aspect of reflective thinking, teachers' problem solving skills inpost-lesson reflections.

There is much research into reflective practice investigating reflection in diverse ways. Some researchers focus on the cognitive (Schön, 1987) or metacognitive dimension (Eraut, 1994) viewing reflection as a form of elaborate, internal problem solving. Others have investigated the importance of reflecting with someone rather than alone (Day, 1993) or whether the time when we reflect (Korthagen & Kessels, 1999) or socio-political contexts influence how we reflect (Boud, 1998). Still others investigate whether different levels of reflection exist with sophisticated reflections linked to experience (Collier, 1999). All conceptualizations though share the notion that reflection involves modifying our existing mental structures through our attempts to analyse our experiences. Therefore, the cognitive perspective unites somewhat the diverse views that exist and is the one that underpins this study.

While the 'reflective' literature provides rich insight into the substance and nature of reflection, paradoxically it is vague in that it fails to illuminate what teachers actually do when reflecting, how they process information and how they learn. Few studies operationalize reflection that is, identify and illustrate teachers' reflective thinking (McAlpine et. al., 1999; Ixer, 1999), little guidance is offered on how to analyse it (Korthagen and Wubbels, 1995; Hargreaves, 2004) all of which is problematic for researchers.This vagueness is also problematic for teacher educators. Reflective thinking is a non-visible skill and trainees often struggle to recognise what they are doing, are not doing and should be doing in order to reflect effectively. Teacher educators must be explicit about what effective reflection consists of, to make it accessible to trainees. To address this problem,

reflection here is conceptualised as a complex, cognitive skill encompassing various constituent sub-skills. This skill-based approach lends clarity to the concept as it allows reflection to be broken down into individual skills which can then be analysed, illustrated and taught, thus rendering it visible and tangible to the benefit of teacher education and research alike. This article addresses just one reflective sub-skill, teachers' problem solving.

1.1 Problem solving

Problem solving was analysed through the problem solving model developed by Mayer (1996). Central to Mayer's model is the notion of problem space which consists of: the problem's starting state (its context, its characteristics and how they interact); the goal/desired outcome; the procedures to move us from the start to goal state and any obstacles that constrain movement through the problem space. Skilled problem solvers first define their problem space before attempting a solution, which they do by working through four processes:

- 'Representing' (Mayer, 1996, p.551), mentally defining the problem to ourselves by identifying the problem space components
- 'planning', calculating how to best achieve a solution
- 'executing', carrying out the plan
- 'controlling', evaluating our progress towards the goal.

Differences between skilled and unskilled practitioners stem from how they address these processes. For example, expert physicists (Chi et. al., 1981), political scientists (Voss et. al., 1983) and teachers (Swanson et. al., 1990) spend much time'representing' and 'planning' but novices tend to move directly onto 'executing', omitting almost the other three processes. Experts 'represent' problems in principled ways and consider why problems appear as they do and what inferences can be drawn but novices just attend to surface features and 'how' problems appear (Alexander, 2003). Interestingly, it was such principled reasoning that was the critical difference in problem solving capability of this study's experienced and inexperienced teachers.

2. The Study

The study took place at a Hungarian primary teacher education institution which offers two English teaching courses: a pre-service degree qualifying trainees to teach Hungarian curriculum subjects plus English language to 6–12 year olds; an in-service course for qualified, practising Hungarian teachers, retraining as English teachers (6-12 years). Nine teachers participated in the study.

Fig. 1Participants

Groups	English teaching experience	Hungarian teaching
Beginners: 3 pre-service teachers	Beginner	Beginner
Accomplished Beginners: 3 in-service teachers	Beginner	Experienced
Experienced: 3 local teachers	Experienced	Experienced

2.1 Data collection and analysis

To research post-lesson problem solving, I observed each teacher's lessons twice, held two post-lesson discussions (Interview 1/Interview 2), analysed documentation. Data consisted of: observational field notes; interview transcripts; diary entries; lesson plans; local curricular.

Data analysis followed grounded theory procedures (Rubin& Rubin, 1995) so data was broken down into thematic sections then segments then concepts until eventually thematic categories emerged that accommodated all data.One category was'Cognitive Skills' which refers to the six skills teachers used to process information in post-lesson reflections: the single descriptive skill, Describing and five analytical skills: Pedagogic Reasoning, Commenting, Evaluating, Predicting, Problem solving (Sherwin, 2011).These then, constitute the sub-skills of reflective thinking, one of which 'problem solving', is in focus here.

2.2 Analysing Problem Solving

In the interview/diary data, I could identify Problem Solving episodes when participants reflected on problematic teaching events. I examined how, during each episode, participants addressed four problem solving processes adapted from Mayer's (1996) model.

