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RESEARCH ARTICLE

An Empirical Study of Gender Differences in Motivational Orientations of Students in Statistics Classroom

Ken W. Li[1]

[1]Retired Lecturer, Department of Information and Communications Technology, Hong Kong Institute of Vocational Education, China

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Abstract

Lecture theatres and computing laboratories are common types of classrooms used for teaching and learning in this study; both were equipped with a computer network through which teachers and students can access learning management system, digital library, educational software, and so on. Students were divided into groups of two or three; each group of students collaborated on the worksheets in the laboratory and naturally sat together when attending a class held in the lecture theatre. The social organization of classroom learning would promote student learning but what drives student learning; how to engage students with learning; and how to maintain their interest in learning are of research interest in the present study. The study illustrated the theoretical and empirical links, student motivation has a relation to rich collaboration with peers, communication as verbal interactions as well as teacher-student interactions. These are within socio-cultural contexts for learning to take place. The study was extended to make comparisons of the motivational orientations between student genders. It was found that female students were keener on fun or enjoyment in learning, peer communication, and teacher's intervention, whereas male students were concerned more about digital learning tools, a positive working relationship, social reciprocity, and interpersonal relationships.

Keywords group process, interpersonal relationships, social interactions, verbal exchanges

• email: dr_ken_li@yahoo.com.hk

I. INTRODUCTION

Research studies (e.g., Fernandes & Ponte, 2014; Wild, Pfannkuch, Regan, & Parsonage, 2017) theorize about using technology to facilitate learning from a student's viewpoint but teachers also play vital roles in technology-enriched classrooms (Bozkurt & Ruthven, 2017; Goos, 2014). Goos directed attention to teacher professional development in the use of technology, teachers' beliefs about and capability of using technology in classroom teaching and learning, as well as schools lacking technical support or without fully utilizing computer resources. Bozkurt and Ruthven echoed that teachers ought to master the technology associated with the adaptation of teaching practices and manage classroom learning. All these issues have an impact on successful integration of technology in classroom. Both researchers raised the socio-cultural issues with respect to social organization of classroom such that teachers should be sensitive to improve or adjust teaching pedagogy and the fostering of a congenial learning environment (Pianta, Hamre, & Allen, 2012).

Peer collaboration is under the influence of social environment in a classroom with respect to peer support as well as positive interpersonal relationships within peer groups, thus motivating students to learn (Wentzel, 2012). But, how the students would be motivated to learn in the environment so organized is a research question of the present study. Moreover, female and male students have different perceptions and interpretations of social environments they have experienced, they may show different patterns of classroom interaction. They also hold different attitudes toward mathematics learning (Leder, 2019; McCormack & Morales, 2021). Hence, student gender is another issue giving rise to differing motivational orientations (Katz, Assor, Kanat-Maymon, & Bereby-Meyer, 2006; Martin, 2004; Meece, Glienke, & Burg, 2006; Wang & Eccles, 2013), and this study will thus be extended to attempt another research question relating to how social environment would be perceived by different student genders.

II. LITERATURE REVIEW

The social organization of the statistics classroom in the present study stemmed from socio-cultural theories of learning (Vygotsky, 1978) which argued that language is a cultural and psychological tool essential for learning. Students using a spoken language during a learning process may find it necessary to ask or answer questions when encountering or solving learning problems; they may give evaluative responses to manifest whether the questions or answers make sense with justifications. The theories stimulated interest of scholars, such as Brown (2005), Goos, (2004, 2009), Lerman (2002), and Mercer (2004) giving various accounts of classroom learning within socio-cultural perspectives. Mercer extended the use of language in the Vygotskian context as a social mode of thinking when participating in intellectual activities. Through verbal communications, students pose questions for concept clarification or problem formulation; to share their insights, thinking, and reasoning; to articulate their thoughts; to compare their own perspectives with their peers; and to regulate problem-solving strategies in

addition. Mercer's elaborations were confined to a cognitive means of communication students would adopt to "represent, compare, explain, justify, agree, and validate" in collaborative learning, as shown in Brown (2005, p. 105). Specifically, Goos speculated on social processes of learning that would yield the product of interactions with classmates, teacher, learning materials, tools, and technology within the social environment as if students were participating in a community of collaborative inquiry in a technology-enriched mathematics classroom. The students verbalized their own beliefs, ideas, understanding, and thoughts; their classmates responded and made different contributions. These verbal exchanges were about developing conceptual knowledge, formulating problems, and devising or regulating problem-solving strategies while teacher orchestrated learning activities. The verbal interaction with peers and teachers generated a more comprehensive view of learning contexts to enhance understanding. All these exchanges are mainly to address cognitive issues but can also cater for social needs (e.g., Arcidiacono, Baucal, & Budevac, 2011; Li & Goos, 2018). Potter (2011) switched to a slightly different perspective toward discursive psychology. Social interactions among students or between a teacher and students are characterized by receptive or expressive language that serve psychological or social needs, e.g., affective expressions, emotional expressions, endorsement of social goals, messages of love or sympathy, an offer of empathy or moral supports, and so on. This is perhaps why educational psychology plays an important role in human learning, especially in the present context of academic motivation.

