

## ***Why the Spiral Moved? – Seeking for Knowledge Building***

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### **ABSTRACT**

This paper tracks the learning experiences in science of three students using Knowledge Forum. We examine the interaction process, in particular the seeking patterns that result as the three students explore and build the knowledge of convection current. Using micro-analysis of contribution on Knowledge Forum and principles of analysis of electronic interaction and discourse proposed by Zhu (1989), this paper analyses the forms of participation a student can assume, focusing mainly on the different forms in which students seek information as they navigate through the sea of information posted online. Using a grounded approach, we characterize two different ways in which students seek for information in an online environment, which we labeled as *interpersonal seeking* and *collaborative seeking*. We believe that the seeking behavior, albeit subtle, is instrumental in directing learning and directing the courses of 'discussion' and the quality of the knowledge that is built.

### **INTRODUCTION**

Scardamalia and Bereiter (2003) argued that in this Knowledge Age, schools should reconceptualize themselves as organisations that enculturate knowledge producers. They believe that every student should be empowered with the dispositions and skills to create knowledge, rather than reserving it for the privileged. Even elementary pupils could naturally employ a range of cognitive, metacognitive and interpersonal skills to adapt to the environment when immersed a knowledge building environment (Scardamalia, 2000). This study is in line with this philosophy of democratizing innovative capacity to all students. We adopt a microgenetic approach to explicate a particular type of interactional behavior in online forum, with the goal of contributing to scaffolding strategies for idea improvement.

As Knowledge Building with Computer-Supported Collaborative Learning is premised on the socio-cultural view of learning, much of the research involves interaction analysis of online discourse. One common approach is content analysis (see Henri, 1992), where online messages are segmented into unit of analysis and categorical labels are assigned to the units (Chi, 1997). Once coded, the data can be analyzed quantitatively in terms of frequency counts of the types of message or interactions, and even statistical comparisons among them. In this paper, we choose to adopt an interpretive approach, by building on the framework proposed by Zhu (1998) to examine discussion on Knowledge

Forum. This framework examines the forms of student participation (whether the student is playing the role of a wanderer, seeker, mentor or contributor) and the direction of participation (whether vertical or horizontal). We build on this framework by analyzing the different ways in which students can play the role of a 'seeker'. The providence of empirical evidence to the tested framework will help to enhance the framework for further analysis. The focus on how students seek information is a deliberate one. Understanding the different ways in which different types of questions are asked is an important aspect in learning and idea development – a key focus in Knowledge Building.

In light of the discussion above, this paper aims to address the research questions of *what are the forms in which students seek information and clarification which will lead to concept formation in science?*

## **METHOD**

The study is carried out in a primary school in Singapore. It is carried out with a group of 15 eleven year-old students. There are nine girls and six boys in the group. The teacher, who is the third author, has had discussions with the students in the classroom as well as the science laboratory about the topic. Three students' learning experiences (represented by pseudonyms Jerry, Jenny and Tanya) are highlighted in this paper. These three students are selected as they were the only three students who wrote a personal reflection on their learning experiences. We took these personal reflections which they have written as indicators of their effort to make sense of their own learning experiences.

The topic of energy is stated in the learning outcomes of the syllabus document which is prepared by the Ministry of Education. As stated in the syllabus document, under the theme of energy, students are expected to:

- a. show an awareness that energy from most of our energy resources is derived in some ways from the Sun;
- b. recognize and give examples of the various forms of energy and
- c. show an understanding that energy can be converted from one form to another. (Curriculum, Planning and Development Division, 2001).

The discussion that was generated in this study targeted specifically on the learning outcome of conversion of energy.

The unit of analysis used in this paper is a single posting by the student. Using Zhu's (1998) framework of explicitly analyzing forms of electronic interaction and discourse, the following was done to analyze the data:

1. Each posting by the student was examined.
2. The information was coded for those that were seeking for information. These are usually postings under the scaffold for students which start with 'I need to understand'. Besides that, the posting by the students are also examined to check if they had also sought information under different scaffolds.
3. The purposes of these various forms of 'seeking' information were then analyzed in context of the discussion and were characterized.

## RESULTS

As this study is intended to be qualitative in nature, we begin with a narrative account of the students as well as their participation in the discussion.

