

TEACHERS' EPISTEMIC BELIEFS AND THEIR PEDAGOGICAL BELIEFS: A QUALITATIVE CASE STUDY AMONG SINGAPOREAN TEACHERS IN THE CONTEXT OF ICT-SUPPORTED REFORMS

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ABSTRACT

Many current ICT-supported reform efforts demand teachers to assume the role of epistemic facilitator of knowledge construction supported by technology. It is thus important for teacher educators to understand teachers' epistemic beliefs. This qualitative study investigated seven Singaporean in-service teachers' epistemic beliefs and their pedagogical beliefs. Two interviews were conducted for each teacher. Employing a case study design, the transcripts were analyzed for assertions that reflected the teachers' beliefs. Results indicated that all seven teachers expressed more or less relativistic epistemic beliefs. The pedagogical beliefs held by teachers were more knowledge transmissionist in orientation. Results also implied that the relationship between epistemic beliefs and pedagogical beliefs seemed to be mediated by teachers' awareness of students' readiness and what they perceived as their priorities in the school context.

Keywords: In-service teachers, Teachers' beliefs, Epistemology, Pedagogical beliefs

INTRODUCTION

Teachers' beliefs have been viewed as a key area that needs to be addressed in the context of most educational reforms (Woolfolk-Hoy, Davis, & Pape, 2006). This is especially so when teachers are to facilitate students' co-construction of knowledge through ICT and computer-supported collaborative learning (CSCL) (Abdelraheem, 2004; Erkunt, 2010; Ertmer, 2005; Teo, 2009). Many studies reported that teachers' beliefs could affect teachers' practice and teachers' learning (Abdelraheem, 2004; Richardson, 1996). In this study, we investigate in-service teachers' epistemic beliefs (beliefs about knowledge and learning; Schommer, 1990) and their pedagogical beliefs (beliefs about teaching; Teo, Chai, Lee & Hung, 2008). The relationships between these two constructs have been conceptually and empirically explored in the literature through the quantitative approach (Chan & Elliott, 2004; Hofer, 2001; Wong, Chan, & Lai, 2009). However, very few qualitative investigations have explicitly explored these relationships among the Asian teachers (Hofer, 2008; Wong & Chai, 2010). It is important for teacher educators to understand the complex relationships between teachers' epistemic beliefs, their pedagogical beliefs and how the teaching contexts influence the enactment of these beliefs. This article attempts to address this research gap. Hofer (2008) suggests that the theoretical models of personal epistemology as well as models linking personal epistemology to other variables in the educational context should be widely tested in diverse cultures. In addition, studies of in-service teachers' epistemic beliefs are arguably rare (Feucht & Bendixen, 2010). This study therefore would contribute to several areas of research.

LITERATURE REVIEW

Teachers' Epistemic Beliefs

Perry (1970) has delineated the developmental trajectory of epistemic beliefs into four stages: (a) dualistic, (b) multiplistic, (c) relativistic and, (d) commitment with relativism. Individuals with a dualistic view of knowledge believe in right-or-wrong knowledge handed down by authority. They move on to the multiplistic stage when they begin to acknowledge the possibilities of multiple views, but they still believe that most knowledge is certain. Individuals progress to a relativistic stage when they see most knowledge as tentative and contextual. Individuals at this stage also tend to believe that knowledge is generated by the self through thinking rather than given by authorities. At the last stage, individuals may commit themselves to the belief that knowledge is uncertain and based on the weighing of accumulated evidence. This scheme of categorization presupposes a structural development of epistemic beliefs. Perry's developmental model has been further refined by others. For example, Belenky, Clinchy, Goldberger and Tarule (1986) have proposed a similar model comprising the following four levels for woman epistemological development: (a) silenced/received knowing, (b) subjective knowing, (c) procedural knowing and, (d) constructed knowing. However, Schommer (1990) contended that the developmental model may fail to capture the complexity of epistemic beliefs due mostly to its unidimensional nature. She proposed a multidimensional model that conceives epistemic beliefs as a system of more-or-less independent beliefs. These dimensions include beliefs about innate ability, quick learning, simple knowledge, and certain knowledge. The first two dimensions focused on beliefs about learning, while the last two on beliefs about knowledge. Based on Perry and Schommer's work, Hofer and Pintrich (1997) suggested that epistemic beliefs should be divided into two major categories: (a) nature of knowledge, which includes certainty of knowledge and simplicity of knowledge; and (b) nature of knowing, which comprises source of knowledge and

justification of knowledge. Later, Hammer and Elby (2002) argued that the above models seem to regard epistemic beliefs as theories and traits that are assumed to be consistent across contexts. Hammer and Elby treat epistemic beliefs as made up of a range of epistemic resources. Individuals are believed to hold both naïve and sophisticated resources in their cognitive structures. Different epistemic resources are activated by different contexts.