Studies of student motivation, such as those undertaken by educational psychologists, Elliot and Dweck (2005), Juvonen, Espinoza, and Knifsend (2012), Mahatmya, Lohman, Matjasko, and Farb (2012), Pianta, Hamre, and Allen (2012), Skinner and Pitzer (2012), as well as Wentzel (2012) reported the social conditions under which students would be motivated to learn. Peer support, peer relationship, peer interaction, and teacher-student interactions are within a broader socio-cultural context that has certain effect on student learning (Wentzel, 2012). Peer relationships relate to students' academic work (Juvonen, Espinoza, & Knifsend, 2012); their academic achievement is under peer influence as well as support (Jacobson & Burdsal, 2012; Martin & Dowson, 2009).

Moreover, there are gender differences in student motivation because female and male students have different personalities and hold different conceptions of social roles and relationships (Meece et al., 2006). Besides, student genders may have different effects on teacher support and peer influence (Wang & Eccles, 2013) and peer interaction (Tenebaum et al., 2020). Specifically, female students were more vocal, more social, as well as more likely to make friends and maintain friendships (Akdemir, 2019). They were more likely to endorse social goals than male students but there was no difference in the level of perceived academic efficacy between their genders (Patrick, Hicks, & Ryan, 1997). Female students had higher levels of behavioural, emotional, and cognitive engagement than their male counterparts, so they excelled, compared to their male counterparts, in various ways like planning, managing, and concentrating on their learning (Martin, 2004). Female students were also less self-reliant, thus wanting instrumental aid or social resources (Jacobson & Burdsal, 2012). They valued social relationships as well as social support, whereas male expectations of social relationships were relatively simple, with less demand placed on personal aspiration. Social relationships were characterized by

companionship, friendship, trust, intimacy, affection, admiration, and respect. The notion of social support was about instrumental aid, reliable alliance, shouldering responsibilities, and the division of labor. In contrast, male students were honoured more to have praise given by a teacher as an acknowledgement of quality intellectual performance and, in turn, this enhanced their intrinsic motivation, whereas their female counterparts felt losing learning autonomy to a certain extent, thereby weakening motivation (Katz, Assor, Kanat-Maymon, & Bereby-Meyer, 2006). Male students, when compared with their female counterparts, were more participative in challenging or competitive learning activities (Meece, Glienke, & Burg, 2006). Gender differences in student motivation is so far related to social contexts but is also associated with cognitive issues. Female and male students hold different goal achievement orientations as well as competency beliefs (Meece, Glienke, & Burg, 2006).

All the above studies are incorporated into a framework for collecting data from a survey about how students would be engaged in statistics learning within an IT environment and elucidating the results of statistical analysis of the survey data.

III. EMPIRICAL STUDY

An empirical study was set within a classroom, the research design and associated methods of collection and analysis of data were selected for their relevance to students as research participants.

Research Participants

The research participants were 58 full-time students enrolling in Year 2 of a 3-year Higher Diploma course in Applied Statistics and Computing (HDASC) in an institute of vocational education in Hong Kong, China. Prior to enrolling in the HDASC course, they all passed a public examination of the Hong Kong Secondary Education as a mark of a successful completion of secondary education. All the students were Chinese and bilingual in Chinese and English. They were from middle-class or working-class families. Among these students, twenty-seven were males and thirty-one were females, ranging in age from 19 to 22.

This cohort of students was selected because their teacher (the author of this research paper) planned for improving classroom teaching practice by dividing the students into groups of two or three for peer learning and collaboration that would consequently arouse students' academic motivation. Theoretically speaking, parents and school policies may affect student motivation, but the research participants in the present study were adult learners under little parental influence or involvement. They chose to enroll in the HDASC course and aspired to a career in statistics under their own discretion. There not any school policies that have recently made changes to influence student learning and progression, graduation requirements, class sizes, teaching and learning resources, classroom contact hours, planned staffing, and so forth.

Research Instrument

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 organized and structured questions was designed and constructed as a standard format for gaining a more comprehensive understanding of motivational contexts of small-group learning in a statistics classroom. There were three parts in the questionnaire, Q's 1-15 in the first part focused on what or how to arouse students' interest in learning.

1. Do you find learning with IT is interesting or boring?
2. Do you feel confident or unconfident when learning with IT?
3. Does IT help you make sense of what you are learning?
4. Do you see learning activities in computer laboratory as relevant or irrelevant?
5. Does IT widen or narrow down your scope of learning?
6. In what ways, does IT widen your scope of learning?
7. In what ways, does IT narrow down your scope of learning?
8. When learning with IT, do you have control or no control of your learning process?
9. What type of learning materials help you focus best on the task, IT-based or non IT-based materials?
10. Do you have a better learning progress learning with or without IT?
11. In what way, do you find you have better learning progress when learning with IT on your own?
12. In what way, do you find you have less learning progress when learning with IT on your own?
13. Outside the classroom, how do you cope with a learning problem related to this subject, "Applied Statistical Methods"?
14. Can you describe what you have learnt from this lesson?
15. Can you describe how well you feel you have learnt this material?

There would be a link between students' motivation and peer collaboration; Questions 16-42 in the second part explored how to engage students with learning activities.

16. Do you find learning with IT helpful or unhelpful when working with your groupmate(s)?
17. When learning with IT, do you have a better learning progress when working alone or working with your groupmate(s)?
18. For what reasons do you find you have a better or a worse learning progress when working with your groupmate(s) in an IT environment?
19. Is your interaction with your groupmate(s) collaborative or disruptive?
20. Does your interaction with your groupmate(s) usually produce agreement or disagreement?
21. If disagreement, how do you resolve the discrepancy/dispute or compromise between one another?