Jerry is an eleven year old boy who excels in science. He is popular among his peers and despite his strong abilities in science and language, is not arrogant and relates well with his peers. His classmates perceive him as 'clever' and he spends time coaching his peers in class. He is a leader in class. The discussion of the topic started with the teacher posting the first problem which asked the students to 'explain how the candle caused the spiral to move'. This generated 12 direct add-ons from various students, with Jerry posting two notes. The first note posted by Jerry in response to the teacher represented his view about how the candle caused the spiral to move. The note reads (*all notes are reflected as they were with no editing or corrections done to them, the bracketed words are scaffolds provided in the Knowledge Forum*):

*<My theory is> that heat energy from the candle flame caused the air to expand, when the air expands, the heat energy in the candle flame is converted into kinetic energy of the expanding air, pushing the coil upwards. <I need to understand> is the heat enough to cause the air to expand?*

This particular note was not built on by others in the class. Here we see an example of seeking for information by Jerry. In this instance, Jerry hypothesized that it was heat energy that caused the air to expand which was converted to kinetic energy that caused the spiral to move. He needed to know whether heat was the only factor that caused the spiral to move before he can confidently conclude the relationship between the candle, the heat and the movement of the spiral. We characterize this form of seeking information as *interpersonal seeking*. Jerry initiated the 'hunt' for information. He realized that he lacked the information that was required for him personally to form the complete knowledge of what made the spiral move. To be able to carry out *interpersonal seeking*, Jerry was aware of the gap between his current state of knowledge and the desired endpoint that he needed to reach.

Jerry did not pursue this strand of discussion but instead read and commented on the notes posted by his other classmates (playing the role of a wanderer and mentor in different instances). He had three other entries in which he commented on a note posted by Tanya on the fact that it was wind energy that caused the spiral to move. Jerry built on that and commented:

*"wind energy in the air, this energy then coverts into kinetic energy" . <I need to understand> is wind energy and kinetic energy the same? <My theory is> that kinetic energy and wind energy is the same because wind is moving air, and moving air has movement energy which is also kinetic energy.*

Here, we witness another form of seeking. Jerry read what was posted by others and sought to understand the information in relation to what others had said. We term this form of information seeking as *collaborative seeking*. Different parties helped one

another come to a realization of their existing level of knowledge of what causes the spiral to move and at the same time, changed their beliefs of what they already knew and also re-examined the end-point of the discussion. In other instances, these *collaborative seeking* notes were posted to reveal or highlight inadequacies of information or knowledge of the note that was posted by others.

Later in the discussion, Jerry illustrated *interpersonal seeking* again after he had explored the many postings made by his classmates. He commented on the experimental design by Gary's group as well, as offered an explanation to Gary on the nature of air molecules when heated. It is only after Jerry's 'exploration' through the notes posted by others did he make a second posting in response to the teacher's question. This time, Jerry wrote:

*<My theory is> that flame from the candle has heat energy and heat causes the surrounding air to expand. As hot air rises, it pushes the coil upwards. <I need to understand> why do rising air have such strength to push the coil.*

This new note posted by Jerry was similar to but an improved version of what he posted initially. Previously, he needed to understand if heat was enough to cause the air to expand. In the second posting, he appeared to have found the answers to his first question and he clearly stated that it was the rising air which causes the spiral to move and as such, his concern was the strength of the rising air in moving the spiral. He needed to find out why the rising air has strength which perhaps the other air has not.

To complete his understanding of the relationship between movement of the spiral, the candle, the strength of the rising air and the heat, Jerry rebuked Jenny's entry by stating:

*"the expansion of molecules in the air will increase" (note: this sentence is a citation of Jenny's entry) <My theory is> that the heat does not cause the molecules to expand but the heat from the candle flame makes the surrounding air less dense and will cause the air to rise/float. <I need to understand> how does heat cause the surrounding air to be less dense?*

Again here, Jerry and Jenny were seeking collaboratively. Jerry might not realize what else he needed to know for complete understanding of what makes the spiral move if Jenny's contribution was absent to generate a discussion – even if it means disagreeing with Jenny. Jenny's contribution serves as a stimulus to enrich Jerry's line of argument.