Researchers typically employ either the developmental model (Perry, 1970) or the multidimensional model (Schommer, 1990, 1994) to investigate pre-service teachers' epistemic beliefs. Adapting the ill-structured problems of the reflective judgment interview (King & Kitchener, 1994) to problematic classroom situations, White (2000) elicited 20 American student teachers' epistemic beliefs. These teachers were mainly second and third year students. Their responses were coded into five categories: Departing Absolutist; Intuitive Relative; Selective Relative; Informed Relative and; Reflective Relative. The results showed that these student teachers held a range of epistemic beliefs distributed across these categories, and that 50% of them were defined as selective relativists. Using interview methods, Brownlee (2001) studied 29 Australian student teachers' beliefs about the nature of knowing. The findings also indicated that participants expressed a range of epistemic beliefs. Eighteen (62%) participants believed that personal truths are constructed individually based on evidence. Ten student teachers held mixed beliefs that knowledge can be both constructed and received. Only one participant believed in received knowledge. These studies seem to be mainly guided by Perry's (1970) developmental model of epistemic beliefs. Also, they were carried out in a Western context involving a small number of participants.

Employing Schommer's (1994) multidimensional model, several researchers have explored the epistemic beliefs of pre-service teachers in Asia. Adapting Schommer's (1990) four-factor questionnaire, Chan and Elliott (2002) surveyed 385 Hong Kong pre-service teachers using the 30-item Epistemic Beliefs Questionnaire. The results indicated that teachers tended to believe that knowledge is ever changing. They seemed to believe that knowledge is constructed through effortful learning processes rather than handed down from authority figures. Most students were uncertain in their beliefs about whether learning ability is innate or fixed. They suggested that the in-depth interview would facilitate better understanding of the complexity of epistemic beliefs. Cheng, Chan, Tang and Cheng (2009) follow-up study employing the same questionnaire coupled with additional interviews has discovered similar pattern of beliefs among the Hong Kong pre-service teachers.

By adapting Chan and Elliott's four-factor instrument, Chai and Khine (2008) have reported similar profiles of epistemic beliefs held by Singaporean pre-service teachers (N=877). Several background variables were found to be associated with these teachers' epistemic beliefs. These variables included teachers' program level, gender, major subjects, ethnicity, and teaching experience. Using the same instrument, Chai, Deng, Wong and Qian (2010) investigated the epistemic beliefs held by teacher education students (N=445) from the South China context. The Chinese student teachers' epistemic beliefs were similar to the preservice teachers from Hong Kong and Singapore.

There are currently only a small number of studies of in-service teachers' epistemic beliefs and these studies are generally situated in the Western society (Feucht & Bendixen, 2010; Kang & Wallace, 2005; Schraw & Olafson, 2002). These studies indicate that practicing teachers' epistemic beliefs are related to their pedagogical beliefs and they are reviewed below. Study on Asian practicing teachers' epistemological beliefs, especially through qualitative interview, seems to be currently unavailable.

Most researchers interested in studying teachers' epistemic beliefs seem to share the assumption that teachers' epistemic beliefs may affect their teaching practices (Pajares, 1992) and that the relation between epistemic belief and teaching practice may be mediated by teachers' pedagogical beliefs (Hofer, 2001). In this article, the focus is mainly on the relationships between teachers' epistemic beliefs and their pedagogical beliefs. A brief review of teachers' pedagogical beliefs is provided in the following paragraphs.

Teachers' Pedagogical Beliefs

Pedagogical beliefs refer to preferred ways of teaching by teachers. These beliefs are generally categorized into the knowledge transmission view or the knowledge construction view (Teo et al., 2008; Wong et al., 2009). Teachers who embrace the knowledge transmission view are inclined to prepare and conduct lessons in a teacher-centered and content-oriented manner. They prefer didactic instruction and act as the sole provider of knowledge. Students accordingly act as passive recipients of content knowledge. By comparison, the knowledge construction view advocates that students should actively make sense of their learning experiences while teachers design meaningful learning experiences and scaffold students' sense making. Teachers who hold the *constructivist* view tend to emphasize more student-centered activities that facilitate students' knowledge

construction through active self-reflection, peer interaction, and meaning-making process (Wong et al., 2009; Chan & Elliott, 2004).

Relationship between Epistemic Beliefs and Pedagogical Beliefs

The relationships between teachers' epistemic beliefs and their pedagogical beliefs have drawn considerable attention from researchers. These researchers generally agree that these two constructs usually relate to each other (Pajares, 1992). For example, Hofer and Pintrich (1997) argued that "beliefs about learning and teaching are related to how knowledge is acquired, and in terms of the psychological reality of the network of individuals' beliefs, beliefs about learning, teaching, and knowledge are probably intertwined" (P. 116).