22. How much knowledge do you want to share with your groupmate(s) when learning with IT?
23. How much do(es) your groupmate(s) share knowledge with you when learning with IT?
24. What type of knowledge do you want to share with your groupmate(s) when learning with IT?
25. What type of knowledge you do not want to share with your groupmate(s) when learning with IT?
26. What type of knowledge do your groupmate(s) want to share with you when learning with IT?
27. What type of knowledge do your groupmate(s) not want to share with you when learning with IT?
28. Compared with a non-IT environment, does an IT environment help you foster a better or a worse interpersonal relationship when working with your groupmate(s)?
29. Do your groupmate(s) help you make sense of what you are learning with IT?
30. Are you co-learning or competing with your groupmate(s) when working in an IT environment?
31. Are your groupmate(s) co-learning or competing with you when working in an IT environment?
32. Is the communication between you and your groupmate(s) beneficial or unbeneficial to your learning process?
33. In what circumstances, do you find the communication between you and your groupmate(s) are beneficial to your learning process?
34. In what circumstances, do you find the communication between you and your groupmate(s) are unbeneficial to your learning process?
35. How do you think you can improve the communication between you and your groupmate(s) in order to achieve mutual benefit from learning?
36. Can you describe the extent of your involvement when learning with your groupmate(s) in IT environment?
37. Do you make any contribution to your groupmate(s) when learning with IT?
38. How do you share the workload with your groupmate(s)?
39. Do you have much or little interaction with your groupmate(s) about the learning tasks?
40. Do you have harmony or conflict between you and your groupmate(s) when learning with IT?
41. Do your groupmate(s) make the learning process more fun or more threatening?
42. How well do you feel you have learnt with your groupmate(s)?

Questions 43-53 in the third part explored how well students' learning was constructed through social interaction between students and their teacher in an IT environment.

43. Do you need or not need teacher's intervention in your learning process?

44. Do you find the timing of the teacher's intervention in your learning process appropriate or inappropriate?
45. Do you find the teacher's intervention beneficial or unbeneficial to your learning process?
46. In what circumstance, do you find the teacher's intervention beneficial/unbeneficial to your learning process?
47. How does your teacher orchestrate the learning activities in the computing laboratory?
48. How well do you feel you have learnt from a teacher?
49. Would you like to learn with a teacher or IT?
50. Would you like to learn with your groupmate(s) or IT?
51. Would you like to learn with groupmate(s) or a teacher?
52. Do you have a better or a worse learning progress when working with your teacher in an IT environment?
53. For what reasons do you find you have a better or a worse learning progress when working with your teacher in an IT environment?

Questions 1, 2, 5, 9, 10, 16, 17, 22, 23, 28, 32, 41, 44, 45, and 52 in the questionnaire provide five response categories, 1-5 the students could choose for their answers (refer to Table 1). They would choose 1 and 5 to indicate the greatest extent to their disagreement and agreement with a proposition respectively. Questions 3, 4, 8, 19, 20, 29, 30, 31, 39, 40, 43, 49, 50, and 51 used a 3-point Likert scale: 1 (disagree), 2 (neutral), and 3 (agree) for response categories interviewees could choose to indicate the extent of their agreement with a proposition because the research participants found difficult to quantify their survey responses. All these response categories were mutually exclusive and collectively exhaustive, balanced, symmetrically about neutral alternatives.

Each of the HDASC students was interviewed by an interviewer to gather their responses and elaborate difficult and in-depth questions the students found ambiguous. The responses given to Q's 1, 2, … , 52, and 53 which were recorded on the questionnaires were then coded and inputted into computers for data processing and validation, the responses thus became relevant and valid data, x_1, x_2, … , x_{52}, and x_{53} respectively (refer to Section IV).

Data Analysis

Preliminary analysis of the close-ended responses was conducted by means of descriptive statistics, the mean and standard deviation of each of the responses are reported in Section V. T-tests were performed to compare the mean scores between male and female survey respondents. The twenty-four open-ended questions were designed to offer students an opportunity of explaining why they had given positive or negative responses to the close-ended questions. The responses may have certain social and psychological contexts of learning in relation to students' motivation.

There are three stages in a model of student motivation concerning: i) what or how to arouse students' interest in learning; ii) how to engage students with learning activities; and iii) how to maintain students' interest in learning. Hence, three key variables, x_1

(student motivation), x_{17} (peer collaboration), and x_{32} (communication) were among the fifty-three responses given by the students and were selected for correlation analyses. The first analysis was conducted to examine the potential relationship between x_1 and each of these variables: x_2, x_5, x_9, x_{10}, x_{16}, x_{17}, x_{22}, x_{23}, x_{28}, x_{32}, x_{41}, x_{44}, x_{45}, and x_{52} to illustrate what or how to drive student learning. As far as student engagement with learning activities was concerned, students' responses, x_{16}-x_{53} had rich social and psychological contexts of learning, the second analysis was performed for assessing the relationship between x_{17} and each of these variables: x_{22}, x_{23}, x_{28}, x_{32}, x_{41}, x_{44}, x_{45}, and x_{52}. It was also of interest in studying how to maintain students' interest in learning by checking the correlation between x_{32} and each of these variables: x_{41}, x_{44}, x_{45}, and x_{52}. Nevertheless, this statistical tool would only give a summative measure to what extent the responses given to two different questions are related, albeit not for making any comparisons between correlations in the present study because the strength of correlation is not of primary interest. To compare motivational orientations between student genders, the survey data were divided into male and female sets, each set was then analysed independently using correlation analysis.