Jenny is an eleven year old girl with average ability in science but has an excellent command of English. She is popular with her peers and is seen as a leader among the girls in her class, but she tends to follow Jerry in the things that he does. In the discussion above, Jenny did not contribute directly to the teacher's question. Rather Jenny made four postings and she presented a comment in response to Henna's theory which reads:

*<My theory is> that the candle flame heats up the air around it (heat energy here) and the heated up (warm air that is) air rises up and pushes against the spiral's underside (the side of the spiral that's facing downward) and that **pushing action** (which is kinetic energy) forces the spiral to move (a little bit at least) and as that*

*'curled snake-like thing' that's moving is a spiral which's 'body' is round and sloping downward so that spiral will be spinning.*

In response to the above note, Jenny posted this:

*"pushing action" <Opinion> –Could the pushing action you were referring to mean the kinetic energy in the air?*

Here, Jenny sought information through the scaffold of 'Opinion'. She picked up the pushing action which Henna was referring to and clarified with Henna what the pushing action could be, although Henna in her note, did indicate kinetic energy within parenthesis. Here Jenny sought more detail to Henna's input, specifically referring to the 'kinetic energy in the air' rather than just kinetic energy. This is yet another illustration of *collaborative seeking* by Jenny. She asked a question in the form of an opinion to a note posted by her peers and sought to help both herself as well as Henna to refine the idea and thought. Clarification is important in building knowledge as a posting made is only as good as what the readers make of it. If the readers cannot make sense of what was written, the intentions and ideas of the writer will fail to be conveyed.

To further illustrate how *collaborative seeking* helps to clarify and refine ideas, the exchange below between Jenny and Tanya is used. Like Jenny, Tanya is an eleven year old girl with average ability in science and high ability in English. Although she is popular among her classmates, they perceive her to have low ability in Science. Tanya is a follower in social events. Tanya posted a note of what her theory of how the candle made the spiral spin. Her note reads:

*<My theory is> that the heat and light energy from the candle flame will heat up the air, making it moving air or kinectic energy. **This energy will the interact with the spiral to make it move.** The spiral will first spin upwards and later proceeds downwards. This cycle continues until the candle flame is blown out.*

To this note, Jenny posted:

*<This theory cannot explain> how the energy interacts with the spiral to make it move. **Do you mean interaction in a way that kinetic energy is transferred to the spiral itself or to the air?***

Here, Jenny sought clarification from Tanya. She pointed out the limitation of Tanya's theory and sought to clarify what Tanya meant by interaction. This is yet another example of *collaborative seeking* where the stimulus for Jenny's thoughts came from reading a note Tanya posted. To Jenny's act of seeking clarification, Tanya refined her theory in the next posting and it reads:

*<My theory is> that the kinetic energy will be transferred to the spiral and making it spin.*

The *collaborative seeking* initiated by Jenny has helped Tanya to rethink her theory, leading to reformulation of it. This **reciprocal change** in knowledge of both the 'seeker'

(Jenny) and the ‘sought’ (Tanya), we believe, is a crucial aspect in learning. This dialectical relationship between the ‘seeker-sought’ appears to be beneficial and an encouragement for learners to present their personal knowledge in public space so that exchanges can take place between different learners and shared understanding can be established (refer to Figure 1). This process appears to have benefited both the parties in enabling both of them to revisit and reformulate their initial ideas and thoughts, leading to a more complete and eventually shared knowledge acceptable by the community.

Tables 1, 2, and 3 show different seeking patterns of Jerry, Jenny and Tanya as they try to build their knowledge of convection current. Jerry shuttled between *interpersonal seeking* and *collaborative seeking* to help him achieve his personal knowledge while Jenny and Tanya relied only on *collaborative seeking* to establish their personal knowledge.

**Table 1: Seeking patterns of Jerry**

Interpersonal Seeking	Collaborative Seeking	Notes
		<My theory is> that heat energy from the candle flame caused the air to expand, when the air expands, the heat energy in the candle flame is converted into kinetic energy of the expanding air, pushing the coil upwards. <I need to understand> <b>is the heat enough to cause the air to expand?</b>
		“wind energy in the air, this energy then converts into kinetic energy” . <I need to understand> <b>is wind energy and kinetic energy the same?</b> <My theory is> that kinetic energy and wind energy is the same because wind is moving air, and moving air has movement energy which is also kinetic energy.
		<My theory is> that flame from the candle has heat energy and heat causes the surrounding air to expand. As hot air rises, it pushes the coil upwards. <I need to understand> <b>why do rising air have such strength to push the coil.</b>
		“the expansion of molecules in the air will increase” <My theory is> that the heat does not cause the molecules to expand but the heat from the candle flame makes the surrounding air less dense and will cause the air to rise/float. <I need to understand> <b>how does heat cause the surrounding air to be less dense?</b>