Such a conceptually accepted viewpoint about the relationship between the two constructs has been buttressed by a few empirical studies. In the Western context, preservice teachers' relativistic epistemic beliefs have been reportedly related to constructivist pedagogical beliefs (Brownlee, 2004; Sinatra & Kardesh, 2004). Using interview methods, Schraw and Olafson's (2002) found that 23 out of 24 practicing teachers can be categorized as relativist. These teachers tended to prefer constructivist oriented teaching. In Kang and Wallace's (2005) work, practicing teachers who view science as a body of factual information were inclined to express a transmissionist pedagogical belief.

Only a small number of studies have investigated the above relationship within an Asian context. Chan and Elliott (2004) required 385 Hong Kong pre-service teachers to complete two five-point Likert-scales for assessing their epistemic beliefs and pedagogical beliefs, respectively. Their results were slightly different from those generated from the aforementioned Western studies. For example, traditional beliefs about teaching were positively and significantly related the three dimensions of epistemic beliefs: "innate/fixed ability", "authority/expert knowledge", and "certainty knowledge". However, the constructivist beliefs about teaching were found to be negatively related to "learning effort/process" dimension. The direction of these correlations appeared conceptually inconsistent. Chan and Elliott suggested that this surprising result may be due to the fact that the Hong Kong pre-service teachers perceive learning effort/process as working hard in terms of repetitive drills for knowledge acquisition. Using Structural Equation Modeling approach, Chai and his colleagues (2010) investigated the relationships among beliefs about learning, knowledge, and teaching of pre-service teachers (N=718) in Singapore. Results indicated that transmissionist pedagogical beliefs were positively related to "innate/fixed ability", but were negatively related to "learning effort/process" dimension. The constructivist pedagogical beliefs were positively predicted by the "learning effort/process" dimension.

However, several conflicting findings should be noted when interpreting the relationships between teachers' epistemic beliefs and their pedagogical beliefs. In Chan and Elliott's (2004) work, for example, Hong Kong pre-service teachers may be categorized as relativists, but these teachers did not show inclination towards constructivist pedagogical beliefs. Likewise, Richardson (2003) suggested that pre-service teachers may express a relativistic epistemic belief, but they may also view teaching as knowledge transmission. As reported by Chai, Teo and Lee (2010), Singaporean pre-service teachers were found to embrace constructivist beliefs about teaching, although they may not hold relativistic beliefs about knowledge. Therefore, the relationships between these two constructs should be addressed in future research. Furthermore, the above studies seemed to investigate such relationships by mainly using quantitative methods (Likert-type questionnaire). According to Hofer (2008), these simplified written measures may risk trivializing the complexity of individuals' beliefs. She also suggested that "assessment has been most reliable and valid with interviews (p. 7)." Furthermore, a large majority of studies reviewed seemed to examine the relationships by recruiting pre-service teachers. Very few studies, especially within the Asian cultural background, have investigated how in-service teachers' epistemic beliefs and pedagogical beliefs are intertwined in their real-life teaching practice. The present study thus attempted to address these research gaps. This study was guided by the following research questions:

- (1) What are the Singaporean teachers' reported epistemic beliefs (beliefs about knowledge and learning)?
- (2) What are the Singaporean teachers' reported pedagogical beliefs?
- (3) What are the relationships between epistemic beliefs and pedagogical beliefs of teachers in Singapore?

METHOD

The study focused on Singaporean teachers' epistemic beliefs and their pedagogical beliefs. The qualitative case study approach was adopted based on principles of constructivist inquiry (Guba & Lincoln, 1989) and a constant comparative method were employed for data analyses (Strauss & Corbin, 1990). The following sections provided the description of the context and research design.

Participants and Context

The seven teachers who participated in this study were enrolled in an in-service program that equips them with advanced pedagogical knowledge for the integration of ICT in classroom teaching through the use of ICT as mindtools (Jonassen, 2000) and CSCL (Scardamalia & Bereiter, 2003). Table 1 shows some background information on these seven teachers. These teachers have at least 3 years of teaching experiences in primary schools. The researcher obtained their permission to participate in this study through private invitation. Pseudonyms were used in this article.

Table 1 *Background of the Seven Teachers*

Teachers (Pseudonym)	Gender	Ethnicity	Years of Service	Teaching Subjects
Ian	M	Chinese	7	Mathematics, Social Studies
Karen	F	Chinese	5	English, Mathematics, Science
Nadia	F	Malay	3	English, Mathematics, Science
Nora	F	Malay	9	Malay Language
Sarah	F	Chinese	5	English, Mathematics, Science
Sue	F	Chinese	3	English, Science
Zoe	F	Malay	4	Malay Language

Data Collection and Analysis

Semi-structured interviews were employed as the main method for data collection. Each participant was individually interviewed twice in this study. In the first interview, all the participants were asked about their epistemic beliefs (beliefs about knowledge and learning) and their pedagogical beliefs (beliefs about teaching). The interview questions are listed in Appendix 1.

