**Title:** Evaluating science trainee teachers' assessment pedagogy in promoting cognitive learning experience among students.

Magaji, A.

Centre for Thinking and Learning, Institute for Lifecourse Development, FEHHS, University of Greenwich, United Kingdom.

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## Theoretically framing the literature

This article reports a section from a large study on trainee teachers' classroom assessment pedagogy and its impact on the learning and progress of students. Developing and promoting cognitive learning requires experience in the various types of assessment strategies such as questioning to check prior and current knowledge of students, feedback, self and peer assessments (Black and Wiliam, 1998; Panadero, Jonsson and Strijbos, 2016; NFER, 2019). However, an effort is required to develop trainee teachers' assessment competence and literacy (DeLuca et al., 2019; Schildkamp et al., 2020) as means to improve teaching and learning. Therefore, in promoting cognitive learning experiences, trainees should be aware of those intrinsic (personal) and extrinsic (behaviour and environmental) factors that can promote learning. The social cognitive theory (SCT) (Bandura, 1989; 1998) has been used in this study as a theoretical framework to explain the interconnections between the intrinsic and extrinsic factors by using a combination of identified assessment frameworks such as the application of prior knowledge, collaborative learning (Major and Mulvihill, 2018; Magaji, 2021) and modelling and eliciting feedback (Magaji, 2021) to aid cognitive learning.

The personal factors may include cognitive, affective and biological, and can be influenced by students' behaviour and their environment. The types of activities that students are engaged in and how teachers check prior knowledge can promote students' ideas and cognitive competencies. In the same vein, Bandura (1998) asserts that a sense of personal efficacy is concerned with perceived capabilities to produce the desired effects. This implies that trainee teachers should be given support to develop and utilise assessment frameworks that can promote cognition among students. Therefore, this study aims to answer the research question: how effective can identified assessment frameworks develop cognitive learning experiences among students.

## Methodology

This study is framed within a social cognitive theory (Bandura, 1989; 1998) to explore how identified assessment frameworks such as the application of prior knowledge, collaborative learning, and modelling and eliciting feedback can promote cognitive learning among students. The participants included a researcher, a research assistant who was involved in the data collection and 20 science trainee teachers in initial teacher education (ITE) in England who were training as secondary school teachers. Data was collected through lesson observations and interviews with a further layer of data verification between the research assistant and the interviewees to promote triangulation (Robson, 2011). The interview questions sought how trainee teachers were promoting cognitive learning by implementing assessment pedagogies to encourage positive behaviour towards learning. The interview data were analysed using a deductive thematic analysis as the data sources were coded based on identified assessment frameworks (Clarke, Braun and Hayfield, 2015). The deductive

thematic analysis is based on a set of predetermined codes from existing theory and the researcher finds comments that fit into them. The analysis involved a transcription of the interview recordings and thorough familiarisation of the data to identify comments that fit into the assessment frameworks. Outcomes from the lesson observations were used as supporting evidence in each of the assessment frameworks.

## Findings and discussion

The assessment frameworks include the application of prior knowledge, collaborative learning and modelling and eliciting feedback. All discussions will centre on these frameworks.

## Application of prior knowledge

Evidence from this study has shown that the trainee teachers value the importance of promoting prior knowledge among students such as trainee 1 who said '*I use retrieval practice to recall knowledge following series of questions developed using Bloom's and Solo taxonomies by focusing on the lower and higher cognitive domain questions',* trainee 3 said *'I use the Do Now tasks by sequencing recall questions from last lesson and end of unit'* and trainee 5 said '*my lesson starts with interleaving tasks on knowledge check of the previous learning to know where they are and how to support them'*.