Correlations significant at the 5% level only show non-causal relationships between two responses, for instance, x_9 (learning resources) may influence x_1 (student motivation) or vice versa. Qualitative analyses of responses given to the open-ended questions (i.e., Qs 6, 7, 11, 12, 13, 14, 15, 18, 21, 24, 25, 26, 27, 33, 34, 35, 36, 37, 38, 42, 46, 47, 48, and 53) as well as responses using three point scale for Qs 3, 4, 8, 19, 20, 29-31, 39, 40, 43, 49, 50 and 51 ensued to supplement the relationship for two reasons. The respsones, x_{16}-x_{42}, illuminated social interactions between students within groups involving cognitive and interpersonal exchanges. First, the former responses do not employ any data scales and the latter responses do not adopt data scales corresponding to the responses using a five point scale so that no correlation analyses are performed. Second, it would be worth noting the responses outside correlation results that could indirectly influence the postulated relationship. The statistically significant correlations and relevant analysis results are reported and interpreted below adhering to the theories of educational psychology.

IV. VALIDITY AND RELIABILITY

The whole questionnaire was validated by two professors of education to ensure correct wordings, appropriate choices of response categories, and a smooth questioning flow. To ensure that valid and reliable responses that would be collected from the students, a pilot study was subsequently done by interviewing nine of the students enrolling in Year 3 of HDASC course in the same institute. 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. According to the professors' comments and students' feedback, some question wordings were revised and the flow of questioning was adjusted. In addition, the number of response categories was reduced because the students in the pilot

study found difficult to quantify the survey responses they gave to Q's 3, 4, 8, 19, 20, 29, 30, 31, 39, 40, 43, 49, 50, and 51.

To ensure data accuracy, data validation was carried out. First, the responses given by each of the students were cross checked with his/her previous responses for data logic and consistency during a personal interview. Second, the survey data, which were coded and inputted into computer by the author of this paper were validated by a data checker. Third, data validation proceeded further checking whether or not there were missing data, meaningless data range, data inconsistency or undefined data codes.

The methodology of the survey data analysis was checked by a statistical consultant. The interpretation of statistical findings was judged by a professor of education.

V. RESULTS AND DISCUSSION

Survey responses given by male and female students to each of the close-ended questions are summarized using means and standard deviations as shown in Tables 1-3. Students' responses, x_1-x_{15} were given to Qs 1-15 focused on investigating students' motivation when learning with IT, their responses were positive irrespective of student genders (see Table 1). Students' interest trigged by the situation of learning with IT (x_1) where the interest would motivate students to learn according to Ainley (2012) as well as Harackiewicz, Smith, and Priniski (2016). As such, x_1 (student motivation) is the key variable selected for examining under which classroom conditions or settings (i.e., x_2-x_{53}) students would be motivated to learn. When learning within an IT environment, students felt confident (x_2) and found the learning activities relevant (x_4) because the pace and sequences of learning were under their autonomy and control (x_8), thereby taking up a proactive role of learning (Wentzel, 2012). IT helped most students make sense of learning (x_3) probably because of IT widening the scope of learning (x_5). They could see the practicality of statistics and develop thinking and reasoning beyond conceptual understanding of statistics (x_6), whereas only a few complained slow information traffic reducing access to the practice of statistics (x_7).

The mean survey scores of x_3, x_4, and x_8-x_{10} given by female students are higher than their male counterparts, whereas male mean survey scores of x_1, x_2, and x_5 are slightly higher than those given by females. These discrepant mean scores would hypothesize that female students held more positive perceptions of the educational use of IT, male students were more motivated to learning with IT. Nevertheless, there is no difference between male and female survey scores at the 5% level of statistical significance (see Table 1).

Table 1. Mean and standard deviation of 27 males and 31 female students' responses given to the close-ended questions, 1-5 and 8-10

Question	Male	Female
1. Do you find learning with IT is interesting or boring?	3.96 (0.528)	3.88 (0.554)
2. Do you feel confident or unconfident when learning with IT?	3.46 (0.706)	3.38 (0.660)
3. Does IT help you make sense of what you are learning?	2.58* (0.504)	2.81* (0.397)
4. Do you see learning activities in computer laboratory as relevant or irrelevant?	2.88* (0.326)	2.91* (0.296)
5. Does IT widen or narrow down your scope of learning?	3.96 (0.445)	3.88 (0.421)
8. When learning with IT, do you have control or no control of your learning process?	2.58* (0.504)	2.66* (0.545)
9. What type of learning materials help you focus best on the task, IT-based or non IT-based materials?	3.77 (0.710)	4.06 (0.435)
10. Do you have a better or worse learning progress learning with IT?	3.81 (0.567)	3.91 (0.390)

Notes. Qs 1, 2, 5, 9, and 10 used a 5-point Likert scale: 1 (very negative), 2 (negative), 3 (neutral), 4 (positive), and 5 (very positive) response categories.
*Qs 3, 4, and 8 used a 3-point Likert scale: 1 (disagree), 2 (neutral), and 3 (agree) for response categories.
Figure in the parenthesis indicates the standard deviation of students' response given to each corresponding question.

