An Investigation of an Instrument for Analysis of Student-Led Electronic Discussions

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Abstract

As communications technologies have been increasingly applied to education in order to improve student learning experiences, newly-created instruments used to assess their effectiveness need to be developed. The study, undertaken within a non-formal education program in Thailand and an undergraduate study at the University of South Australia, aims to propose a suitable instrument that can be used to analyze student discourse in the online environment. Computer-conferencing technologies have been applied to both groups. An instrument based on grounded theories has been developed and applied to data analysis. It was found that both groups of students varied in their approaches to learning at the individual level, while at the group level, there was little variance, with neither group demonstrating higher cognitive skill development. Student learning outcomes and collaborative learning have been discussed. Recommendations regarding the application of the instrument have been made.

Keywords

Student-led electronic discussion, Computer conferencing, Student learning outcomes, Student interactivity, Collaborative learning

Introduction

Computer Mediated Communication (CMC) has provided off-campus and on-campus students with the opportunity for increased student interaction and collaboration. Student-to-student communication through computer conferencing and electronic mail will be a major focus of this study. An outcome of integrating CMC into learning activities has resulted in massive amounts of discourse produced by the students. The dilemma of how to handle the quantity of discourse has led to the need for better analysis tools. This research study has been undertaken within a non-formal education program in the educational context of Thailand, and an undergraduate study at the University of South Australia.. The main purpose of this study, therefore, is to propose a suitable instrument that could be universally used to analyze the discourse for improved learning outcomes at both individual and group levels.

Brief Overview of the Educational Contexts

Education in Thailand

The structure of education in Thailand covers formal and non-formal education. Formal education is mainly provided for students in educational institutions. Non-formal education or lifelong education is provided for those unable to enroll in formal education. Non-formal students can obtain knowledge from a variety of learning sources. Their education can be undertaken at anytime in their life.

Information technologies have been applied to education in this country for such a long time. The utilization of television broadcasts for education started in 1964 when the government launched an instructional television project to broadcast television programs to primary schools in Bangkok. The expansion of education opportunity of the government has led to the establishment of the Center for Distance Education by Satellite in 1994 (The Ministry of Education, 1999). Computing facilities have also been used in education since 1979 when the Ministry of Education established the Ministry of Education Network (MOENet). The progress of computer technology for education is rapidly increasing in formal education due to the government policy of expanding educational opportunities to the provinces through the use of information technologies. In non-formal education, owing to the limited budgets provided, computers are still in great demand.

Education in Australia

The educational structure is similar to that of Thailand, where students can engage in both formal and informal education. In Australia it is compulsory for children to attend school between the ages of 6 and 15 years. Home schooling during these years is also acceptable under certain conditions approved by the Education Department. Enormous investments of time, money and intellectual energies are being thrown into the educational infra-structure at the various levels in order to provide access to the learning technologies that are hoped will improve student learning outcomes and better equip them for their role in society.

Review of Research Studies

Student learning at the individual level

A number of studies have concentrated in describing student critical thinking and student reasoning skills by the use of Computer Supported Co-operative Learning (CSCL) technologies. These studies have aimed at analyzing student text contributions within student-content interaction by applying Garrison's theory (1992) of critical thinking and Henri's theory (1992) of critical reasoning skills (Kitchen & McDougall, 1998; Marttunen, 1998; Newman et al, 1997).

Henri's critical reasoning skills can be applied to surface and deep learning or surface and in-depth processing as described by Biggs & Moore (1993). Biggs & Moore categorized student approaches to learning into 3 main types as follows: surface, deep and achieving approaches. An approach to learning reflects the interaction between a student's current motivation and the teaching context. In developing a content analysis technique to measure the quality of learning taking place in CSCL, Henri suggested using paired opposites, one indicating surface processing and the other in-depth processing. By simplifying Henri's pairs, by looking for indicators in all of Garrison's stages and from their experience of using similar techniques for assessing student work in computer conferences, Newman et al (1997) developed a new set of paired indicators and these pairs were then used to define the type of statements in seminar and computer conference transcripts.

When comparing critical thinking stages and reasoning skills with student approaches to learning, it can be concluded that some stages can be integrated. Briefly, there are two main processes of cognitive skills which include surface and in depth or deep-achieving processes. It can be

concluded that student engagement with the content provides evidence of the level of critical thinking and reasoning skills achieved. This engagement will be a focus of this study.