All interviews were audio-taped and transcribed. Verbatim transcriptions of interviews were then returned to the participants for verification. After that, the interview transcripts were analyzed through a combination of the thematic coding (Flick, 2002) and constant comparative methods (Strauss & Corbin, 1990). Open coding was first performed on the transcript of an individual teacher. Categories were then formed by grouping the labels during open coding. Thereafter, the relationships between the codes and the categories were explicated through the general scheme of axial coding. Case profiles for individual teacher were then generated and cross case analyses were employed to identify emerging themes. After three months, a follow-up interview was conducted and the data was analyzed employing the same process.

Issues with Reliability, Internal Validity, External Validity and Objectivity

For the purpose of this study, the researcher adopts the standard of “trustworthiness” as laid down by Guba and Lincoln (1989) to guide this study. Based on the notion of trustworthiness, Guba and Lincoln derived four criteria to assess the quality of a naturalistic study. They are credibility, transferability, dependability and confirmability. They are parallel to the notions of internal validity, external validity, reliability and objectivity respectively. Detailed discussion is omitted here due to space constraint.

This study employed a number of strategies to enhance its trustworthiness. First, the professional development activities were about six months, allowing the researcher to have prolonged period of contact with all the participants. This had provided the researcher with ample opportunities to observe how the teachers learn and construct knowledge, which served as a form of check against what they say during the interview. Second, the verbatim transcripts of the interviews and the interpretations in the form of assertions and supporting quotes were provided to all seven participants for member check. This allowed the researcher to be corrected by the participants. Third, the findings were subjected to peer examination. For example, the pilot study had been written and given to two colleagues for comment. The researcher had also reported the findings through departmental sharing and asked for critical feedback. Fourth, all transcripts and coded data have been subjected to external examination as part of the audit trail for the author’s doctoral examination. These measures, taken together, should be able to ensure the rigor of this study (Cohen, Manion, & Morrison, 2000, Creswell, 1998; Merriam, 1998).

FINDINGS AND DISCUSSION

The findings are reported in the form of assertions supported by quotes from the interview transcripts. Assertion 1 and Assertion 2 jointly answered the first research question of this study. The other two research questions were addressed by Assertion 3.

Assertion 1: The teachers held a range of epistemic stances that were more or less relativistic in orientation.

The seven teachers were likely to hold a range of epistemic beliefs that stretched from multiplistic to relativistic (Perry, 1970). None of the teachers was at the dualistic stage where everything could be labeled as either right or wrong. They all seemed to be well aware that truth is evolving and knowledge claims can change as new evidence is found. In the following quote, Nora expressed her view that scientific constructs were possible explanations that could be overturned.

I don't think scientists can really discover the truth... presently, scientists have made a lot of improvements. They do research and they come out with all those theories which can help us to explain what are happening so far. But it might not be the true theories... I don't think scientists can ultimately find the truth. (Nora)

The other teachers also reported a similar notion of knowledge as ever changing. For example, Sarah reported that, “*The truth now is the truth now. You won't know whether the truth will still be the truth in the future.*” Ian drew on the example that the earth was once treated as flat but later proven to be spherical. These results were within the researchers' expectation. Since all the teachers had completed their tertiary education, they should be aware that many “truths” have been replaced by better understanding.

The multiplistic stage is different from the relativistic stage since the former regards uncertain knowledge as exceptional while the latter regards certain knowledge as exceptional (Hofer & Pintrich, 1997). This distinction posed some difficulties for the researcher with respect to distinguishing who among the participants were more relativistic than the others. All teachers disagreed with the statement that “Scientists can ultimately discover the truth” to a certain extent but how extensive was the disagreement was unclear. Responses such as “*maybe some but not all*” (Zoe) and “*I don't think I agree totally*” (Nadia) indicated that both were relativistic. The degree to which they were inclined towards the relativistic beliefs appeared to differ when the participants' level of consciousness about epistemic issues and their views about themselves as knowledge constructors were taken into account. Among the participants, Zoe and Nora were recognized as at the multiplistic stage, or in White's (2000) terms, as departing absolutists. They both revealed that they had not consciously considered epistemic issues during the first interview. For example, when Nora was asked when she began to develop the relativistic stance, her reply was “*when you asked me.*” She further elaborated that “*if you were not to ask me, I would not really think about it.*” There was another incident that may help to corroborate the researchers' argument. When Nora was asked how she would respond if the experts disagreed, part of her response was as follows:

To personally construct or to follow? Hmm... I think I belong to the category that I will be the follower, based on majority. But of course I will think whether what I am going to follow is really the correct thing, especially at this point of time, whereby I can really know how to judge and analyze thing. Maybe I will be more open-minded; I will be thinking more about whether what the majority think was right or wrong. (Nora)

When the researchers alleged that what she was doing was constructing her knowledge about this matter, she responded, “*Ah... correct, Yah, come to think of it.*” This may indicate that she was not conscious for her active role as a knower. Within this short quote, it also seemed that she was changing her stance as a knower from accepting what the majority says to constructing her own understanding. This could mean that she had not encountered controversial situations that compelled her to reflect on epistemic issues (Schraw & Olafson, 2002) prior to the interview.

Only two participants, Sue and Ian seem more relativistic than their peer. For example, Sue did not treat knowing as a matter of receiving knowledge from authority figures. To her, knowledge was not exclusively mastered by the experts. The role of experts in instructional settings was to her that of facilitators “*rather than providing me with all the facts.*” The relationships between the learners and the experts are illustrated by the following quote.

The learners have to do the groundwork, rather than trying to get all the inputs from the experts. The experts will be there to answer certain questions, which I feel that the learners might not be able to find. Then again, the experts might not be able to answer all the questions. (Sue)

Among the seven participants, Ian seemed to be the only teacher who had reached the stage of committed relativism. He appeared to have carefully considered some philosophical issues. The following interaction episode (R-Researcher; I-Ian) may provide a glimpse of his epistemic stance.

*R: Some people think that scientists can ultimately discover the truth, what do you think?
I: Scientists cannot. The question is...first define truth.*

R: Scientific truth.

I: Scientific truth? They can never. In philosophy there is this concept about truth. It caused a lot of fall of theories actually. Question is they came out with a new philosophy which is called verification. For example numbers are infinite. However, numbers are infinite does not mean that the calculators cannot be used. You just have to test one plus one and the answer is two. You have verified that the calculator is working. It is a question of verification.

The above quote seems to imply that although truth cannot be arrived at, it does not follow that everything is therefore relative. One can test and verify certain assumptions and act according to the verification. The next quote provides further corroborating data on Ian's relativistic understanding of situations and yet absolutely committed stance to certain values.

R: Do you agree when someone says that there is no right answer, anybody's opinion is as good as another?

I: Wrong. I do not agree. There are certain things that I would say are definitely right. Maybe I give an example. Some people tend to say that when you get cancer...cancer is evil, but that is questionable. It is relative. I remember that I knew about this doctor. Famous oncologist, when he operates on patients, he was so inhuman. But when he had cancer himself, he began to realize the pain of cancer. He became a patient. When he was finally cured, the cancer actually did him good.

R: You saw it as contextual?

I: Contextual. But there are certain things that are of absolute values. For example, killing a person... The value can be verified by the impact that it has. For example, let's look at the impact that it creates on people. Pain. Negative connotations all come out from it... So there are absolute values. There are certain things that I believe that are still absolute.

As to the other three participants, their responses are clearly relativistic and could perhaps be also classified as either "subjective knowing" (Nadia and Sarah) or "procedural knowing" (Karen) according to Belenky et al.'s (1986) scheme. For instance, Sarah appeared to be a rather comfortable in relying on herself.

How confident? If I don't believe B and B is not believing what I believe, it's like why should I follow B? No point! Even if what I believe might not be the universal truth at least I'm comfortable with my thinking... (Sarah)

Karen appeared to be less subjective in a similar situation and she would attend to the evidence bearing on the assertions.

If they disagree, there must be some basis of this disagreement. I'll respect their decisions as long as the two of them can come up with evidence...I won't choose (sides) because normally it's like for this type of study you have to base it on evidence. (Karen)

In summary, the seven participants of this study appeared to embrace a range of epistemic beliefs with Nora and Zoe at the multiplistic end of the continuum and Ian at the committed relativistic end. Although the sample of this study was small, the distribution seemed to parallel Brownlee's (2001) work where most teachers were at the relativist stage (see also Chan & Elliott, 2004; White, 2000). None of the participants was holding the naïve belief that knowledge is certain.

Assertion 2: The teachers' beliefs about learning may vary along the dimension of knowledge acquisition and knowledge construction. Their beliefs about learning generally matched their beliefs about knowledge.

As previously mentioned, the beliefs about knowledge and beliefs about learning are considered to be two inter-related aspects of "epistemic beliefs" (Schommer, 1990). In this study, we recognized that the teachers' beliefs about how learning occurs and how students should learn may be related to their beliefs about knowledge. For two teachers, Ian and Sue, learning seemed to be more of a process of constructing personal understanding and problem solving. For example, Ian reported that he would consider a person as having learnt something when "they've considered actually all possible and allowed research on the matter." Sue's response indicated that she appeared to believe rather strongly that learning should be active and constructive.