The assessment practices carried out by trainees show the ability to promote the application of prior knowledge and develop new knowledge using various questions on the cognitive domains in the taxonomies of learning. Some trainees designed retrieval questions (Rowley and McCrudden, 2020) to help students recall information from memory and interleaving tasks to promote long-term memory. All these activities enhance the intrinsic factors of learning as it creates the right environment through the various assessment pedagogies that enable students to participate in their learning. This can have a positive impact on the students' behaviour to learn (Bandura, 1998) and encourage them to persevere during the tasks. However, the trainees are at different levels of experience regarding classroom assessments as seen in their responses. For example, trainee 1 demonstrates the ability to promote the cognitive learning experience of students using lower to higher cognitive domain questions on Bloom's taxonomy while trainee 5 focuses on knowledge recall. Both trainees understand how to support students' learning but with variations in their assessment competence and this can have an impact on the cognitive learning experience of students. This shows that the trainees would require further support to develop their assessment literacy. The outcomes of lesson observations between the researcher and a trainee support this:

Researcher: *what other strategies can you use to promote prior knowledge of the students?*

Trainee 13: *I use the ABCD cards, traffic light cards and mini plenaries. My mentor also suggests that I use fun and interactive ways such as whiteboards, but I will need support in using other strategies.*

Researcher: *when using questions, ensure you develop them before the lesson to stretch and challenge students. The questions should engage and promote curiosity among students but give them thinking time to respond to the questions.*

## Collaborative learning

Creating an environment for collaboration promoted the intrinsic and extrinsic factors responsible for learning as trainee 6 said '*I give them problem-solving and bounce back*

*questions to allow them to explain and create knowledge',* trainee 17 commented '*I allow them to do self and peer assessments and verbal feedback on given tasks'* while trainee 19 said '*I use assessments to promote active learning and participation so that students can share ideas'*. These conversations are further developed between the researcher and the trainee below

Researcher: '*you used questioning, feedback and group work to promote learning, what other strategies could you use'.*

Trainee: '*I will create opportunities for collaborative problem-solving to allow them to share ideas'.*

From a social construction perspective, collaborative learning can provide an opportunity for deeper learning among students (Forsell et al., 2019), and this is exemplified in the comments made by trainees. They suggest that an environment that facilitates problem-solving enables students to develop cognitive abilities as it can sustain interactions, allow them to persevere during longer tasks and improve behaviour towards learning. However, a key factor according to Bandura (1998) centres on the capabilities of students to produce effects that facilitate personal efficacy and their behaviour in learning. Trainee teachers should also be made aware of the drawbacks associated with collaborative learning where one group of students may dominate the tasks at the expense of others.

**Modelling and eliciting feedback**

Trainee teachers should provide constructive feedback that promotes the intrinsic and extrinsic factors responsible for learning, and the activities created should motivate and encourage students to take part. Evidencing this, trainee 14 said *'I create opportunities for peer feedback as students understand themselves better than the teacher*. Trainee 16 commented *'I do peer questioning and utilise questions such as how, why, describe, explain and justify.* In the same vein, trainee 17 avers that '*I ask questions and provide formative feedback considering what went well and even better if, to guide the students'* while trainee 18 said *'I do peer assessments and group discussions with verbal feedback to help them know what quality feedback looks like'*. These comments show that trainees value the role that both feedback from teachers and students can have on learning as a trainee suggest that students should be shown what quality feedback looks like. However, an emphasis should be placed on how teachers can create the right environment to support students by modelling and eliciting feedback, an area in which trainee teachers may require support to promote cognitive learning among students. The conversation between a trainee and the researcher shows this:

Researcher: '*students responded to some of your questions but not all of them how can this be improved?'*

Trainee: '*the students do not ask questions and when I ask high order questions, most of them do not answer, I guess it is difficult for them'*

Researcher: '*you could model how to ask high order questions using Bloom's taxonomy question prompts and the type of feedback required'.*

This study has shown that the quality of feedback from teachers and student-student can close gaps in students' knowledge (Black and Wiliam, 1998; EEF, 2021) and promote the intrinsic and extrinsic factors responsible for learning due to the satisfaction in students' competence and autonomy needs (Burgers et al, 2015). Burgers et al (2015) argue that the quality of

feedback must have effects on motivation, the way the feedback is delivered, how students interpret the feedback and how their behaviour is related to the feedback. Conversely, Baadte and Schnotz (2014) contend that the effects of feedback on motivation and affect depend on the student's prior academic self-concept. Thereby giving students the agency in deciding how their behaviour to learn can enhance cognitive abilities based on the positive learning environment created by teachers. Evidence from this study, therefore, has shown that trainees can promote positive feedback and enhance students' behaviour to learn through modelling and eliciting feedback, however, students need to be trained to develop questions and give feedback as this would enable them to know what quality feedback looks like.