Student interaction at the group level

Johnson & Johnson (1996, 1998) have provided a strong theoretical basis for cooperative learning as outlined in cognitive developmental, behavioral and social interdependence theories. Most of this theoretical basis has been derived from face to face studies, but such theories are finding support in computer-mediated environments. An understanding of the theory of social interdependence provides insight into the behaviors that occur through computer conferencing. They cited a number of studies in which collaborative learning has been shown to yield high levels of achievement and also has demonstrated other positive outcomes such as 'greater interpersonal relationships' and 'improved psychological health'.

Gunawardena et al (1997) studied the five categories of the content analysis of the transcripts suggested by Henri (1992) and pointed out some weaknesses within the 5 dimensions. They identified only 3 dimensions: interactive dimension, the content indicating the application of cognitive skills and the content showing metacognitive skills. From these 3 dimensions, they attempted to investigate an appropriate interaction analysis/content analysis to assist in examining the negotiation of meaning and co-construction of knowledge in collaborative learning environments. The new interaction analysis model was developed and proposed. The interaction analysis model is outlined in 5 phases as follows: 1) sharing/comparing of information; 2) discovery and exploration of dissonance or inconsistency among ideas, concepts or statements; 3) negotiation of meaning/co-construction of knowledge; 4) testing and modification of proposed synthesis or co-construction; 5) agreement statement(s) /applications of newly-constructed meaning

Johnson & Johnson (1996) identified numerous behaviors in their own research and also in other research studies which they referred to as 'Interaction Patterns'. These patterns are categorized as follows: 1) giving and receiving help and assistance; 2) exchanging resources and information; 3) giving and receiving feedback; 4) challenging each other's reasoning; 5) advocating increased efforts to achieve; 6) mutually influencing each other's reasoning and behavior; 7) engaging in the interpersonal and small group skills; 8) processing group members effectiveness

Other research studies were carried out to look at student interaction within collaborative learning environments and they categorized student interaction patterns into different dimensions. Bonk et al (1998, p.283), for example, in their study, organised the content analysis of electronic discourse into 8 categories. These are 1) social acknowledgment; 2) unsupported opinions and statements; 3) justified opinions and claims; 4) questions and strategic statements; 5) case components; 6) case summary and extensions; 7) types of mentor scaffoldings; and 8) others (can't code or off-task).

Group learning is a good way of encouraging social interaction and has often been used to promote deep learning. Students learn best by interacting with others, rather than working in isolation. Through group work students are motivated and encouraged to remain focused on the task. The resultant interactivity leads to knowledge-building which requires "articulation, expression or representation of what is learned" (Jonassen et al, 1999). Student interaction at the group level has greatly helped students to learn and develop some subject knowledge by planning, sharing/comparing and contributing of informative resources. They also have to clarify, negotiate with their peers when disagreement occurs. Testing and modification of co-construction of knowledge and application of new knowledge are also important issues that can be applied to group interactivity.

Collaborative learning

Collaborative learning is a kind of learning style by which an individual can learn with partners for a common purpose. In the process, learners can share work, information, experience and have social interaction. Collaboration can increase interaction in adult distance learning. Collaboration and cooperation are different. Pugach and Johnson (1995) emphasize that collaboration is more than just sharing ideas. Collaboration grows out of trust between professionals. It cannot be constructed artificially. Cooperation is defined as acting together, in a coordinated way at work, leisure, or in social relationships, in the pursuit of shared goals, the enjoyment of the joint activity, or simply furthering the relationship. Collaborative learning has basically been valued for its benefits. It can prepare learners for the workplace and it can help individuals to work and live well. Collaborative learning groups can be a valuable teaching tool in countering the isolation felt by distance education students. In collaborative learning, participants share ideas and elaborate on new

material. The outcomes of such collaboration in terms of their approach to learning will be dependent on their willingness to be involved, to share ideas with other students, and to take responsibility for their own learning.