I feel that learning involves, it's not purely from text, from what you have read from the textbook. It involves exploration, self-discovery...In a way it's like you see the real thing, and then you try to find out more facts about it, that's what I would define as meaningful learning. (Sue)

The beliefs about learning held by Ian and Sue seemed rather congruent with current emphases in Singapore education reforms (Ministry of Education, 2008). However, the researcher also discovered some inconsistencies between what they have advocated as ideal learning and their reports on their teaching practices. This will be elaborated later.

Three teachers' (Nora, Sarah, and Zoe) beliefs about learning seemed to be more inclined towards traditional view of learning as acquiring more knowledge and new knowledge. As examples, the following quotes from these participants are given below:

Learning is about role modeling after someone who I think is right. It is also about gaining more knowledge in aspects that I already know or gaining new knowledge in aspects that I have no knowledge at all. (Sarah)

You learn to gain knowledge. You will improve or discover you own talent and skill. Learn something new that can be related to your life in future. (Zoe)

However, the following quotes may imply the inappropriateness of portraying Sarah and Zoe simplistically as only holding onto a narrow view of learning as receiving knowledge.

Learning requires students to be involved and to explore and to search for knowledge on their own. They are usually given the necessary help so that they are able to explore on their own. (Sarah)

Student learning is whereby the students are able to widen their knowledge horizon meaningfully, able to think and answer critically and creatively. (Zoe)

When Karen or Nadia talked about learning during the interviews, they tended to emphasize more on learning as meaning making as indicated by the following quotes.

Pupils are able to make meaning of what they have learnt in class and try to apply it in other circumstances...They must see the connection between what they have learnt and how it benefits them in the real world. (Karen)

I believe learning takes place when the learners can make sense of what is being taught and being aware of how it becomes relevant in the future. (Nadia)

All the participants reportedly support student-centered learning. However, in supporting their stance, Nora and Zoe did not quote substantially concrete experiences from either personal learning or teaching experiences. Sarah explicitly expressed that she did not implement student-centered learning because she questioned “*how much can they learn on their own?*” Sarah seems to see her students as not being ready (see Kang & Wallace, 2005). Karen, however, had started to experiment with students creating their own PowerPoint presentation based on mini projects, and she “*was quite impressed that most of them are able to come up with the final product.*” Nadia, on the other hand, seemed to have incorporated student-centered learning in her classroom.

In summary, the teachers' beliefs about learning appeared to vary along the dimension of knowledge acquisition and knowledge construction. The pattern seemed to match their beliefs about knowledge. This may lend support to Schommer-Aikin's (2004) argument that individuals' beliefs about knowledge and their beliefs about learning were intimately related to each other. However, it seemed that none of teachers embraced only one type of belief. In the following paragraphs, their pedagogical beliefs, with some references to their reported teaching practices, are delineated.

Assertion 3: The teachers' pedagogical beliefs in this study were more knowledge transmissionist in nature. The relationship between the teachers' epistemic beliefs and their pedagogical beliefs seemed to be mediated by other factors such as teachers' beliefs about students' readiness and what they conceived as important in the school context that they were in.

Four teachers (Nora, Zoe, Sarah, Karen) reported that teaching is a process of “*imparting knowledge*” among students. For example,

“Pupils have to be able to understand what is being conveyed to them during the teaching process. It is a two-way process that involves the transmission of knowledge from teachers to pupils.” (Nora)

Inferring from the term “*imparting knowledge*”, these teachers tended to believe that knowledge could be transmitted from the teachers to the students. All of them also admitted that they mainly adopted a teacher-centered pedagogy at school. Their reported teaching practices also seemed to corroborate their reported beliefs.

For instance, Sarah viewed her duty as completing the syllabi and expressed that, *“I will deliver whatever that is required.”* She elaborated further that unless *“I am very sure that after removing this time for student-centered activity, I will still cover my syllabus”*, she would not implement student-centered learning.

The other three teachers also articulated that they adhered to the syllabi closely and based their teaching on the textbooks. Assessments were reported to be in-class questioning for correct answers and tests and examinations at the end of the semesters. Sarah was aware that her teaching practice was not congruent with her epistemic beliefs and acknowledged that she taught *“absolute truth”*. The main reason for her was *“the system makes us do so”*. Since the teachers adhere to syllabi and textbooks, it seems that one possibly simple and effective way to tweak their practices would be for the local education curriculum planners to conceptualize and write the curriculum in a more relativistic manner. Textbooks could also present a more relativistic and historically evolving view of today’s truths (see Grossman & Thompson, 2008).

