

Investigating Teacher Questions Within the Framework of Knowledge Building Pedagogy

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Abstract: This study is designed to investigate the impact of teacher experience and cognition on teacher questioning in the framework of Knowledge Building (KB) pedagogy. We already know that teachers ask the most questions in a classroom and that the majority of their questions have little impact on learning since they focus on classroom management (Almeida, 2010; G. Brown & Wragg, 1993; Floyd, 1960; Hogan & Gopinathan, 2008; Kerry, 2002). However, there is relatively little research done to discover how inquiry-based and dialogic classroom discourse would influence a teacher's approach to using questioning strategies. In this paper, we present a research project that was conducted in a Singapore primary school, and we argue that teaching experience has a powerful influence on the questioning teachers use in their classrooms. Furthermore, the implementation of Knowledge Building pedagogy has a positive impact on teacher questioning and contributes to creating an effective learning environment.

Key words: Knowledge Building, questioning, teacher cognition, social studies

Introduction

This study is designed to investigate the impact of teacher experience and teacher cognition on teacher questioning in the framework of Knowledge Building pedagogy (Scardamalia & Bereiter, 2010). Previous research indicated that teachers ask the most questions in a classroom and that the majority of their questions have little impact on learning since they focus on classroom management (Almeida, 2010; G. Brown & Wragg, 1993; Floyd, 1960; Hogan & Gopinathan, 2008; Kerry, 2002). Will this be true when we examine an inquiry oriented pedagogical approach, such as Knowledge Building (KB)? There is relatively little research done to discover how inquiry-based

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and dialogic classroom discourse might influence a teacher's approach to using questioning strategies.

As teachers do not rigidly follow methods or pedagogical approaches (see e.g. H. D. Brown, 2002; Kumaravadivelu, 1994), they are guided by their attitudes, beliefs, and experience when teaching (Borg, 2003). Therefore, we raise the question: How does teacher cognition impact questioning strategies in the classroom? Do differences in teaching experience influence what questions teachers ask?

Teacher questioning

How and what questions teachers ask in classroom discourse has a significant impact on learning. Learners often mimic and copy their teachers' behavior (Lortie, 1975), so the questions teachers pose have a direct influence on the learning and thinking habits of their learners. Just as babies learn to walk and talk by observing the adults around them, students learn to ask the questions their teachers ask.

Studies have shown that teachers do, in fact, ask many questions in the classroom: according to Floyd (1960), 93% of all questions asked in a classroom are asked by teachers. Indeed, teachers ask 300 to 400 questions per day (Levin & Long, 1981; Stevens, 1912), or approximately 2 million questions in an average teaching career (Kerry, 2002). Therefore, questions play important educational roles in the classroom, as they can be used for eliciting answers, guiding, scaffolding, and arousing curiosity, to name a few. But is there a variety of purposes in teachers' questions?

Although teachers ask a large number of questions, these are typically low-level, memory-intensive questions (Almeida, 2010) which, although effective for confirming learned facts and checking for errors in concepts, do not engage learners in higher levels of thinking. The use of low-cognitive-level questions is observed across all school levels, although some differences can be noticed between subject matter. As helpful as low-level questions can be, they alone do not promote the learners' cognitive development, contributing instead to dependence upon teacher-provided information instead of a co-construction of knowledge.

In contrast, high-cognitive-level questions are open, divergent, and dialectical; they allow for a range of answers and help learners think critically, imaginatively, and creatively. As the modern classroom becomes more inquiry-based, anchored by social constructivist theories (Scardamalia & Bereiter, 2010; Vygotsky, 1978), such questions become increasingly necessary as they support

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learning that moves beyond examination-oriented educational goals, cultivates inquisitive minds, and promotes understanding (Redfield & Rousseau, 1981).