Collaborative learning can be applied to CMC environments, especially in distance learning where learners lack the interaction between instructors and learners and among learners. Stacey (1998), in her study, investigated the experiences of the students over two semesters of their MBA course, focusing particularly on their use of group communication through the electronic system. The use of CMC has been researched as a means of facilitating the groups' social construction of knowledge in small group electronic conferencing. It was found that the group processes and tasks in the researched course could facilitate the social construction of knowledge within the groups. Their process of collaborative learning was achieved through a range of collaborative behaviors and through a model of the attributes of collaborative learning which emerged from the analysis of the data gathered from the students participating in the study. In summary, a tool has been developed based on the models developed by Henri and Gunawardena and the interaction patterns identified by Johnson & Johnson. CMC technologies, which are used to support collaboration, discursive interaction and the building of relationships, can provide the scaffolding that guides, supports and develops the construction of knowledge leading to improved learning outcomes.

Methods

The Study conducted in Thailand

Participants

The participants in the first study were 28 distance adult students (57% 18-25 years, and 29% > 25 years) who enrolled in the subject entitled "Quality of Life Improvement" at a non-formal learning center in the second semester of the academic year 1999 in Thailand. The students were divided into small groups, and participated in online discussion by using computer-conferencing technologies on ten different topics within a period of 10-week experiment

Procedures

Before the research experiment was implemented, the students were trained to gain basic information technology skills and to participate in online discussion. Before participating in the online discussion, students

attended their tutorial group session for about an hour once a week so that they could discuss the weekly topic with their peers. In each tutorial session, an educational television program was shown as an introductory lesson before they went on discussing in small groups. The discussion topic was organized by the teacher / facilitator. In some topics, students were provided with some additional readings. In online discussion developed by using the Discussion Web Wizard of Microsoft FrontPage 2000, the students were asked to post at least two contributions to the group discussion for each topic. Indeed, they were encouraged by the teacher / facilitator to contribute as frequently as they wished. The student text contributions were then archived electronically by the researcher for data analysis.

The Study conducted in Australia

Participants and Procedures

The context for the second study was an on-campus, first year, undergraduate subject of some 200 students (average age, 20 years), taking a core, first year subject, *Becoming Information Literate*, in an education degree in Semester 1, 2000. The focus of the subject was to develop information literacy skills using conventional and new technologies to enhance the potential of their own learning and to equip them for independent and lifelong learning.

All students had email accounts and subscribed to an e-mail discussion list based on their tutorial groupings of approximately 20 students. They were introduced to the Internet-based environment through a series of four electronic tutorial discussions, which were spread over the semester. All students were obliged to provide a 400-word response to each of the four tutorial topics. The four tutorial responses of the participants have been analyzed for improvements in learning outcomes and indicators of interactivity.

Behavior analysis at individual level:

I1 Elementary clarification
- I1-a Observing/studying a problem
- I1-b Identifying its elements
- I1-c Observing/studying their linkages

I2 In-depth clarification
- I2-a Analyzing a problem
- I2-b Identifying assumptions
- I2-c Establishing referential criteria
- I2-d Seeking out specialized information

I3 Synthesis and application
- I3-a Drawing primary conclusions
- I3-b Proposing an idea based on links and relevant information
- I3-c Value judgment on relevant solutions
- I3-d Making final decisions and deciding on the action(s) to be taken

Interactive Behavior analysis at group level:

G1 Planning
- G1-a Organizing work/planning group work/setting shared tasks
- G1-b Initiating activities/setting up activities for group work

G2 Sharing/comparing/contributing of information
- G2-a Defining and identifying a problem
- G2-b Stating opinions regarding the problem
- G2-c Asking and answering questions to clarify details of statements
- G2-d Sharing and exchanging knowledge, resources and information
- G2-e Corroborating examples provided by one or more participants
- G2-f Challenging others to engage in group discussion
- G2-g Help and feedback giving

G3 Inconsistency of ideas, concepts or statements
- G3-a Identifying and stating areas of disagreement
- G3-b Asking and answering questions to clarify the source and extend of disagreement
- G3-c Restating the participants' position and advancing arguments or considerations supported by references

G4 Negotiation of meaning/co-construction of knowledge
- G4-a Negotiating or clarifying the meaning of terms, areas of agreement and disagreement
- G4-b Proposing new statements embodying compromise and co-construction
- G4-c Integrating or accommodating metaphors or analogies

G5 Testing and modification of proposed synthesis or co-construction of knowledge
- G5-a Testing against existing knowledge and information
- G5-b Testing against personal experience
- G5-c Testing against formal data collected

G6 Agreement statement(s) and application of newly constructed knowledge
- G6-a Summarization of agreement(s)
- G6-b Application of new knowledge

Table 1: Cognitive Development and Interactive Analysis Model

Instrument Development and Data Analysis

An instrument was developed, based on grounded theories to analyze the data gathered from Thai adult students and undergraduate students at the University of South Australia. The data was collected from a random selection of 21Thai students from 3 groups responding the topic, "Problems of natural water and how to conserve it". The responses of a random selection of 13 Australian students from 2 groups discussing the topic, "Consider the issues associated with screening the Internet information coming into schools", were also examined.

