A Study on Students' Attitudes Towards Teacher's Intervention in Statistical Computing Laboratory

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Abstract. Within an IT environment, the teacher's role has changed from transmitting knowledge to managing IT resources for learning and facilitating student learning. Thus, the teacher planned for improving classroom teaching practice by playing these two roles, particularly in computing laboratory sessions. Students within each computing laboratory session were divided into small groups so as to enable teacher's intervention to offer assistance or directives within each group more efficiently. A question which arises here is how the teacher's intervention promoted learning and statistical thinking of students when using IT in a statistics classroom. A questionnaire based survey was then conducted to study the attitudes of students towards teacher's intervention within IT environment. The results of the survey indicated that the teacher played facilitating and supporting roles in their learning to foster a learning atmosphere, restructure learning tasks and provide feedback.

Keywords: social process of learning, modelling heuristics, statistical thinking.

1 Introduction

Within an IT environment, the teacher's role has changed from transmitting knowledge to managing IT resources for learning and facilitating the construction of knowledge. For instance, Knutzen discussed how teachers could develop and manage an online learning management system in which they posed the learning content for discussions among students and the teachers monitored their discussion activities [1].

The teacher planned for improving classroom teaching practice by adopting facilitating as well as managerial roles within an IT environment. Using Taylor's model, IT refers to enabling students to have a more intuitive feel for the concepts being studied; serving students to alleviate computational burden; and implementing computer logic by students [2].

The teacher taught a statistics module, "Regression Modelling", following the pattern of 2-hour lectures and 1-hour computing laboratory sessions in each of fifteen weeks. In lectures, the teacher initiated discussions inviting all his students to respond. They talked about how they addressed a question of common concern based on their

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own understandings, opinions, judgments or perspectives. The discussion they held was a form of interaction where they joined together to evaluate ideas their classmates brought forward in order to come up with a joint decision leading to a correct and complete answer. In computing laboratory sessions, the teacher used talk to guide the construction of students' knowledge and orchestrate learning activities. Students within each computing laboratory session were divided into 2-person or 3-person groups in order to increase students' opportunities for peer learning; and to enable teacher's intervention to offer assistance or directives within each group more efficiently and to monitor their learning progress. Each group of students was assigned laboratory exercises demanding the analysis, design or implementation of the solutions in a statistical computing laboratory. Apart from apparent uses of IT in teaching and learning, IT has an educational role in organising environment to promote interaction among students as well as students and teacher.

2 Literature Review

In Li and Ng's study, they found that students demanded peer collaboration and student-teacher interaction when learning with IT [3]. Learning with IT here refers to the way that can organise the learning environment to promote social interaction among students as well as between students and a teacher. Thus, Li proposed a model of pedagogy in an IT environment aiming at quality teaching and learning of statistics to address the significance of teacher guidance and peer collaboration [4].

Li conducted a questionnaire based survey to study how students perceived the learning activities taking place in an IT environment [5]. The survey results indicated that most students held positive perceptions of learning with IT associated with productive social interactions with their learning partners. They found their interaction with their learning partners collaborative and their communication beneficial to learning as it enabled them to verbalise their thoughts to sustain task-centred discussion.

Fisher argued that teachers played managerial and facilitating roles in classroom teaching would be beneficial to student learning [6]. Students sought assistance from their teacher to overcome learning difficulties or mediate between a student and their learning partners. That is why Hoyles and Sutherland found that learning progress is associated with teacher's interventions for maintaining control with students; offering teacher-directed tasks; and being in the form of teaching episodes [7]. They also studied the nature of the intervention and further classified the interventions as being motivational, reflectional or directional.

Mercer provided a framework to analyse talk used by teachers assisting students in knowledge construction in the following ways [8]. The teacher elicited knowledge from students; responded to what students said; and recapped to re-organise, or call attention to the significant ideas students had just presented. The recap so used can be reflectional, and may end up offering hints or directives.