Problem Solving Processes

1. Identifying the problem's most significant features. This answers the question, '*What's the problem?'* and corresponds to Mayer's 'representing'.

2. Identifying the problem's cause: *Why did this occur*? This focuses on one part of 'representing', of recognising the problem's underlying principles.
3. Identifying solutions: *How can I solve it?*This refers to participants selecting and/or carrying out solution strategies. It relates to Mayer's 'planning' and 'executing' (ibid).
4. Evaluation: *What comments/reflections do I have on this episode?* This corresponds to 'controlling' where participants comment on some aspect of the problem solving process.

For example,

There are some pupils not interested in studying English (Problem). *English is a bit over their head, they always feel that the others are much better and maybe that's why they are passive* (Cause). *The only thing that worked with them is differentiating and when they create something in groups and they all do different things. Then they are really interested* (Solution). *However if we do these things all the time then they don't learn the material they should by the end of the school year and it's lots of work for me, too*(Evaluation).

I then tallied the processes each teacher covered in each Problem Solving episode thus (see Appendix 1 for complete version).

Fig. 2 Processes of Problem Solving(Sample)

		Identify Problem	**Identify Cause**	**Identify Solution**	**Evaluation**
Experienced Teacher Csilla	Interview 1	5	5	5	5
	Interview 2	1	1	1	1

The rows represent Problem Solving episodes, the columns the four processes, the numbers record when a participant completed a problem solving process. Thus, Csilla dealt with five episodes in Interview 1 and one in Interview 2 and always worked through all four processes.

3. Findings

It emerged that the inexperienced English teachers (beginners/accomplished beginners) solved problems in similar ways, differently from and less proficiently than the experienced teachers and I

illustrate this through a comparison of three episodes. My comparison is structured through: the number of problem solving processes covered, the accuracy, the depth of participant's performance.

Beginner Amélia

Amélia aimed to teach present simple through the context of jobs to her 10-year-old pupils. Pupils consistently made mistakes such as *I wears a uniform...He wear a uniforms....she wear a uniform…They wears a uniforms* .Amélia constantly corrected pupils, but mistakes persisted. Post-lesson, Amélia commented,

> *I think they don't understand every words that "works in a uniform"…not "wears in a uniform". Maybe don't the form was the problem just the meaning of the words* (Problem 1)*. But somebody change it so they don't know that the boy is "he" and the girl is "she"* (Problem 2*). I tried to help them to show the picture that he hasn't a…ponytail* (Solution)*..but I don't know what was the problem with "he" or "she".*

Amélia worked through two processes of identifying a problem and identifying a solution. Indeed, she identified two problems. Problem 1 concerned concept when Amélia believed pupils made mistakes because they did not understand the new vocabulary and Problem 2 concerned form when pupils were confused by 'he/she' pronouns. This suggests that Amélia herself was unsure of how to represent the problematic situation to herself.

The problem was actually grammatical as pupils were confused by the's' verb-ending (*I wears*), plurals (*uniforms*) and 'he/she/it' pronouns. Amélia's solution of showing a picture of a boy referred neither to the problem nor its cause both of which were grammatical in nature and required a solution that helped pupils notice the 's' forms. Amélia could not see the underlying cause, misinterpreted the problem and consequently identified an inappropriate solution. Thus, Amélia's problem solving during and post lesson was inaccurate.

Accomplished Beginner Bella

Bella aimed to teach a restaurant dialogue to 12-year-olds. In the lesson, pupils were inattentive and disruptive. Post-lesson, Bella commented,

> *Sometimes they talk when they had to listen to me* (Problem)*.....I didn't want to look like a witch but I think after that I will....tell them that..."What I promise badly or good, I always keep it. So, please be quiet and if you don't then I will write a notice into your book"* (Solution).

Bella accurately recognised the problem that pupils misbehaved, and suggested a solution that did refer to the problem, of punishing the miscreants. She did not however, consider the differing causes to pupils' misbehaviour: seating arrangements were inappropriate; the lesson was late afternoon; a visitor (me) was present; the materials were perhaps uninteresting, irrelevant to pupils' needs. Nor did she evaluate the episode. This suggests that she focused on the problem's surface features rather than its underlying structure, creating the impression that her analysis lacked depth.

Experienced Csenge

In Csenge's lesson, 12-year old pupils in groups had to construct from word cards, sentences related to a subsequent reading. Word cards were colour-coded to represent parts of speech (e.g. red = verb). Pupils found this extremely challenging. Csenge commented,

> *They have the small cards and they were mixed, there was a pattern and they could not find the place* (Problem)*...I gave them some help and I think that they could solve the problem then* (In-class solution).

She continued that pupils did not know:

> *The strategy where to start with and how to work with this pattern* (Cause*).....In previous lessons, I....should've tried some patterns* (Solution)*.....it comes from history and we have to learn it...it takes time* (Evaluation*).*

NB: "*it comes from history"* means that she believes the traditional Hungarian education system does not foster the strategic thinking such problem solving tasks require.