**Table 2: Seeking Patterns of Jenny**

Interpersonal Seeking	Collaborative Seeking	Notes
		"pushing action" < Opinion> –Could the pushing action you were referring to mean the kinetic energy in the air?
	↓	<This theory cannot explain> how the energy interacts with the spiral to make it move. <b>Do you mean interaction in a way that kinetic energy is transferred to the spiral itself or to the air?</b>
	↓	According to your picture, it shows that before the candle was lighted, the molecules are crowded together. And after the candle was lighted, the molecules were spreaded out. < I need to understand> does that mean that the situation in which the molecules spread out cause the air to be less dense?
	↓	"is that the smoke from the flames causes the spiral to move" - how does the smoke cause the spiral to move? Do you mean the heat and light energy from the flame instead?

**Table 3: Seeking Pattern of Tanya**

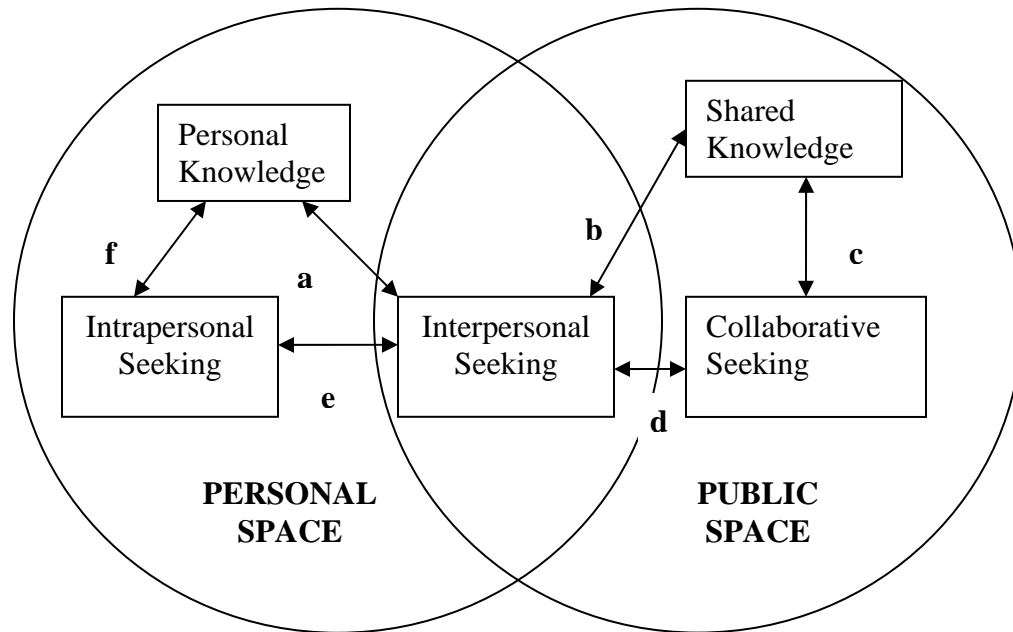
Interpersonal Seeking	Collaborative Seeking	Notes
	↓	<I need to understand> does the "rapid moving molecules interact with the spiral to make it move".
	↓	<I need to understand> "where heat is from"

## DISCUSSION

In the first part of this section, we explicate the intricate relationship between *interpersonal seeking* and *collaborative seeking* from the narrative presented above by characterizing the two forms of seeking to understand why the spiral moved under the influence of the candle. In the later part of this section, we theorize the implications and importance of these two forms of seeking in the light of knowledge building in personal and public spaces.

In Figure 1, we attempt to illustrate the multifaceted nature of seeking and the role and position which interpersonal seeking and collaborative seeking play in the process of building both personal as well as shared knowledge.

**Figure 1: Relationship between interpersonal seeking and collaborative seeking**



**a:** It indicates how self realization of gaps in personal knowledge results in *interpersonal seeking* by posing questions in a personal-public space. This form of seeking can result in a change in personal knowledge which might in turn affect the kinds of interpersonal seeking patterns.

**b:** The act of *interpersonal seeking* by an individual affects the shared knowledge that is formed by the community. This happens as others read the personal notes in the form of questions that are posted by the individual in the personal-public space and engages in *collaborative seeking* in the public space.

**c:** The shared knowledge that is formed in the public is visible to all participants and is a result of various individuals questioning and clarifying in the *collaborative seeking* process.