Tharp and Gallimore also developed a framework for categorising ways in which teachers' talk assists their students to learn, via modelling, questioning, cognitive structuring, contingency management, feeding back and instructing [9]. Within each

of these discourse categories, teachers may elicit, respond, or recap. For instance, questioning can be used to elicit what students already know or how their understanding develops or misunderstanding arises. Alternatively, questioning can be used for responding to students if the teacher wishes to extend discussions. Questioning can also be used to offer directions towards task improvement or accomplishment after recapping students' useful ideas as hints. The talk analysed by Mercer [8] and Tharp and Gallimore [9] seems not focusing on student motivation.

Nevertheless, almost no research has explored how teacher's intervention in statistics classroom is significant, especially in the way that promoting students' statistical thinking in statistical computing laboratories. As such, an empirical study was conducted to address the research question, "How does the teacher's intervention promote learning and statistical thinking of students when using IT in a statistics classroom?".

3 Empirical Study

A questionnaire based survey is a commonly used tool by education researchers to solicit feedback from students and the findings are used for enhancing both teaching and learning. A questionnaire consisting of a set of organised and structured questions was designed and constructed as a standard format for gaining a more comprehensive understanding of student-teacher social interactions when learning with IT.

It was decided that survey data could best be gathered by means of personal interview. Through a personal interview, it was possible to elaborate difficult and in-depth questions; to achieve a higher response rate; and to facilitate communications between an interviewer and interviewees in order to gather more accurate and genuine responses given by interviewees [10].

3.1 Questionnaire Design

A questionnaire on learning activities in a statistical computing laboratory was designed and constructed to develop a deeper understanding of how social interaction was constructed when students were learning with IT. The questionnaire should include clear instructions, optional wordings and an appropriate flow of questions, and must be arranged in proper order and divided into parts and numbered (Foddy, 1998). The first four questions, Q's 1-4 were to gather students' general views about the teacher's intervention. Q's 5 and 6 enabled students to express the role and significance of the teacher in their learning process. Q's 7-9 wanted to know whether or not IT was regarded as a vehicle of education delivery that could replace human teaching. The prime purpose of the last two questions, Q's 10 and 11 was to know students' experience of interacting with their teacher.

The questionnaire was made of multiple-choice questions (Q's 1, 2, 3, 7, 8, 9 and 10). All multiple-choice questions were closed-ended and provided proper response categories that were mutually exclusive and collectively exhaustive. Mutually exclusive response categories provided non-overlapping options so that interviewees found no confusion and could provide clear-cut answers to the questions. Collectively

exhaustive response categories provided interviewees with all possible options to select as their answer. Most of these multiple-choice questions used a five point Likert scale for response categories so as to enable interviewees to indicate the extent of their agreement with a proposition. Some used a three point Likert scale for response categories so as to enable interviewees to indicate whether they agreed or disagreed with, or were neutral towards a proposition. All these response categories were also balanced, symmetrically about neutral alternatives.

To understand why interviewees chose their answers for closed-ended questions, open-ended questions (Q's 4, 5, 6 and 11) were also designed to collect their views and enabled them freely to express what aspects of teaching were beneficial to their learning and in what they would like the teaching to be changed to help them learn better.

3.2 Research Participants

The research participants for this questionnaire-based survey were all the 58 full-time students (whole class) enrolling in Year 2 of the Higher Diploma in Applied Statistics and Computing (HDASC) course in the Hong Kong Institute of Vocational Education. Among the students, 32 were females and 26 were males, ranging in age from 19 to 22.

3.3 Pilot Study

The format and layout of the questionnaire were initially checked with two experienced education researchers. They also scrutinised the wordings in questions to ensure the questions were clear, specific, precise and unambiguous and could be understood by most interviewees. Some questions and question wordings were rephrased for ensuring unbiasedness as well as improving clarity and conciseness.

To ensure that valid and reliable responses would be collected from the students, a pilot study was subsequently done by interviewing nine of the students enrolling in Year 3 of HDASC students. They were selected for this study because they had experience of learning with IT and learning with their learning partners as well as their teacher. They were willing to participate in this pilot study prior to the main study. This pilot study did not only provide an estimate of time taken for responding to this survey but it could also highlight what aspects in the questionnaire should be improved.

3.4 Main Study

3.4.1 Data Collection

Each of the 58 full-time HDASC Year 2 students (whole class) was interviewed by the first author. Through the personal interview, it was possible to achieve 100% response rate. As all the 58 students is the HDASC Year 2 student population, no sampling is required. Thus, the survey conducted has no error due to sampling.