All responses given by students to Qs 16-42 were about how they had interacted with groupmate(s) in small-group learning situations within an IT environment (see Table 2). Students found learning with IT helpful when working with their groupmate(s) (x_{16}) whereby they had better learning progress (x_{17}). The reasons the students held for having better learning progress were concerned with intellectual exchanges like getting help from a more able groupmate, exchanging views for co-construction of knowledge, clarifying or correcting misconceptions, formulating goals and strategies for problem solving, accessing more or new ideas, as well as resolving conflicting views (x_{18}). These three responses, x_{16}, x_{17}, and x_{18} were in accord with the response, x_{19} (collaborative interactions). Besides, almost all students found their interactions produced agreement rather than disagreement (x_{20}). Collaborative and productive interactions (x_{19} and x_{20}) within groups of students is characterized by the process of concurrence during which social cohesion would be maintained as long as issues within groups is resolved quickly (Johnson & Johnson, 1998). Seemingly, both interactions focus on the conditions favoring the fulfilment of the needs for within-group relatedness, thereby student engagement (Furrer, Skinner, & Pitzer, 2014). Only two students sought opinions of their teacher or third person to resolve disagreement (x_{21}).

Table 2. Mean and standard deviation of 27 males and 31 female students' responses given to the close-ended questions, 16, 17, 19, 20, 22, 23, 28-32, and 39-41

Question	Male	Female
16. Do you find learning with IT helpful or unhelpful when working with your groupmate(s)?	4.00 (0.849)	4.06 (0.619)
17. When learning with IT, do you have a better learning progress when working alone or working with your groupmate(s)?	3.96 (0.824)	4.13 (0.492)
19. Is your interaction with your groupmate(s) collaborative or disruptive?	2.65* (0.562)	2.91* (0.296)
20. Does your interaction with your groupmate(s) usually produce agreement or disagreement?	2.69* (0.471)	2.81* (0.397)
22. How much knowledge do you want to share with your groupmates when learning with IT?	4.19 (0.801)	4.22 (0.553)
23. How much do(es) your groupmate(s) share knowledge with you when learning with IT?	3.85 (0.784)	4.16 (0.628)
28. Compare with a non-IT environment, does an IT environment help you foster a better or a worse interpersonal relationship when working with your groupmate(s)?	3.58 (0.758)	3.72 (0.634)
29. Do(es) your groupmate(s) help you make sense of what you are learning with IT?	2.81* (0.492)	2.84* (0.369)
30. Are you co-learning or competing with your groupmate(s) when working in an IT environment?	2.92* (0.272)	2.94* (0.246)
31. Are your groupmate(s) co-learning or competing with you when working in an IT environment?	2.85* (0.368)	2.91* (0.296)
32. Are the communications between you and your groupmate(s) beneficial or unbeneficial to your learning process?	3.77 (0.765)	4.13 (0.492)
39. Do you have much or little interaction with your groupmate(s) about the learning tasks?	2.46* (0.582)	2.50* (0.568)
40. Do you have a harmony or a conflict between you and your groupmate(s) when learning with IT?	2.69* (0.471)	2.91* (0.296)
41. Do(es) your groupmate(s) make the learning process more fun or more threatening?	3.88 (0.766)	3.75 (0.762)

Notes. Qs 16, 17, 22, 23, 28, 32, and 41 used a 5-point Likert scale: 1 (very negative), 2 (negative), 3 (neutral), 4 (positive), and 5 (very positive) response categories.

*Qs 19, 20, 29, 30, 31, 39, and 40 used a 3-point Likert scale: 1 (disagree), 2 (neutral), and 3 (agree) for response categories.

Figure in the parenthesis indicates the standard deviation of students' response given to each corresponding question.

Most students shared considerable knowledge with their groupmate(s) and vice versa (i.e., x_{22} and x_{23}). Four follow-up questions, Qs 24-27 probed into the type of knowledge students did and did not want to share, and the type of knowledge they thought their groupmate(s) did and did not want to share with them. Many students shared conceptual, procedural, and/or technical knowledge or knowledge around communication

skills associated with reporting writing (x_{24}). They said there was nothing they did not want to share with their groupmate(s) (x_{25}). Their groupmate(s) shared similar types of knowledge with them (x_{26}) and had nothing not to share with them (x_{27}). These six responses, x_{22}-x_{27} sum up reciprocal interactions in terms of students sharing knowledge generously with each other.

Many students thought that an IT environment helped them foster better interpersonal relationships (x_{28}). Some students gave a neutral response. Most students thought that groupmate(s) helped them make sense of what they were learning and a few students gave a neutral response (x_{29}). Almost all students said they co-learnt rather than competed with their groupmate(s) and many students thought their groupmate(s) co-learnt with them. No students reported that they competed with their groupmate(s) or their groupmate(s) competed with them (x_{30} and x_{31}). These survey responses, x_{28}-x_{31} show a positive working relationship within groups and a collaborative interaction.