**d:** *Collaborative seeking* can impact and influence *interpersonal seeking* or vice versa. What is posted on the public space will influence what the individual thinks and hence the kinds of questions, doubts and clarification that will be required. Similarly, what an individual needs to find out for one self and when made public, can serve as stimulus of others thoughts processes and hence trigger different questions to be asked. This is a dialectic relationship that results in reciprocal change.

**e:** *Interpersonal seeking* is a result of *intrapersonal seeking* that takes place *within* an individual. Gaps in the knowledge of an individual are largely realized by the individual through *intrapersonal seeking* and this will impact on the kinds of *interpersonal seeking* which the individual will engage in. Similarly, the responses and results from



*interpersonal seeking* will change *intrapersonal seeking*. This appears to be the link between public space and personal space.

**f:** This happens in solely in personal space. This is a reflective process that an individual engage in consolidate one’s learning and seeks to evaluate the kinds and type of seeking that still needs to be engaged in before personal knowledge can become ‘complete’.

Table 4 characterizes the two forms of seeking which is evident in the results presented above.

**Table 4: Seeking Information**

Ways of seeking	Origin	Space	Purpose
Interpersonal Seeking	Self	Personal-Public	To make visible what is required for individual to form complete understanding of phenomena.
Collaborative Seeking	In response to another posting	Public	To help clarify one’s doubts and to build on other’s existing ideas. To help highlight inadequacies in the ideas which are posted.

Now, we attempt to theorize the role and importance the two different types of seeking play in knowledge building. Jerry, Jenny and Tanya showed different means of achieving their understanding of why the spiral moved. While Jerry showed that he shuttled between the two different forms of seeking to build his knowledge, Jenny and Tanya depended largely on only *collaborative seeking*. The two different forms of seeking serve different purposes. Here we argue that it is important for an individual to be engaged in both *interpersonal seeking* as well as *collaborative seeking* for meaningful learning to take place. Engaging solely in *collaborative seeking* appears indicate a lack of self understanding of one’s personal knowledge and it also reflects a lack of personal ownership for the shared knowledge. Also, the quality of notes and ideas posted is raised only if participants of the discussion have self knowledge of themselves and what they need to progress their personal knowledge. They also need to know how their personal knowledge can contribute to shared knowledge. This notion of *intrapersonal knowledge*, although not evident in the interaction cited in this paper, is important as it parallels Vygotsky’s (1978, p253) statement that the complex transition from internal to external speech ‘depends on shaping a thought first in inner speech, then meaning of words, and finally in words.’

Much has been discussed about the importance of interpersonal seeking in one’s learning. However, we would like to caution that being involved only in personal seeking will not allow an individual to harness the advantage and innovative ideas of the collective. Interaction with self only is not an effective means for change. As such, we

propose that for successful and meaningful learning, individuals must be engaged in both *interpersonal seeking* and *collaborative seeking*.

The implication of the above proposal for a facilitator of the discussion would be an increased awareness of the seeking patterns which participants are engaged to build their knowledge and facilitate meaningful interaction by accurate inputs to the students so that their ideas can be build up. For an analyst, understanding the different seeking strategies gives an insight into the thinking processes of the students. It allows one to know how individuals see and construct the same idea (in this case, why the spiral move) differently. The characterization of different forms of seeking also provides a meta-language for teachers, learners and researcher to analyze interactions in a learning environment.

## CONCLUSION

Frameworks for analyzing online learning and computer-mediated communications could evolve to include more details analysis of broad processes like student participation, depth of processing etc to characterization of the nature of participation and kinds of participation. Detailed knowledge of the processes will enable correct diagnosis of the causes of breakdown in discussion or idea development should they break down. Similarly, if a discussion is successful, the knowledge of what and how it works would also enable its reproduction.

*Interpersonal seeking* and *collaborative seeking* are two forms in which students seeking information in a Knowledge Forum discussion platform. Although students assume the role of a seeker in both instances, the origin and the motivation for seeking the information is different and hence different interaction will result. Seeking the information and clarifying are essential first steps to idea refinement and knowledge building. Seeking for information, whether *interpersonal seeking* or *collaborative seeking*, happens in personal-public and public spaces and hence offers opportunities for reciprocal change in personal knowledge. The *dialectic relationship* between the seeker and the sought is an important one to bring about *reciprocal change* and learning in a socially dominant learning environment.

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