3.4.2 Data Validation

To ensure data accuracy, three phases of data validation were carried out. The first phase of data validation took place in the process of personal interview, since the responses given by the interviewees were cross checked with their previous responses for data logic and consistency. The interviewer found no questions were missing or unanswered and no answers were incomplete or redundant.

In the second phase of data validation, a double-check system was adopted to allow the first author of this paper and a data checker to code and input the data into two spreadsheets independently. A computer program was written to detect whether or not there was discrepancy between the two spreadsheets of the data codes and input. There was no such discrepancy, implying that the data were properly coded and correctly inputted.

The data validation tasks were basically accomplished at the first two phases. The third phase of data validation was to perform an exploratory data analysis subject to the scrutiny of data. Its results revealed whether or not there were missing data, meaningless data range, data inconsistency and undefined data codes.

3.4.3 Error Handling

As the response rate was 100%, there was no non-response error. If questions were missing or unanswered or answers were incomplete or redundant, the interviewees were asked to answer questions or clarify their answers. However, no missing data or no redundant information was found. If answers were illegible, the interviewer was asked to transcribe his writings. Some validation rules were built in a spreadsheet to perform data range and consistency checks according to the content and context of data. If any of these checks was failed, no more data would be accepted and the data needed to be amended immediately. This could safeguard data to fall into meaningful range and be consistent at each time data was being inputted.

3.4.4 Data Analysis

Statistical analysis of students' responses was divided into preliminary and in-depth levels by using the statistical software SPSS. In preliminary data analysis, gaining statistical insights and ideas from data was by means of descriptive statistics and statistical tables that provide valuable clues to what and how an in-depth statistical analysis of students' responses ought to be carried out subsequently. Contingency tables and Chi-square tests were used in the in-depth data analysis for investigating factors that might be related to teacher's intervention.

3.4.5 Research Findings

Statistical analyses of these data were performed by examining the general characteristics and patterns of data. The analysis addressed these questions: how did students perceive the educational use of IT when learning with the teacher's intervention? How beneficial to their learning process is interacting with their teacher? How did the teacher's intervention prompt student learning?

Question 1 asked students "Do you need or need not teacher's intervention in your learning process?" Most students (46, 79.3%) said they needed the teacher's intervention, 12 (20.7%) students gave a neutral response but none said "No need".

Table 1 gives a summary of students' attitudes towards the teacher's intervention. A little over two-thirds (40, 68.9%) found the timing of teacher's intervention appropriate and about one-quarter (15, 25.9%), and 3 students (5.1%) gave neutral and negative responses respectively (Q2). Almost all students (54, 93.1%) thought their intervention was beneficial and none gave a negative response, while 4 students were neutral (Q3). One student found his teacher ensured he was on the right track of learning but he also felt uncomfortable when his teacher pointed out his mistake. Two students found the teacher gave constructive ideas or explained the approach to problem solving but they both found the teacher sometimes gave direction instead of answers to their questions. One student found the teacher provided well-timed feedback, as well as direction but she felt under pressure during the teacher's intervention.

Table 1. Students' attitudes towards teacher's intervention (Q's 2 and 3)

Questions	% of students responded to options (N=58)				
	1	2	3	4	5
Q2. Do you find the timing of teacher's intervention in your learning process appropriate or inappropriate?[1]	10.3	58.6	25.9	3.4	1.7
Q3. Do you find the teacher's intervention beneficial or unbeneficial to learning process?[2]	12.1	81.0	6.9	0.0	0.0

Notes.

Owing to rounding, there may be a slight discrepancy between the sum of individual responses and the total as shown in the above table.

[1]Options 1-5: "very appropriate", "appropriate", "neutral", "inappropriate" and "very inappropriate".

[2]Options 1-5: "very beneficial", "beneficial", "neutral", "unbeneficial" and "very unbeneficial".