Nadia seemed to differ slightly from the above four teachers. This was first reflected in her initial articulation of her pedagogical beliefs as shown below. She appeared to agree less with fixed objectives and curricular.

“I cannot go into the classroom with the sole objective to complete the syllabus and deliver the lesson planned per se. Teaching has to have an impact on the students’ learning. If by the end of the day my students only manage to regurgitate facts without understanding and appreciation, then effective teaching hasn’t taken place and learning would have been minimal.” (Nadia)

Among the participants, Ian and Sue again seemed to be outstanding in terms of their pedagogical beliefs. However, their reported teaching practices appeared to differ because Ian treated his context as not so supportive while Sue seemed to have a very supportive school environment. Ian has ample experience in facilitating students’ digital art project and robotics project. However, Ian appeared to adopt didactic teaching practices because of the students that he was currently teaching. Ian stated rather clearly that his goal for his class was to help students to pass examinations. In other words, he was teaching to the test. The following account may reflect the eclectic nature of his teaching approaches based on students’ achievements in mathematics.

First stage, it’s more of drilling...it is more behavioral technique. But when it comes to the later part when it is more abstract, it is a mixture of the different theories about the ways to teach. When coming into the third stage, if the very weak ones still cannot understand, then I apply solely behavioral technique of teaching...But the fast ones, you can start using a lot of constructivist scaffolding. Keep scaffolding their understanding by either real-life examples or real-life situations. (Ian)

Ian reported that his class was the weakest in the Primary 6 level. Most of them *“never pass mathematics before in their whole life”*. He has about 10 months to prepare his pupils for the Primary School Leaving Examination. Employing this mixed approach that was coupled with many drill-and-practices, Ian proudly stated that most of his students passed mathematics and went on to the secondary schools. Ian’s account appeared to be a case of school context inhibiting the actualization of beliefs (Richardson, 2003). More concretely, it seemed to be a case where teachers’ perceptions of student readiness may influence the teacher’s instructional design (Kang & Wallace, 2005). However, Ian did not seem to be concerned about the potential inconsistencies between what he believed to constitute knowing and what he was practicing in teaching. Given the sociocultural context of Singapore and other Asia regions (example Hong Kong and Taiwan) that emphasize much on examination results, teaching to test is likely to be deemed as appropriate and responsible behavior among teachers.

Sue’s pedagogical beliefs seemed to be more consistent with her epistemic beliefs. Her goal in teaching was to *“develop independent learners”* who *“will learn for the quest and joy of learning rather than learn for the sake of passing exam”* and *“share their knowledge with their friends and peers”*. She tended to believe strongly in activity-based lessons that are *“dependent on teamwork”* and *“encourage them to explore things”*.

I feel that for kids to learn, they need to have hands-on and activities that are meaningful, that will engage them in order for them to be able to remember whatever they have actually learnt. And it must be something that is enjoyable. (Sue)

Sue described a series of lessons anchored by an animated and interactive website that she had designed. The following quote illustrates how she realized her pedagogical beliefs.

This lesson is supposed to be in unit one, on My School. So in one of the activity books they are supposed to write down the functions of the various rooms... I felt that the pupils already know, so

what's the point of me doing this? I came up with this idea of promoting the Media Resource Library (MRL), which I proposed the name to be Media Magical Island. So it's actually a 3-in-1 kind of thing because I'm supposed to have an assembly talk for MRL. Bearing in mind the pupils are actually good pupils, I have actually come up with this reader's theatre. They are able to read, but most of the time they are not able to read with expression. So at the end of the lesson it is hoped that they are able to come up with a script pertaining to Media Magical Island that promotes the Media Magical Island to the school. This also allows them to read the script because reader's theatre you don't memorize, they read, but with expression. It allows them to gain confidence when they're on stage. It was quite a success because at the end of it when I get the people to write the reflections, they actually wrote that they enjoyed and they hoped to have another session. (Sue)

This account demonstrated how Sue typically used her knowledge of the students (they knew about the places but were lacking in reading with expression), the purpose of the curriculum (practicing writing about places), school contexts (assembly talk as consequential task) to craft engaging activity-based lessons. Sue's pedagogical beliefs were clearly reform-oriented. Her teaching context also allowed her to implement what she believed in. She reported that the principal had created the "mega" class where all the high achievers were put into one class and assigned her to challenge the students with innovative teaching. She had also reported an incident whereby her principal defended her when one parent expressed her displeasure with Sue's series of mini projects.