In this paper, the findings will mainly focus on the analysis of student text contributions in their online discussions. A set of modified indicators based on Henri's Theory of critical reasoning skills, a set of interactive behaviours based on Gunawardena's Interaction Analysis Model and interaction patterns identified by Johnson & Johnson will be used to analyze the discourse at both individual and group levels.

Findings and Recommendations

In this exploratory investigation no comparison will be made between the two groups as there are too many variables, such as the number of students, student characteristics and discussion topics. The results of the two groups of students in different settings will be presented separately.

Analysis of Thai students

Student learning outcomes

Thai students tended to have interaction with the content at the in-depth level. Their contributions were mostly in proposing an idea based on links and relevant information (I3-b per Table 1, frequency 23.40%) and observing/studying a problem (I1-a, frequency 17.02%). When looking at male and female students, it was found that their contributions were similar. Both male and female student’s contributions were in proposing an idea based on links and relevant information (I3-b, frequency 23.40%). Thai students were mainly mature-aged students. Most students had jobs and family commitments. Such experiences with family and workplace helped them to engage in the deeper approach.

Student interaction and collaborative learning

Most of the Thai students engaged in group discussion by giving help and feedback (G2-g, frequency 6.38%), restating the participant's position and advancing arguments or considerations supported by references (G3-c, frequency 6.38%) and identifying/stating areas of disagreements (G3-a, frequency 4.26%) respectively. It is evident that students were involved in interaction and collaboration, although not at the higher levels of enagagement.

The type of question asked can also impact on the approach adopted by students. The Thai topic, "Problems of natural water and how to conserve it" was more precise and required that solutions to the problem be proposed. The type of task therefore, can impact on the depth of engagement and elaboration that takes place in the discussion groups.

Coding	Thai Students (M=13, F=8)					
	Male		Female		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
I1-a	8	17.02	8	17.02	16	17.02
I1-b	5	10.64	5	10.64	10	10.64
I1-c	1	2.13	4	8.51	5	5.32
I2-a	5	10.64	4	8.51	9	9.57
I2-b	0	0	0	0	0	0
I2-c	0	0	0	0	0	0
I2-d	0	0	0	0	0	0
I3-a	0	0	1	2.13	1	1.06
I3-b	11	23.40	11	23.40	22	23.40
I3-c	2	4.26	5	10.46	7	7.45
I3-d	3	6.38	1	2.13	4	4.26
G1-a	0	0	0	0	0	0
G1-b	0	0	0	0	0	0
G2-a	0	0	0	0	0	0
G2-b	1	2.13	1	2.13	2	2.13
G2-c	0	0	0	0	0	0
G2-d	2	4.26	0	0	2	2.13
G2-e	0	0	0	0	0	0
G2-f	0	0	0	0	0	0
G2-g	3	6.38	3	6.38	6	6.38
G3-a	2	4.26	2	4.26	4	4.26
G3-b	0	0	0	0	0	0
G3-c	4	8.51	2	4.26	6	6.38
G4-a	0	0	0	0	0	0
G4-b	0	0	0	0	0	0
G4-c	0	0	0	0	0	0
G5-a	0	0	0	0	0	0
G5-b	0	0	0	0	0	0
G5-c	0	0	0	0	0	0
G6-a	0	0	0	0	0	0
G6-b	0	0	0	0	0	0
Total	**47**	**100**	**47**	**100**	**94**	**100**

Table 2: Analysis of responses of Thai students- Student interaction at individual and group levels

Analysis of Australian students

Student learning outcomes

Most of the Australian students had interaction with contents at the surface level. Their contributions were mostly in identifying its elements (I1-b as per Table1, frequency 16.30%), observing/studying a problem (I1-a, frequency 13.04%) and observing/studying their linkages (I1-c, frequency 13.04%). When looking at male and female students, it was found that most of the male students had interaction with the content at the in-depth level. Their contributions were mostly in drawing primary conclusions (I3-a, frequency 22.22%) which could be attributed to the fact that 2 of the 3 students were mature-age students. Most of the female students had interaction with the content at the surface level. Their contributions were mostly in identifying its elements (I1-b, frequency 16.22%).