Experienced Csenge was more thorough, principled and critically aware in her problem solving than both Amélia and Bella. First, by working through all four processes, Csenge automatically considered more aspects of the situation suggesting a more thorough approach than Amélia and Bella who only considered two processes. Second, Csenge provided a principled, in-depth analysis and clearly perceived the problem through its cause, that pupils lacked problem solving skills and matched her solution of training in strategic thinking to this cause. Neither Amélia nor Bella addressed the cause and only discussed the problem and solution. This suggests they focused on the problem's surface features rather than its underlying structure, implying that their analyses lacked depth. Third, by referring to Hungarian education in Evaluation, Csenge highlighted a constraint to

her solution that pupils need time to learn problem solving skills. This suggests she was more insightful and critically aware than Amélia and Bella who omitted this process.

Analysis of all nine participants' problem solving revealed similar findings. Processes of Problem Solving(Appendix 1) records the processes participants used when solving teaching problems.The table reveals that all inexperienced English teachers (beginners/accomplished beginners) worked through fewer processes and considered causes and evaluation far less frequently than the experienced teachers who in fact almost always worked through all four processes. This implies that all beginner/accomplished beginners were less thorough, principled, critically aware problem solvers than the experienced teachers.

4. Discussion: Developing Principled Reasoning

Principled reasoning emerged as central to the proficient problem solving of the experienced teachers and refers here to how they automatically asked themselves questions about the problem's underlying structures/principles:

Why did this problem occur?
What theory can explain it? How? Why?
How can I break it down?
What are my reasons for….?
What comments do I have on the cause? Solution?

It was the spontaneous posing and answering of these questions that underpinned the experienced teachers' principled reasoning. Therefore, I have been exploring ways to develop such principled reasoning with my teacher trainees through the activities presented below, which draw on two teaching methods: modelling and problem solving heuristics. Modelling gives learners access to the cognitive processes experts use in principled problem solving (Bandura 1996, has details on modelling). The problem solving heuristics below combine a task plus on-task questions to foster learners principled reasoning. Nickerson (2004) contains details on how problem solving heuristics, King 1991, on how guiding questions, Berry and Broadbent (1984), how on-task rather than pre- or post-task questions foster principled reasoning). These activities aim to help student teachers notice the underlying structures of problems and so view them in the principled, insightful ways of experienced teachers.

4.1 Discussing cases

Student teachers (STs) compare a real problem scenario (Teacher A) with two fictive scenarios of the same problem solved differently (Teachers B/C). STs observe how Teachers B and C consider the problem's cause prior to selecting an appropriate solution and use theory in their explanations (differentiation, socialisation skills) whereas Teacher A just attends to surface features.

Fig. 3 Same problem solved differently

- Which problem solving do you like best? Why?
- What are the differences between them?

TEACHER A

Sometimes they talk when they had to listen to me (Problem). I didn't want to look like a witch but I think after that I will....tell them that..."What I promise badly or well, I always keep it. So, please be quiet and If you don't then I will write a notice into your book.

TEACHER B

Sometimes they talk when they had to listen to me (Problem). I thinkthe exercise was too easy for Juli, Laci, Dani and Zsolti and they disturbed the others. Next time I will give them harder tasks and I think this will motivate them more. Children are different so we need to differentiate between them but I think we Hungarians are just learning how to do this. It takes time.

TEACHER C

Sometimes they talk when they had to listen to me(Problem). Daniand Zsolti and Juli and Laci are best friends and they always play too much when they sit together. Next time I will change the groups so they don't work together. And this is also good, cos maybe they can get used to working with new people and develop socialisation skills.

4.2 Decomposing the problem

STs break down the real problem scenario in 'Teaching the Chant' through one of the tasks below.

Fig. 4 Teaching the Chant

Atilla wanted pupils to create new versions of a simple chant, to develop their speaking skills. Pupils were aged 8, beginner learners of English. Atilla,

1. Taught/revised new words: *Snow, snowman, eyes, mouth, nose*.

2. Taught and practised the chant.

Snow!
Let's make a snowman!
OK, 1, 2, 3.
Eyes, mouth nose.
Yippeeee!

3. Createda new version of the chant on the blackboard.

Pizza!
Let's make a pizza!
OK, 1, 2, 3.
Salami, cheese, tomato.
Yippeeee!

4. Askedpupils to create (in pairs) their own *Pizza* version by changing food items.

5. Pupils did one of the following

5a. Produced incomplete versions *Pizza! 1,2,3, Yippeeee!* OR
5b.Produced inaccurate versions *Let's Pizza! 1,2,3, Yippeeee!* OR
5c.Copied Atilla's bb. *Pizza* version
5d. Did nothing.