Teacher-dominated instructional discourse is a common practice in Asian schools. Hogan and Gopinathan (2008) observed that teachers in Singapore classrooms monopolize the classroom discourse at both primary and secondary levels (with secondary classrooms seeing slightly more teacher talk). Furthermore, Asian students are often seen as reticent and passive, a result of the Asian educational culture into which they are socialized (Biggs, 1991). This over-generalization persists despite studies that suggest that Asian learners do have a “strong desire to participate in classroom activities” (Cheng, 2000, p. 435). Another study by Watkins (1991, p. 21) involving Filipino and Nepalese students found “little evidence to support the contention that Asian learners were more prone to rote learning than were the Australians.” This suggests that there is need for neither a teacher-dominated classroom nor an excessive use of low-order questions.

Research

The aim of this study is to provide insights into the questioning behavior of teachers in the classroom as well as the impact of teacher experience and cognition on questioning strategies teachers employ. An understanding of how and why teachers ask questions can provide valuable learning points for curricular reform and professional development. Specifically, this study hopes to answer two research questions:

1. What differences (if any) exist between the questioning styles of experienced and beginning teachers when they engage students in Knowledge Building in a Singapore primary school classroom?
2. What impact do the teachers’ knowledge, attitudes, and beliefs have on their questioning strategies?

This study aims to discover what questions teachers ask as well as what influences the amount and types of questions that they ask. Borg (2003) model of teacher cognition can provide an understanding of the “the unobservable cognitive dimension of teaching – what teachers know, believe and think” (Borg, 2003, p. 81) through four factors: educational experience as learners, professional coursework, contextual factors, and classroom practice. Borg (2003) argues that a teacher’s classroom actions are influenced by the kind of educational instruction received (schooling), the training received in becoming a teacher (professional coursework), the

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educational context in which their teaching takes place (contextual factors), and experiences and years of teaching (classroom practice).

Furthermore, this research is framed in the context of Knowledge Building (KB) pedagogy developed by Scardamalia and Bereiter (2010), which adopts a social-constructivist views towards learning. They advance the notion that learners need to work in knowledge building communities (KBC) in order to address real-life problems and generate a variety of ideas that can be improved. Learners are then guided to see their ideas and solutions in larger contexts. Since participants in the classroom are actively creating knowledge together, they democratize knowledge and have epistemic agency in the learning process with an emphasis on equal participation. The students should understand that all tasks and activities are related to knowledge work and pervasive knowledge building. Scardamalia and Bereiter (2010) identify these processes as principles of KB: *idea diversity, idea improvement, epistemic agency, rise above, and collective knowledge responsibility*.

Members of the KBC are able to identify authoritative sources of information and knowledge of their ideas (*constructive use of authoritative sources*) and engage in dialogical conversations that improve, refine, and transforms ideas (*knowledge building discourse*). Day-to-day activities and conversations have built-in assessment and fine-tuning processes that add to the idea improvement process (*concurrent, embedded, and transformative assessment*) (Scardamalia & Bereiter, 2010). These principles, particularly the knowledge-building discourse, should have an impact on how teachers choose questioning strategies in their classrooms.

Participants

The school in which the study was conducted is a *Future School*, a designation given by the Singapore Ministry of Education to recognize schools involved in curricular reform using Information Technology (IT). Beyond using IT, the school has also engaged in pedagogical innovation across various subjects using innovative pedagogies, one of which is Knowledge Building (KB) in Social Studies.

One experienced and one beginning Social Studies teacher participated in this study. To protect the teachers' identities, they are called John and Jane. John is 39 years old, with seven years of teaching experience. He holds a Bachelor of Science in Education (Physics & Chemistry) degree and a Master in Education (Science) degree. Jane is 24 years old and has been teaching for two years. She has a Bachelor of Arts in Education degree. They earned their degrees from the same teacher education institute in Singapore.

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Data collection

The data collection was carried out over 10 weeks between July and September, 2014. The participating classes had a single one-hour Social Studies lesson each week; the data were gathered during the third term when they focused on a 'Build a Coolie House' project, an extension of their studies in the preceding terms. Students worked in groups to design a building that can accommodate 500 coolies, or migrant workers. It was a single unit of work, and the objective was for the students to generate as many ideas as possible, select the best idea, and improve it through research and discussion. Students expected to come up with ideas and solutions, conduct research, and discuss improvements and alternatives with their teammates.

The main sources of data included lesson observations, which were video-recorded, and an in-depth interview with both teachers. The procedures for data collection are described below.