Most students believed that communications with their groupmate(s were beneficial to their learning process (x_{32}) under the following cirumstances (x_{33}). Communication was an effective means of sharing personal views, enhancing interpersonal relationships, resolving conflicting views, clarifying misconceptions and/or misunderstandings, stimulating thinking, setting goals and formulating strategies in order to accomplish learning tasks more efficiently. Their misconceptions or misunderstandings were clarified through communication to achieve better understanding (x_{33}), thus being benefical to their learning process. On the other hand, a few students had a negative response when dealing with less able groupmate(s) who were unable to offer learning assistance (x_{34}).

Many students said they had communicated satisfactorily and found no need for improvement. Those students who were inclined to improve the communications between their groupmate(s) thought they should seek a mutual interesting topic about sports skills, music billboard, or celebrity lifestyle, etc. to initiate a discussion, following a frank exchange of personal views (x_{35}). The responses, x_{32}-x_{35} display the communication is sort of verbal interaction for maintaining social relationships within groups and further for addressing cognitive needs.

Regarding students' involvement in group learning, they played active roles in formulation of statistical problems based on data context; statistical calculations and graphing, and Excel programming to solve the problems; and reasoning about statistical results (x_{36}). Both problem formulation and statistical reasoning acquire higher-order thinking whereras statistical calculations and graphing as well as Excel programming are relatively straightfoward. Almost all students reported positively about their contributions to peer learning (x_{37}) such as those which aroused interest and built teamwork spirit, focused discussion on tasks, identified key points in lecture notes, and gave constructive ideas. Interestingly, they firstly gave their responses relevant to social contributions in building mutual trust and confidence and then moved on to make cognitive contributions to constructing knowledge. Students reporting learning tasks that were equally shared within groups (x_{38}) were cognitive in nature as similar to those responses in x_{36}. Interestingly, they initally gave their responses, x_{36}-x_{38} relevant to social contributions in building mutual trust and confidence and then moved on to make cognitive contributions to constructing knowledge. The order of contribution (i.e., from social to cognitive) they

gave is rational, as students would find a social environment in which they feel secure prior to learning.

Half of the students reported having much interaction, nearly as many gave a neutral response (x_{39}). The great majority found this partnership harmonious while some students gave a neutral response but none found this partnership conflictive (x_{40}). Most students said their groupmate(s) made learning more fun (x_{41}) and some students gave neutral responses and none gave negative responses. It seems that students responded positively to the learning atmosphere created by their groupmate(s). Students had positive feelings of learning with groupmate(s) mostly related to development of rapport, good interpersonal relationships and a pleasant learning climate (x_{42}). Students' responses like these, x_{39}-x_{42} entail the social relationships among students within groups.

All the mean survey scores given by female students in Table 2 except x_{41} (i.e., x_{16}, x_{17}, x_{19}, x_{20}, x_{22}, x_{23}, x_{29}-x_{32}, and x_{40}) are higher than their male counterparts, thus speculating that female students were more inclined to have collaborative, productive, and reciprocal interactions as well as harmonious and interpersonal relationships when learning with peers. Yet, this speculation would not become sustainable at the 5% level of statistical significance.

Most students said they needed the teacher's intervention (x_{43}). Many students found the timing of teacher's intervention appropriate and a few students gave neutral responses respectively (x_{44}). Almost all students found the teacher's intervention beneficial to their learning process (x_{45}) because the teacher maintained an active dialogue with students to encourage their participation; monitored their learning process and regulated their learning (x_{46}). None gave a negative response, while a few students were neutral (x_{45}) because they felt uncomfortable or embarrassed about their mistakes being pointed out. The timing and quality responsiveness to address students' concerns relate to teacher sensitivity and are instrumental in engaging students in learning (Pianta, Hamre, & Allen, 2012; Furrer, Skinner, & Pitzer, 2014).

The quality of student-teacher interactions is further evident from two similar responses, x_{47} and x_{48}; the students reported the interactions were about providing instructional scaffolding; monitoring their learning progress; maintaining group cohesiveness or mediating group issues; and fostering a positive climate for collaborative learning in line with generating feelings of confidence, competence, and control. A teacher's dedication has the potential to positively influence motivation (Mahatmya, Lohman, Matjasko, & Farb, 2012) because the teacher provided both social and instructional supports to alleviate their stress when coping with learning problems. However, a few students held negative views about their teacher because direct insructions were not given or their queries were not directly answered by the teacher.

Students were asked three scenario questions to examine their preferences for interaction with: i) the teacher versus IT, ii) groupmate(s) versus IT, and iii) groupmate(s) versus teacher. Many students preferred learning with a teacher to IT (x_{49}). Similarly, many students preferred learning with groupmate(s) to IT (x_{50}). Students were evenly divided in choosing to learn with a groupmate(s) or the teacher, and about half of students gave a neutral response (x_{51}). Summing up, students prefered interaction with humans to IT. These three responses together with x_{11} and x_{13} hold an implict assumption about social

interactions among students or between a teacher which follows Vygotsky's socio-cultural theories (1978) arguing that learning is a social process through verbal and intellectual exchanges. This futher conjectures that there are links between students' motivation to learn (x_1) and such social interactions.