6. Atilla scolded pupils.

4.2.1Working Backwards

STs work backwards though the lesson guided by '*Why?'* questions: *Why did Atilla scold pupils? Why did some pupils do nothing?* Etc…

This task helps STs analyse a problem as experts do. The study's experienced teachers (and experts in general, Nickerson, 2004) invariably decompose teaching problems by working backwards from the goal to start point, which helps them identify the problem's key features(e.g. problem's cause, reasons for their actions) and the causal links between them.

4.2.2 The Grid

STs represent the problem scenario in columns that replicate problem solving processes (2.1). This task prompts STs to copy how experts decompose a problem for analysis, through the four processes.

Fig. 5 The Grid

Problem	**Cause**	**Solution**	**Evaluation**
What's the problem?	Why did it happen?	How would *you* solve the problem?	Comments? (Will your solution work?)
Pupils didn't write new version	*Atilla taught wrong words: ~~Snow~~ X → Let's make a….. √*		

4.2.3 Concept map

STs draw the teaching steps on individual pieces of paper (individual pictures for steps 5a-5d), arrange pictures on a poster, draw lines between them to show how they 'fit together', then write on the lines to express any relationships that exist. Prompts include: *Why did pupils make the mistakes in Step 5a-5d? Where Atilla could avoid these mistakes?* Etc…

This task focuses STs' attention on key events and how they interact.

4.3 Grouping problems

STs group seven-eight problem scenarios according to whether they are:

(a) Superficially different but with similar causes: e.g. pupils underachieve because they lack knowledge of how to fulfil a task(Appendix 2 has example scenarios).

(b) Superficially similar but with different causes: e.g. pupils are naughty but for different reasons (see 4.1, Fig. 3).

The discussion generated by this task pushes STs to understand problems by examining the underlying rather than surface features thus mirroring the principled reasoning of experts.

5. Conclusion

I argued earlier that the diversity and vagueness of the 'reflective' literature is perhaps unhelpful when teaching and researching reflection. I suggested that viewing reflection as a complex cognitive skill lends the specificity that the reflective literature lacks. It allows reflection to be decomposed into its constituent sub-skills, one of which is problem solving. I recognise that reflection is multi-layered, complex and so hard to capture in sub-skills which may not account for the collaborative, temporal, contextual dimensions mentioned earlier. But, decomposition has enabled me to identify aspects of expert performance to help beginner teachers. Experienced teachers address problems in principled ways, through four processes, by asking themselves principled reasoning questions. I now encourage beginner teachers to do the same by exposing them regularly and systematically to activities such as those described above. This approach to developing reflective thinking, I believe may be of use to teacher educators in Hungary and elsewhere.

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APPENDIX 1: Processes of Problem Solving

This table records the problem solving processes used by participants when solving teaching problems.

		Problem	**Cause**	**Solution**	**Evaluation**
Beginners					
Amélia	Interview 1	1			1
		1			
		*****1		1	
	Interview 2	1		1	1
Anikó	Interview 1	1	1	1	
		1		1	1
		1		1	
		Int.	1	1	
	Interview 2	2	2	2	
		2			
		Int.		1	
Atilla	Interview 1	1	1	1	
		1		1	
		Int.	1		
	Interview 2	*Int.*	1	1	
Accomplished beginners					
Bettina	Interview 1	1			
	Interview 2				
Boglárka	Interview 1	3		3	3
	Interview 2	1		1	1
		1	1		
		2			
Bella	Interview 1	1	1		
		1			1
		1	1	1	
	Interview 2	*****1		1	
Experienced					
Csilla	Interview 1	5	5	5	5

	Interview 2	1	1	1	1
Csenge	Interview 1	*****1	1	1	1
		2	2	2	2
		1		1	
	Interview 2				
Cecília	Interview 1	3	2	3	3
	Interview 2	1	1	1	1
		1		1	1

NB: The words *"Int."* indicate the problem was identified by the interviewer but the other processes in this particular episode were completed by the participant.

The * indicates that this episode was illustrated in '3. Findings'.

APPENDIX 2: Superficially different, similar causes

These two problem scenarios are superficially different because the lesson context, content, problem types are different. However in both cases the pupils underachieve because theyhave not yet learnt how to accomplish the taskof how to: (A) Work in pairs; (B) Guess meaning from the second language context using intrapersonal skills.

(A)

My 12 year old pupils don't like each other. When I put them into groups to work together, they work by themselves, they don't share ideas and they don't help each other. This isn't good. What can I do?

(B)

My ten year old pupils are a bit lazy. It's a new class to me (They've been learning English for 2 years) and if I speak to them in English, they refuse to understand so I have to translate everything into Hungarian. This isn't good. What can I do?