Lesson observation. Lesson observation was one of the main research instruments of the study, providing information regarding the teachers' questioning strategies in the classroom. Each of the 10 lessons in the unit was observed and video-recorded for further analysis. Lessons in which there was no teacher-student interaction (when students worked independently on their projects) were omitted from the study. In total, five 50-minute lessons per teacher were used.

In-depth interviews with teachers. An in-depth interview was conducted with both teachers. During the interview, each teacher was shown two video segments of their lessons which had either teacher-student interaction or teacher-directed learning. The criteria for choosing the two video segments were 1) using all three question types, and 2) connecting the questions to the learning objective of the lesson.

The teachers were asked to comment on what they did in terms of their intentions and thought processes at the time. They were given the opportunity to discuss their choice of questions and to provide a rationale and justification for their use with reference to their educational values and beliefs.

Data analysis

The lesson observation aimed to identify a) the types of questions the teachers used in the classroom, b) the frequency of occurrence for each type of question, and c) the functional uses of the questions asked. Therefore, the video recordings were selectively transcribed to focus solely on teachers' questions; other forms of discourse such as instructions, explanations, and input from students were omitted. The transcribed data from the lesson observations were

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coded in two stages. First, the focus was on the type of questions teachers asked using Brown and Wragg's (1993) categories as a priori codes. For example, teachers used managerial questions (e.g. "Can I have silence, please?"), low-order questions (e.g. "What are their living conditions?"), and high-order questions (e.g. "How do we combine?").

The second cycle of coding categorized questions by KB principles (Scardamalia & Bereiter, 2010). In preparation for the second cycle of coding, the transcripts were broken down into smaller units of analysis, or instructional episodes. These, as explained earlier, refer to a teacher-student interaction regarding a specific topic with the intent of learning, i.e. discourse which rarely contained managerial questions.

A challenge for the researchers was to decide what would count as a "question" in the episodes. For this study, we defined an utterance as a "question" when its function as a question was either signalled by its linguistic format (use of question words such as "what" or "why") or a linguistic purpose, i.e. a statement, usually accompanied by a questioning intonation, used for the purpose of eliciting information or elaboration from learners. Additionally, questions like "okay?" were identified as discourse markers and were omitted from the analysis.

Since the school in which the research took place implemented five of the 12 KB principles, namely *idea diversity*, *idea improvement*, *rise above*, *epistemic agency*, and *collective knowledge responsibility*, the coding only focused on these areas. Certain questions were coded under two or more principles. For example, the question "How can you make this better?" was classified as promoting both *idea improvement* and *epistemic agency* as it emphasized the learners' ownership of the ideas.

The interview data was transcribed, and "open coding" was used to allow conceptual categories to emerge from the data to identify themes and patterns (Saldaña, 2009, p. 81). Pattern coding was applied in the second stage to "pull together a lot of material into a more meaningful and parsimonious unit of analysis" (Saldaña, 2009, p. 152). The data was re-examined with the codes generated during the previous stage, and similarities and differences were identified and given a broader, more encompassing category.

Results and findings

The results and findings address the two research questions posed at the beginning of this study:
a) differences, if any, in the questioning strategies of a beginner and a more experienced teacher

in a Knowledge Building community, and b) how the teachers' knowledge, attitudes, and beliefs may influence the strategies they adopt in their questioning.

Amount and types of questions

The analysis of the questioning revealed that John, the experienced teacher, asked significantly more questions (280) in his classroom, while Jane, the inexperienced teacher, only asked about a third of the questions John posed.

Table 1: The amount and type of questions asked.

	Management	Low-Order	High-Order	Total
John	114	45	121	280
Jane	38	12	35	85

One reason for this could be that Jane does not feel confident in her preparation and, therefore, is unwilling to ask too many questions. She explained, "I thought that maybe more preparation was needed in terms of how I structure my questioning, how I structure my instructions to the pupils." This lack of confidence may perhaps be attributed to a need for professional development in the area of questioning, and also perhaps to the novelty of the KB pedagogy that calls for such a skill, especially in an exam-oriented school culture such as Singapore.