Table 3. Mean and standard deviation of 27 males and 31 female students' responses given to the close-ended questions, 43-45 and 49-52

Question	Male	Female
43. Do you need or not need teacher's intervention in your learning process?	2.69* (0.471)	2.88* (0.336)
44. Do you find the timing of the teacher's intervention in your learning process appropriate or inappropriate?	3.65 (0.977)	3.78 (0.553)
45. Do you find the teacher's intervention beneficial or unbeneficial to your learning process?	4.00 (0.490)	4.09 (0.390)
49. Would you like to learn with a teacher or IT?	2.31* (0.471)	2.47* (0.567)
50. Would you like to learn with your groupmate(s) or IT?	2.42* (0.578)	2.66* (0.483)
51. Would you like to learn with groupmate(s) or teacher?	2.12* (0.588)	1.97* (0.740)
52. Do you have a better or a worse learning progress when working with your teacher in an IT environment?	3.92 (0.628)	4.03 (0.400)

Notes. *Questions 43 and 49-51 used a 3-point Likert scale: 1 (disagree), 2 (neutral), and 3 (agree) for response categories.
Qs 45 and 52 used a a 5-point Likert scale: 1 (very negative), 2 (negative), 3 (neutral), 4 (positive), and 5 (very positive) response categories.
Figure in the parenthesis indicates the standard deviation of students' response given to each corresponding question.

Students appreciated that the teacher was attuned and responsive to their questions and also created and maintained a positive and warm classroom atmosphere conducive to learning, so that they made better learning progress when working with their teacher (x_{52} and x_{53}). The responsive interactions as well as classroom envrionment are essential for students' motivation (Skinner & Pitzer, 2012; Mahatmya, Lohman, Matjasko, & Farb, 2012) but a few responses pointed out that knowledge building through the teacher's scaffolding assistance in making students clear how facts or concepts were interconnected, organized and conditioned upon one and another slowed down their learning progress. They experienced caring and supportive relationships with the teacher and appreciated his role of improving communication with groupmate(s) and fostering their interpersonal relationships in ways that encouraged intellectual and verbal exchanges, thus leading to achievement of mutual benefit from learning.

Most students made better learning progress when working with their teacher in an IT environment, and a few students gave a neutral response, but no students gave a negative response (x_{52}). There many commonalities between two students' responses, i.e., x_{47} and x_{53} (the reasons they gave for better learning progress with the teacher) although these

responses given by students to two different questions. Negative reasons included a lack of confidence, or lack of direction in exploring problem solving approaches suggested by the teacher, and communication with the teacher slowing down progress. Summing up, the students' responses, x_{43}-x_{53} are much about the way students interacted with the teacher.

The mean survey scores of x_{43}, x_{44}, x_{45}, x_{49}, x_{50}, and x_{52} given by female students are higher than their male counterparts, whereas male mean survey score of x_{51} is higher than that of the female mean survey score. To summarize, teacher's intervention is a concern of female students; male concern is that they would made better learning progress when working with teacher. However, no difference between male and female survey scores is statistically significant at the 5%.

Statistical analysis of students' responses proceed further using a correlation approach; correlations statistically significant at the 5% level either in male or female students are reported, together with a comparision between male and female correlations (see Table 4). With regard to male students, x_1 positively correlates with x_9, x_{10}, x_{17}, x_{22}, x_{23}, and x_{28} with correlation cofficients ranging from 0.458 to 0.681. There are relations between student motivation to learning (x_1) and IT as digital learning tools helping students best focus on their learning tasks (x_9) and better learning progress when working alone (x_{10}) probably owing to these associated responses, x_{11}-x_{15} they gave to the open-ended questions, Qs 11-15. They considered that IT enabled them to have a more intutive feel for statistical concepts being studied through animation and visualization tools; to develop an ability to apply statistical methods, analyze statistical data, and evaluate statistical results by using computational and graphing tools; and to use social media as a platform for learning. Students' confidence would be enhanced because the pace and sequences of learning were under their autonomy and control, thereby taking a proactive role in learning (x_{11}). They did not give any negative responses (x_{12}) because they did not have less learning progress when learning with IT. Students reported coping practices with learning problems outside the classroom through finding reference materials from libraries or academic support from their peers via social media sites and platforms (x_{13}). The interactions with peers endsores a positive effect on students' engagement in the classroom (Mahatmya, Lohman, Matjasko, & Farb, 2012). They learnt how to examine data characteristics (x_{14}). They felt good about using the IT-based learning materials from which they learnt how to fit data to regression models. They worked together and developed a good rapport when modelling data (x_{15}). IT is regarded as a physical tool for learning enahncement, but more importantly, IT is a cultural tool for supporting social process of learning within which students' positive feelings, learning autonomy, confidence, and social interactions lead to learning motivation.

As seen in Table 4, male academic motivation (x_1) shows direct links with x_{17}, x_{22}, x_{23}, and x_{28}; males were more likely than females to express their concerns about working relationships with peers (x_{17}), social reciprocity (x_{22} and x_{23}), and interpersonal relationships (x_{28}). The positive working relationships (x_{17}) correlated with social reciprocity (x_{22} and x_{23} – generosity in sharing knowledge with groupmate(s)). Such productive interaction resulted from group cohesiveness and good social relationships with which students developed mutual trust and mutual assistance. The reciprocity conducive to building interpersonal relationships (x_{28}) agrees with Wentzel (2012) and is rational

because the right to be treated fairly and equally and with respect is a common expectation. Their relationship with other students was also an issue male students attempted to address. After fulfilling the social condition or needs, the students would be motivated to learn, i.e., x_1 (student motivation) with x_{17} (working with groupmate(s)), x_1 with both x_{22} and x_{23} (social reciprocity), and x_1 with x_{28} (interpersonal relationships) displays a positive relation between the interactions and student engagement, albeit may not be direct because the interactions fostering their positive perceptions of competence would play the mediating or promoting role in student engagement (Furrer, Skinner, & Pitzer, 2014).