## Conclusion

Findings from the study suggest that the assessment frameworks including promoting prior knowledge, collaborative learning, modelling and eliciting feedback enhance cognitive learning experiences among students. For example, trainees discussed how using retrieval tasks with differentiated questioning was useful in recalling prior knowledge and advancing learning. In addition, they engaged students in problem-solving and created opportunities for discussions and sharing ideas and feedback with their peers. These types of learning are key factors that produced effects that facilitated personal efficacy and behaviour in learning among the students and enhanced their cognitive abilities. An implication for teacher development would focus on mentors providing relevant support for trainees to create activities that can enhance the cognitive learning experience of students. This includes observing experienced teachers, feedback from lesson planning and observations, reviewing the curriculum and attending related professional development activities.

## Reference

Baadte C and Schnotz W (2014) Feedback effects on performance, motivation and mood: Are they moderated by the learner's self-concept? *Scandinavian Journal of Educational Research*, 58(5): 570–591.

Bandura A (1989) Social cognitive theory. In: Vasta R (eds) Annals of child development. Vol. 6. Six theories of child development Greenwich, CT: JAI Press, pp. 1-60.

Bandura A (1998) Health promotion from the perspective of social cognitive theory, *Psychology and Health*, 13(4): 623-649.

Black P and Wiliam D (1998) *Inside the Black Box. Raising standards through classroom assessment*. London: School of Education, King's College.

Burgers C, Eden A, van Engelenburg, M. D. and Buningh S (2015) How feedback boosts motivation and play in a brain-training game, *Computers in Human Behavior,* 48, 94-103

Clarke V, Braun V and Hayfield N (2015) Thematic Analysis. In: Smith JA (eds) Qualitative Psychology: A Practical Guide to Research Methods, London: SAGE Publications, pp. 222-248.

DeLuca C, Willis J, Cowie B, Harrison C, Coombs A, Gibson A and Trask S (2019) Policies, programs, and practices: exploring the complex dynamics of assessment education in teacher education across four countries, *Frontiers in Educ*. 4, 132.

Education Endowment Foundation (EEF) (2021) Teacher feedback to improve pupil learning: Guidance report. Available at: https://educationendowmentfoundation.org.uk/education-evidence/guidance-reports/feedback (accessed 27 April 2022)

Forsell J, Forslund Frykedal K and Hammar Chiriac E (2019) Group Work Assessment: assessing social skills at group level. *Small Group Research*, 51(1): 87-124.

Magaji A (2021) Promoting problem-solving skills among secondary science students through problem-based learning. *International Journal of Instruction*, *14* (4): 549-566

Major T and Mulvihill TM Dr (2018) Problem-based learning pedagogies in teacher education: the case of Botswana. *Interdisciplinary Journal of Problem-Based Learning*, 12(1).

National Foundation for Educational Research (NFER) (2019) Assessment 101. A trainee and early career teacher's handbook to primary assessment in England. Available at: https://www.nfer.ac.uk/for-schools/free-resources-advice/assessment-hub/assessment-101/ (accessed 14 February 2021)

Panadero E, Jonsson A and Strijbos J (2016) Scaffolding self-regulated learning through self-assessment and peer assessment: Guidelines for classroom implementation. In: Laveault D and Allal L (eds) Assessment for learning: meeting the challenge of implementation. Boston, MA: Springer, pp.311-326.

Robson C (2011) *Real world research. A resource for users of social research methods in applied settings* (3rd ed). West Sussex: Wiley

Rowley T and McCrudden M T (2020) Retrieval practice and retention of course content in a middle school science classroom. *Applied Cognitive Psychology*, *34*(6): 1510-1515.

Schildkamp K, van der Kleij FM, Heitink MC, Kippers WB and Veldkamp BP (2020) Formative assessment: A systematic review of critical teacher prerequisites for classroom practice. *International Journal of Educational Research*, 103, 101602.