When John was presented with the amount of questioning he performed in the lessons, he was not surprised:

Well, if you ask[ed] me two years ago, I would tell you that I wouldn't come up with such a volume of questions, at a certain time, at a certain duration. But now, I'm exposed to 'Knowledge Building' and all, so it comes naturally.

He quickly corrected himself and added, "[n]ot to say naturally, I still need to... a teacher still needs to be prepped, because of this exact nature, where you need to be thinking on your feet, you need to ask 'how'... it's not anyone's cup of tea, but it can be bought in." It appears that the introduction of KB as a pedagogy transformed John's questioning behavior.

As for the types of questions asked, Jane asked proportionally more high-order questions than low-order ones (about 41% of all her questions), which is more than what research in this area

would project. This could be attributed to having a KB-infused curriculum which not only promotes high-order questions, but also offers materials that suggest questions to be asked. Jane, following the materials closely, may have used some of these in her lessons.

John also asked more high-order questions than one would expect based on the findings of other studies. In a traditional classroom, high-order questions account for a small percentage of classroom questions (G. Brown & Wragg, 1993; Cruickshank, Jenkins, & Metcalf, 2003; Lee & Kinzie, 2012; Martin, 2003), whereas about 42% of John’s questions fall into this category. That both the experienced and the inexperienced teacher asked more high-order questions may be linked to the redesigned, KB-infused curriculum of the school.

When we categorized the questions in terms KB principles, we noticed that both John and Jane mainly asked questions that promote *idea diversity*, such as “What kind of meal do they eat?” and “What is your idea about this building?” (John), or “If these people do not manage the floor plan properly, what will happen?” and “Is that the only thing that coolies do?” (Jane).

Table 2: Questions addressing Knowledge Building principles

	Idea Diversity	Idea Improvement	Epistemic Agency	Rise Above	Collective Knowledge Responsibility	Total
John	78	10	4	0	2	94
Jane	17	8	0	0	0	25

A possible reason for the large number of questions promoting idea diversity could be the relative ease of crafting such questions. The core function of idea diversity questions is raising awareness, to get students think about an area that they have not previously considered. Having more knowledge of the subject area, both teachers had a much higher awareness of the context and content of what was being discussed, so these questions may have seemed more natural to ask.

John explained that he was using questions to “check for understanding,” which he considers to be an important function of questioning:

I’m always checking for understanding, that’s the first thing, because I think that, like I said, this kind of a project, this kind of method, pedagogy, if you don’t check for understanding once in a while, the kids might get lost and their focus will be a bit off.

John is also keen on student participation: “I’m very particular about their involvement, every single one of them, every single group member, because I wish to inculcate good group dynamics.”

Jane, on the other hand, seems to favor more direct teaching over the asking of high-order questions. She explained that she does not like asking too many questions:

I think I did mention the fear, I think, the fear of getting our instructions across to the pupils, ensuring that they are able to carry out the activities well, so we teachers tend to give more instructions or direct teaching... use the direct teaching approach because we just want to get our ideas and instructions across, rather than, you know, spending time asking open-ended questions, getting them to answer the questions.

John believes that asking open-ended questions, a “lot of ‘why’ and ‘how’ questions, which [are] more of probing questions, where I won’t be, kind of like, be giving them the answer straight” are questions that promote KB principles. When he asked such questions, a single student’s response could be quickly added upon, creating a multitude of ideas (*idea diversity*). As more and more ideas are generated, the class will generally focus on one or two ideas and collectively expand them by suggesting ways to make them better (*idea improvement*). As the ideas are generated by the students themselves, they feel a sense of ownership (*epistemic agency*), a shared sense of responsibility towards developing the idea (*collective knowledge responsibility*) and building knowledge.

In contrast, Jane uses higher-order questions not as a means to construct knowledge collectively in the classroom, but to get students to reflect, to think about the answers: “I think what I realize is that, when I ask those open ended questions, it is more for them to reflect rather than voice out their opinions.” Therefore, she can still maintain a teacher-controlled direct instruction which helps her effectively deliver the material she plans for the lesson.