It is of interest to investigate factors that might be related to the needing of teacher's intervention by using Contingency tables and Chi-square tests. Most of the data were found in factor 1 (i.e., Q1-needing teacher's intervention) and factor 2 (i.e., Q3-teacher's intervention beneficial to learning progress) cell of the contingency table of factor 1 by factor 2, indicating these two factors might be related. Moreover, Chi-square test (χ^2 (2, $\underline{N}$ = 58) = 7.751, p = 0.021) shows statistical evidence to support the relationship between factor 1 and factor 2 would exist. Similarly, data concentrated in the common cell of a contingency table, factor 3 (i.e., Q2-appropriate timing

of teacher's intervention) and factor 2 (i.e., Q3-teacher's intervention beneficial to learning progress), revealing that these two factors might be related, statistical evidence (χ^2 (4, $\underline{N}$ = 58) = 13.739, p = 0.008) substantiates the relationship between factor 3 and factor 2 would also exist.

An open-ended question (Q4) was asked to explore under which circumstances students found the teacher's intervention beneficial or unbeneficial to their learning process. The students who found the teacher's intervention beneficial to their learning process, their responses were categorized by using Tharp and Gallimore's means [2] of offering learning assistance (see Table 2) so that their responses could fall in more than one of the categories. The teacher provided regular feedback to supplement explanations and clarify their misunderstanding (29 students, 50.0%). He gave them cues and restructured learning in order to model thinking (25 students, 43.1%). He posed questions to organise students' thoughts towards task accomplishment (4 students, 6.9%). He offered students cognitive structuring assistance to formulate goals for problem solving (3 students, 5.1%). When students did not respond to the means of learning assistance the teacher adopted, he eventually gave them instruction (9 students, 15.5%). Feeding back and modelling were the two most common means of assistance the students found beneficial to their learning process, whereas contingency management seemed not to be adopted. Apart from these categories, some students mentioned that the teacher maintained an active dialogue with students to encourage their participation and involvement, share their views as well as ideas and respond to assistance they sought (8 students, 13.8%). Conversely, those few students who found the teacher's intervention unbeneficial to their learning process felt uncomfortable when their mistakes were pointed out.

Table 2. Circumstances under which students found the teacher's intervention beneficial (Q4)

Circumstances	% of students (N=58)*
I. Feeding back	50.0 (29)
II. Modelling	43.1 (25)
III. Instructing	15.5 (9)
IV. Questioning	6.9 (4)
V. Cognitive structuring	5.1 (3)

Note.

*Frequencies add to more than 58 because students' responses could be placed in more than one category.

The teacher's intervention is a social process within which the teacher and students were engaged in various assisting means, feeding back, modelling, instructing, questioning and cognitive structuring.

In the context of statistics teaching and learning, the teacher found the first four means of assisting students' learning useful. It was possible to model the acts of translating the strength of data relationship and mapping the direction of data context when assisting students in interpreting a regression slope. Questioning was used to assist students in achieving specific learning objectives through free and open exchange of their ideas, and this was particularly useful as an implicit means of developing students' thinking and reasoning. Cognitive structuring was adopted to organise students' thinking associated with selecting among models and justifying model practicality as being parts of regression heuristics. Contingency management exhibited in the form of praise was used to build, maintain or bolster students' confidence before moving into more difficult learning tasks.

An open-ended question (Q5) asked students to describe how the teacher orchestrated the learning activities in the computing laboratory. Their responses to the question were summarized and could be placed in more than one category in Table 3. The teacher provided good learning materials and organised meaningful learning activities, with 52.6% (30 students). He structured learning process by reviewing key concepts, clarifying misconceptions, initiating discussions and outlining problem background and settings, and context, content and measurement of data, with 36.8% (21 students). He fostered an amusing climate for learning and told students jokes in order to reduce work stress in the computing laboratory, with 33.3% (19 students). He monitored learning activities and provided feedback to students, with 26.3% (15 students). He utilised IT resources for teaching and learning, with 14.0% (8 students). He organised students to engage with tasks, as well as peers in line with generating feelings of confidence, competence and control, with 8.8% (5 students). The responses given by the students suggest they thought that the teacher was conscientious and responsive in the ways he organised learning. They considered that he did not merely provide knowledge, but also created and maintained a positive and warm classroom atmosphere conducive to learning.