While Sue's reported teaching practice seemed constructivist oriented, her account also seemed to emphasize more of the activities aspect rather than the sense-making of the activities. Focusing on activities has been pointed out by researchers as a potential danger which could lead to shallow constructivism (Scardamalia & Bereiter, 2003). Sue also seemed to hold an accumulative view of knowledge. For example, when she talked about the advantage of collaboration, she stated, "*I always encourage students to find out from their peers because their peers could have more knowledge*". She also referenced the strength of problem-based learning as "*retain the facts that they have learned*." Similar to Ian, she was not concerned about the potential inconsistencies. An alternative explanation for the inconsistencies would be that the participants were expressing relativist views of knowledge because they were aware that the researcher, who was their facilitator/ teacher, was portraying such a view most of the time. However, this seems unlikely since both Ian and Sue had provided consistent accounts across their epistemic beliefs, personal histories, views of learning and their teaching practices. It was only in this aspect that they were providing inconsistent views.

In summary, it seemed that none of the participants believed that knowledge is not transmittable and in varying contexts all of them practiced didactic teaching. Regarding teaching as transmitting knowledge is common among teachers (Richardson, 2003). Also, it seemed that the teachers who were more relativistic tended to prefer constructivist teaching practices. However, to construct or to transmit knowledge seemed to be for the teachers a methodological choice informed by contextual constraints for achieving their goals of enabling students to advance to the next grade rather than an actualization of personal epistemic beliefs. In schools, teachers are not held accountable for such inconsistencies. Rather, they were accountable for students' examination performance. As such, the inconsistencies between the teachers' epistemic beliefs and their teaching practices reported in the literature (Fang, 1996; Schraw & Olafson, 2002) may only be meaningful to the "theorist". The teachers' accounts appeared to be moving along the pragmatics of school rather than on the plane of philosophical arguments. Alternatively, Hammer and Elby's models of epistemology (2002) seemed to help to account for such inconsistencies. Teachers may possess different teaching approaches along with its epistemological assumptions. They employed these approaches based on the various contexts they encounter (whether students were ready or not).

CONCLUSION

This case study examined teachers' epistemic beliefs and their pedagogical beliefs within the Singapore context. Based mainly on their reports, the seven teachers seemed to hold more or less relativistic beliefs about knowledge. As it seems that there are not many teachers with highly developed epistemic beliefs, it would imply that teacher educators should provide opportunities for teachers to explicate their beliefs. This forms the foundation of future development for the teachers' epistemic beliefs. The teachers' beliefs about learning appeared to vary from knowledge acquisition to knowledge construction. Their reports also indicated that their pedagogical beliefs were fundamentally knowledge transmissionist. Furthermore, it seemed that the extent of (epistemic) beliefs manifestation depended mostly on what the teacher conceived as their priorities with regard to goal achievement and their awareness of students' readiness. Given these, it seems important to change the context in which teachers operate in if the ICT-supported reform efforts are to take root. In other words, it is insufficient for teacher educators to facilitate development in teachers' beliefs. A more conducive environment jointly created by the policy makers and school leaders has to be in place. Without such environment, teachers

may choose to adopt traditional teaching approach that works well for examinations and tests. It is the hope of the researcher that this article illustrates the complex interplay between teachers' beliefs and their teaching context, from the teachers' point of view. For future research, it seems important for researchers to identify teachers who are able to resolve the tension between their beliefs and their teaching context and document their development trajectories. Case studies on systemic changes that facilitate development of teachers' beliefs coupled with changes in teaching context are also needed to advance the course of ICT-supported reforms.

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Appendix 1: Interview Schedule

Learning

1. Can you describe a significant learning experience?
2. What comes to your mind when you think about learning?
3. How do you go about learning in general?
4. What strategies do you use?
5. How do you know when you have learnt something?

Teaching

1. Let's talk about a lesson that you have conducted.
 - a. How do you decide the instructional goals and the objectives?
 - b. How do you select the activities?
 - c. How do you select the resources?
 - d. How do you make use of students' interest and prior knowledge?
2. How reflective is this lesson compared to the rest of your lessons?
 - a. What comes to your mind when you think about teaching?
 - b. What are the things that you do before you teach a lesson?
 - c. What are the things that you do when you teach?
3. How do you usually evaluate students' learning?
4. How do you usually make use of the textbook?
5. What do you think of student-centred lessons?
 - a. For example, project work. Do you consider it as a student-centred lesson? What are the value and problem?
 - b. Can students construct knowledge? How?

Epistemology

1. Some people think that scientists can ultimately discover the truth. What do you think about this statement?
2. What about the statement "Today's truth maybe yesterday or tomorrow fiction"?
3. How do you come to know?
4. How do you know when you know something?
5. In learning about something that you really want to know, what is the role of an expert?
 - a. How do you know someone is an expert?
 - b. What do you do when you discovered that experts disagree with each other?
6. Do you agree when someone says that there are no right answers and anybody's opinion is as good as another's?