Beliefs and values

Both John and Jane consider themselves to be student-centered teachers who want to realize the potential of their students. However, their approaches are different. John said that he tries to give his students autonomy by encouraging them to make decisions about their own learning, explaining that he usually tells his students to “do whatever you want, put in the effort that you

want, make sure you are focused; at the end of the day, try to surprise me. I do not have any preconceived so-called end point for you. You think about it.”

John’s educational philosophy resonates with the inquiry-based nature of KB, which may be why he so easily adopted the KB pedagogy. He says it’s important “to relinquish some control ... over what they learn, over what they say in class.” This is the opposite of Jane’s pedagogical approach, which emphasises teacher control in the classroom. Nevertheless, she talks about empowering students and allowing them to be inquisitive while the teacher acts as a facilitator:

Teaching involves the sharing of skills and values and guiding pupils to solve their own problems. To me, teaching has never been and should never be teacher-directed, where pupils are passive learners. Teaching is more of guiding and directing pupils to solve their own problems and finding more information on their own. Teachers act as facilitators.

This contradicts what she previously said about the need for a direct approach in which the teacher gives information and student participation is limited. The tension between what she aspires to do as a teacher and what she actually does in the classroom likely stems from her lack of experience. The influences of her own schooling and professional coursework present different alternatives to her teaching reality, and she has not yet managed to sort out these conflicting beliefs.

Personal schooling experience

John, being a more experienced teacher, has managed to resolve the conflict between his schooling and how he sees himself as a classroom teacher. In his school years he was exposed to teaching that was teacher-dominated: “At that time, the teacher was a vessel of knowledge. Knowledge comes through the teacher ... So whatever the teacher said is true. The teacher is basically the expert of so-called the subject matter.” This is in stark contrast to the way he teaches now. The transmission model that he was part of is very far removed from the inquiry-based KB pedagogy, where learning is no longer a matter of memorization but of understanding. Apart from the changes in classroom discourse and questioning, the modern classroom also affords access to technology, which John considers to be beneficial to learning:

Give them another avenue to show, even they are not vocal as a person, but just another avenue for them to show the class that “ok, I have all this information with me but I, you know, I just don’t like to talk out loud in front of the class, but I’ll do it online.”

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Jane, despite the difference in age between her and John, experienced similar teaching as a student:

During my primary school days, we just sit there and receive information, and it can be quite boring, and at the same time, like what I mentioned, the amount of information that you can obtain and retain is not so much as to when we are more active in, you know, in our finding out the knowledge, the content knowledge of something that we are curious about.

Interestingly, she believes that learning happens when students are motivated by curiosity (*epistemic agency*) and are active participants in the process. Yet, she favours direct teaching, the very kind she received as a student herself. The reason for this disconnect may be that she has relatively little experience as a classroom teacher. Therefore, beliefs and tacit knowledge she unconsciously acquired about teaching as a student may override those that she overtly learned as a student teacher during her training. She has not yet had the chance to re-examine her established values and beliefs in light of personal teaching experiences, so she chose to teach in the most familiar way, perhaps due to a lack of confidence, and fear, as she had often mentioned during the interview.

Discussion

Despite the similarities in schooling, professional coursework, contextual factors, and classroom practice, the teachers in this study used questioning differently in their teaching. Both of them had similar “schooling,” as they were recipients of a transmission model of instruction, where memorization and recall of facts and information were the tools of learning. They had similar “professional coursework,” as they graduated from the same teacher-education institution, although some years apart. Both have similar “contextual factors” in that the school at which they work adopted the KB pedagogy. Therefore, according to Borg’s model of teacher cognition (Borg, 2003), it is reasonable to say that John and Jane had similar schooling, professional coursework, and contextual factors, which could have an impact on their educational values and beliefs, and which, thus, might have influenced their employment of certain questioning strategies. Yet, they are not similar when it comes to their teaching style and questioning strategies. How can we account for this difference, then?

When looking at the results of data analysis, the obvious distinction between John and Jane’s questioning strategies would be the *amount of questions* each of them asked: John asked 280 questions, whereas Jane asked 85 questions.