Table 3. Ways learning activities orchestrated by teacher (Q5)

Ways learning activities orchestrated by teacher	% of students (N=57)*
I. Provided good learning materials and activities	52.6% (30)
II. Structured the learning process	36.8% (21)
III. Fostered learning atmosphere	33.3% (19)
IV. Monitored learning progress regularly	26.3% (15)
V. Used IT	14.0% (8)
VI. Organized students to engage with tasks and peers	8.8% (5)

Note.

*Frequencies add to more than 57 because students' responses could be placed in more than one category.

In response to an open-ended question (Q6), which asked how well students had learnt from the teacher, the following positive views were expressed. When approaching students, the teacher monitored students' learning progress and regulated their learning. To respond to differing student needs, he made effective use of questioning to check student understanding and offer directives. He did not provide direct instruction to his students, but encouraged them to construct their own understanding by helping them learn how to recognise problems; and set goals and determine strategies for solving regression problems. The teacher demonstrated the use of computer software and provided good command of English language. He was conscientious and enthusiastic about teaching and patient to elaborate concepts and explained problems clearly. He managed class time and activities and guided effective learning. He used effective communication skills and utilised illustrations and examples in the computing laboratory, as well as the lecture theatre. He developed a rapport with students and helped students build confidence. He was very statistically competent to provide correct knowledge with ease and broadened their views of statistics learning. The students held positive perceptions of the teacher's teaching as well as interpersonal skills. However, a few students also had negative views about their teacher because they felt his presentation was sometimes boring and he did not explain concepts clearly and answer their queries directly.

It is interesting to examine preferences for interaction with the teacher, learning partners and IT. Table 4 shows students' responses to Q's 7, 8 and 9. Twenty-three (39.7%) students preferred learning with a teacher to IT, only one student preferred learning with IT to a teacher and 34 (58.6%) students gave a neutral response. When asked to choose between learning partner and IT, about half (30, 51.7%) preferred the former, while 24 (41.4%) students had no preference and very few preferred the latter (4, 6.9%). Students were evenly divided in choosing to learn with a partner (14, 24.1%) or the teacher (12, 20.7%), and about half (32, 55.2%) gave a neutral response. The results of analysing students' responses to these three questions showed that students would like to interact with humans rather than IT but it is still worth noting that significant numbers of neutral responses given by students. The majority of students gave favorable responses to the teacher's intervention, while a significant proportion of students (25.9%) neutrally responded to one item, concerning the timing of the teacher's intervention. Apparently, students who expressed a preference would like to interact with humans, the teacher or their partners rather than IT.

Question 10 asked students "Do you have a better or a worse learning progress when working with your teacher in an IT environment?" Seven (12.1%) students had much better learning progress when working with their teacher in an IT environment, 43 (74.1%) had better learning progress, and 8 (13.8%) gave a neutral response, but no students gave a negative response (i.e., neither much worse nor worse learning progress) respectively. One of the eight neutral respondents did not give any specific reasons and another elaborated with a positive reason, "Teacher provided clear learning objectives so as to focus better on problem-solving task". The others identified a variety of reasons why they sometimes did and sometimes did not experience learning progress. The positive reasons were similar to those in Table 2, while negative reasons included lack of confidence, confusion or lack of direction in exploring problem solving approaches suggested by the teacher, and communication with the teacher slowing down progress.

Table 4. Students' preference for learning (Q's 7, 8 and 9)

Questions	% of students selected options (N=58)		
	1	2	3
Q7. Would you like to learn with a teacher or IT?[3]	39.7	58.6	1.7
Q8. Would you like to learn with your learning partner(s) or IT?[4]	51.7	41.4	6.9
Q9. Would you like to learn with your learning partner(s) or teacher?[5]	24.1	55.2	20.7

Notes.

[3]Options 1-3: "teacher", "neutral" and "IT".

[4]Options 1-3: "learning partner", "neutral" and "IT".

[5]Options 1-3: "learning partner", "neutral" and "teacher".