All of the females except one were school-leavers (17 & 18 year olds) which suggested that they would have only just moved from an individual, competitive approach to one of sharing and cooperation. Another factor, that may have accounted for the predominantly surface approach to learning, was that although responses to the topic were required, the responses themselves were not formally assessed. Students tend to put more effort into activities that they know are being assessed. The motivational factor of assessment was not present to encourage students to delve and elaborate on the topic.

Student interaction and collaborative learning

When looking at student–student interaction, it was found that most of Australian students engaged in group discussion by asking/answering questions to clarify details of statements (G2-c, frequency 3.26%), stating opinions regarding the problem (G2-b, frequency 2.17%) and restating the participant's position and advancing arguments or considerations supported by references (G3-c, frequency 2.17%) respectively. There was some interaction between students, but it was less effective in supporting collaborative learning. As mentioned earlier, the type of question asked can also impact on the approach adopted by students. The Australian students were asked to "Consider the issues associated with screening Internet information coming into schools", which required discussion around the topic without necessarily proposing solutions which are aspects of deeper engagement with the topic.

Coding	Australian students (M=3, F=10)					
	Male		Female		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
I1-a	3	16.67	9	12.16	12	13.04
I1-b	3	16.67	12	16.22	15	16.30
I1-c	2	11.11	10	13.51	12	13.04
I2-a	2	11.11	6	8.11	8	8.70
I2-b	0	0	6	8.11	6	6.53
I2-c	0	0	0	0	0	0
I2-d	0	0	3	4.05	3	3.26
I3-a	4	22.22	5	6.76	9	9.78
I3-b	3	16.67	7	9.46	10	10.87
I3-c	1	5.56	5	6.76	6	6.53
I3-d	0	0	2	2.70	2	2.17
G1-a	0	0	0	0	0	0
G1-b	0	0	0	0	0	0
G2-a	0	0	0	0	0	0
G2-b	0	0	2	2.70	2	2.17
G2-c	0	0	3	4.05	3	3.26
G2-d	0	0	0	0	0	0
G2-e	0	0	0	0	0	0
G2-f	0	0	1	1.35	1	1.09

G2-g	0	0	0	0	0	0
G3-a	0	0	1	1.35	1	1.09
G3-b	0	0	0	0	0	0
G3-c	0	0	2	2.70	2	2.17
G4-a	0	0	0	0	0	0
G4-b	0	0	0	0	0	0
G4-c	0	0	0	0	0	0
G5-a	0	0	0	0	0	0
G5-b	0	0	0	0	0	0
G5-c	0	0	0	0	0	0
G6-a	0	0	0	0	0	0
G6-b	0	0	0	0	0	0
Total	**18**	**100**	**74**	**100**	**92**	**100**

Table 3: Analysis of responses of Australian students- Student interaction at individual and group levels

Recommendations

The proposed instrument, designed to assist the analysis of the discussion, proved useful in assessing higher level reasoning and critical thinking. However, some modifications may be made but these could result in compromising instrument validity and reflecting researcher's bias in analysis and interpretation of data.

It is of some concern that both groups of students did not engage in the deeper approaches to learning at the group level. Student–led groups may lack experience in scaffolding, guiding and constructing their knowledge. Teacher/facilitator intervention may provide the encouragement, direction and guidance needed to attain the higher levels of reasoning and critical thinking in interaction and collaboration.

Teachers/facilitators must carefully consider the multiple levels of the topic (not just the '*what*', but the '*hows*' and the '*whys*'), as it will affect their depth of engagement and the quality and quantity of interactivity.

As technology is increasingly integrated into student learning and the quantity of student discourse multiplies, a fast and efficient instrument is needed to assess the impact that learning technologies are having on student learning outcomes. Educators require reliable and efficient measures that can authenticate the time, money and intellectual energies that are being invested in learning technologies.

In summary, the instrument is effective in terms of identifying student learning outcomes in accordance with their approaches to learning, their engagement in electronic discussions and their interaction with peers, both at the surface and in-depth levels. The above recommendations should be

considered when applying the instrument to student-led electronic discussions.

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