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This difference may possibly be attributed to the fact that John's educational philosophy is aligned with the KB pedagogy, and the adoption of KB as pedagogy may have impacted the questions he asked in class, transforming questions of factual recall to those of a more speculative, exploratory nature. Additionally, John received more instruction pertaining to questioning (Socratic Questioning) while pursuing his Master degree, which may positively dispose him toward the questioning style required by the KB pedagogy.

Furthermore, Jane expressed on numerous occasions that she was afraid of "letting go," that her pupils would not understand or would misunderstand her instructions. She was also anxious regarding the implementation of the KB pedagogy, something which was new to her: "Maybe it's the fear of whether the pupils understood what I was saying ... of getting our instructions across to the pupils, ensuring that they are able to carry out the activities well..." The fear that Jane experienced is something every beginning teacher faces, and it usually stems from a lack of confidence in the classroom (Anhorn, 2008; Wilson, Ireton & Wood, 1997; Brickhouse & Bodner, 1992). However, in Jane's case, this fear is exacerbated by her having to adopt the KB pedagogy, which she did not experience as a student and which was not part of her professional coursework. Jane's schooling and professional coursework experience up to this point may not sit well with the "new" pedagogical context. This could have led to further anxiety which may hinder Jane from effective questioning.

That said, the crucial distinction between John and Jane, and indeed, the focus of this study, is their teaching experience. John and Jane have different amounts of experience as teachers; John has been teaching for seven years, while Jane has taught for two. John hardly expresses doubt regarding his own capabilities, be it in terms of adopting a new pedagogy or in terms of skills in questioning. Perhaps the years spent in teaching have afforded him time to reflect upon his professional actions and to consider the choices he makes in the classroom. This may translate into a greater awareness of his beliefs, values, attitudes, and consequent actions. Jane, on the other hand, is still struggling with the issues of her pedagogical approach and confidence because of her inexperience as a teacher.

This may also explain why Jane's classroom practice appears to run contrary to her beliefs. While she thinks that her students learn best when they are actively involved in the learning process (through the effective use of open-ended, high-order questions), Jane inadvertently reverts to the didactic instructional approach she received as a student herself. This may not have been a conscious action on Jane's part; it may have been an attempt to gravitate towards the known and familiar in a new, unsettling situation.

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The proportion of questions asked by John and Jane is also interesting. While previous studies have shown that high-order questions are consistently the least frequently used among the three types of questions (G. Brown & Wragg, 1993), 43% of John's and 41% of Jane's questions fell into this category. This may be explained by the fact that KB pedagogy was implemented in the classes John and Jane taught. As it is an inquiry-based approach with roots in social-constructivist theories, it is reasonable to expect that more high-order questions be asked in the classroom.

On the other hand, is it possible that asking too many high-order questions might be too much of a good thing? John asked, on average, 24 high-order questions in a single 50-minute lesson. Do his students have the time to think about the concepts and meaningfully answer his questions? Jane asked, on average, seven high-order questions per 50-minute lesson. On the surface, it seems that her students had more time to consider and discuss those questions, but in fact classroom management was teacher-centered, and thus students were not provided with time and space for constructing meanings. Therefore, it must be noted that quality of learning cannot be measured by simply calculating the percentage of the different types of questions used in a lesson.

Conclusion

This paper argues that teaching experience has a powerful influence on teacher cognition and the questioning teachers use in their classrooms. Using Borg's (2003) framework for teacher cognition, we argued that the differences in the experienced and inexperienced teacher's pedagogical approach can be attributed to the amount of time they spent in the classroom and their level of confidence in (and possibly awareness of) their classroom instruction. Although we do not rule out that the individual teacher's personality might play a significant part in their pedagogical choices, this is beyond the scope of this paper.

As far as questioning strategies are concerned, the implementation of Knowledge Building pedagogy has a positive impact on teacher questioning. Through specially designed resources and materials, as well as applying the carefully designed KB principles, teachers are able to use open-ended questions to promote a dialogical classroom discourse that features more high-order questions. Regardless of teaching experience, such an approach may help teachers break the century-old traditions that have dominated classrooms and prevented students from creating their own meanings or contributing to knowledge construction.

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