To understand why the students had a better or a worse learning progress when working with your teacher in an IT environment, an open-ended question (Q11) was asked to collect their responses. Their positive responses spelt out the form of teacher's intervention as being motivational, reflectional or directional as in Hoyles and Sutherland [7]. As being motivational, the teacher was more concerned with student participation in learning activities so as to motivate students to learning. In reflectional form, the teacher checked student understanding as identifying their learning difficulty; and assisting in reasoning and enquiring about what they were doing. For the interventions being regarded as directional, their teacher posed directive questions or gave cues resulting in escalating their thoughts towards problem solving. Besides, the teacher made effective use of information and IT resources to drive student learning and demonstrated how to build regression models using IT tools. They found their teacher was communicative in learning in the way that they could interact and exchange views. One of the responses was affection, as indicated that the teacher was participative and students were accompanied by the teacher in tour of learning.

Conversely, students had worse learning progress when working with teacher because they were anxious and had less freedom and limited room for problem solving. They found wasting time for student-teacher communication that would slow down learning progress. The teacher did not provide a clear and directive approach to tackling a problem but posed questions that were demanding and created confusion.

4 Conclusion

The research findings from this study outlined the importance of the teacher's intervention in students' development of statistical understanding. Students believed that the teacher played facilitating and supporting roles in their learning to foster a learning atmosphere, restructure learning tasks and provide feedback. It was important to

them that their teacher organised their interaction with tasks and peers in ways that facilitated their learning of regression modelling heuristics.

When the teacher adopted the role as a learning facilitator, he knew when to supplement his students information, knowledge and skills; when to leave students to solve problems on their own; and when to use questioning to stimulate thinking; to direct thoughts; or to have intellectual exchanges between the teacher and their students. He encouraged student participation, involvement and autonomy. Under these circumstances, IT supported and initiated learning and promoted social interaction.

Based on the data collected and findings from the survey, how teacher's intervention may facilitate student learning in an IT environment can be understood but the survey findings cannot lead to in-depth understanding of how different categories of teacher's intervention interplays so as to develop the ownership of learning. Therefore, it would be better to be supplemented by observation study.

References

1. Knutzen, K.B.: Driving and assessing participatory learning. Paper presented at CITE Research Symposium 2013, Hong Kong (2013)
2. Taylor, R.T.: The computer in school: tutor, tool, tutee. Teachers College Press, New York (1980)
   Li, K., Ng, T.: Enhancing students' understanding of regression concepts. In: Kong, S.C., Ogata, H., Arnseth, H.C., Chan, C.K.K., Hirashima, T., Klett, F., Lee, J.H.M., Liu, C.C., Looi, C.K., Milrad, M., Mitrovic, A., Nakabayashi, K., Wong, S.L., Yang, S.J.H. (eds.) Proceedings of the 17th International Conference of on Computers in Education, pp. 792–800. Asia-Pacific Society for Computers in Education, Hong Kong (2009)
3. Li, K.: A pedagogy model for an IT Environment. In: Kong, S.C., Ogata, H., Arnseth, H.C., Chan, C.K.K., Hirashima, T., Klett, F., Lee, J.H.M., Liu, C.C., Looi, C.K., Milrad, M., Mitrovic, A., Nakabayashi, K., Wong, S.L., Yang, S.J.H. (eds.) Proceedings of the 17th International Conference of on Computers in Education, pp. 890–895. Asia-Pacific Society for Computers in Education, Hong Kong (2009)
4. Li, K.: A study on computer-supported collaborative learning in statistics classroom. In: Lam, P. (ed.) Proceedings of the 7th International Conference on e-Learning, pp. 259–268. Academic Publishing International Limited, Reading (2012)
5. Fisher, E.: The teacher's role. In: Scrimshaw, P. (ed.) Language, Classrooms and Computers, pp. 51–74. Routledge, London (1993)
6. Hoyles, C., Sutherland, R.: Logo Mathematics in classroom. Routledge, London (1989)
7. Mercer, N.: The guided construction of knowledge. Multilingual Matters Ltd., Clevedon (1995)
8. Tharp, R.G., Gallimore, R.: Rousing minds to life: teaching, learning and schooling in social context. Cambridge University Press, Cambridge (1988)
9. Foddy, W.H.: Constructing questions for interviews and questionnaires: theory and practice in social research. Cambridge University Press, Cambridge (1998)