Table 4. Correlation patterns of x_1 versus x_2, x_5, x_9, x_{10}, x_{16}, x_{17}, x_{22}, x_{23}, x_{28}, x_{32}, x_{41}, x_{44}, x_{44}, and x_{52} between male and female students

	x_2	x_5	x_9	x_{10}	x_{16}
Male	0.372	0.164	0.508**	0.509**	0.268
Female	-0.133	0.069	0.167	0.093	0.306

	x_{17}	x_{22}	x_{23}	x_{28}	x_{32}
Male	0.641**	0.681**	0.662**	0.458*	0.373
Female	0.059	0.303	0.244	0.080	0.296

	x_{41}	x_{44}	x_{45}	x_{52}
Male	0.286	0.051	0.001	0.232
Female	0.382*	0.330	0.205	0.164

Note. *p<0.05, **p<0.01.

On the other hand, the female significant correlation presents a probable link between x_1 (student motivation) and x_{41} (peers making learning fun), implying that somewhat of affective engagement. Female students were more concerned about positive emotional responses to learning, whereas male students' responses, x_9, x_{10}, x_{17}, x_{22}, x_{23}, and x_{28} characterize both cognitive and affective domains for developing students' interest, perceiving as a positive orientation toward learning (Ainley, 2012).

The interpretation of the response, x_{17} (students had better learning progress when working with their groupmate(s)) elicited by situations perceived positive draws our attention to studying which of these close-ended responses, x_{16}, x_{22}, x_{23}, x_{28}, x_{32}, x_{41}, x_{44}, x_{45}, and x_{52} are related to x_{17}. Both male and female correlations evident in Table 5 show that a significant positive relationship between x_{17} (better learning progress when working with groupmate(s) in an IT environment) and x_{16} (IT helpful when working with groupmate(s)) may implicitly manifest something similar to x_{11}, i.e., learning would become more concrete upon watching how statistical concepts are interconnected when interacting with the digital learning tools. They used digital tools to alleviate much of the computational and graphing drudgery, thereby concentrating on thinking and reasoning associated with problem resolution. Either x_{16} or x_{17} is construed as a positive working relationship. They shared in the decision-making process in formulation or solution of problems. Both responses, working with groupmate(s) and knowledge sharing are at the core of better learning progress. The reasons the students held for having better learning progress (x_{18}) were concerned with intellectual exchanges like getting help from a more able groupmate, exchanging views for co-construction of knowledge, clarifying or

correcting misconceptions, formulating goals and strategies for problem solving, accessing more or new ideas, as well as resolving conflicting views. These three responses, x_{16}, x_{17}, (i.e., a positive relationship) and x_{18} (i.e., better learning progress) were in accord with the response, x_{19} (collaborative interactions). In addition, the second correlation between x_{17} and x_{23} (groupmate(s) reciporated knowledge) in both male and female students has an implication that they achieved better learning progress when working with groupmate(s) given that they treated each other fairly.

Table 5. Correlation patterns of x_{17} versus x_{16}, x_{22}, x_{23}, x_{28}, x_{32}, x_{41}, x_{44} , x_{45}, and x_{52} between male and female students

	x_{16}	x_{22}	x_{23}	x_{28}	x_{32}
Male	0.630**	0.739**	0.671**	0.614**	0.303
Female	0.397*	0.252	0.353*	0.323	0.467**

	x_{41}	x_{44}	x_{45}	x_{52}
Male	0.31	0.033	0.001	0.071
Female	0.382*	-0.015	0.273	-0.184

Note. $^{*}p<0.05$, $^{**}p<0.01$.

The only male correlations in Table 5 are statistically significant, i.e., x_{17} correlates with x_{22} (knowledge sharing within a peer group) or x_{28} (IT helping foster a better interpersonal relationships). Male students more concerned with social reciprocity than their female counterparts, i.e., a mutual contribution to achieving a common goal of knowledge construction or task accomplishment on an equal basis. Evidently, both x_{22} and x_{23} are postively correlated with $r=0.686$, $p<0.01$ and show symmetrical relations in social reciprocity conducive to building interpersonal relationships (Wentzel, 2012), which in turn motivates students to learn. Specifically, conceptual, tactical, analytic, as well as technical knowledge and communication skills were the types of knowledge they shared when answering both open-ended questions 24 and 26. Technical knowledge refers to statistical graphing, statistical methods as well as Excel syntax and programming. They demanded communication skills for presenting regression ideas and justifying results that would acquire thinking and reasoning.

A students' positive interpersonal relationship is efficacious learning (Laible & Thompson, 2007) but it was found that discrepant correlations, x_{17} (having better learning progress) and x_{28} (IT helping foster a better interpersonal relationship) between male and female students existed. More importantly, the significant correlation ($r=0.614$, $p<0.01$) indicates that male students are more inclined to build interpersonal relationships than their female counterparts. Students thought that peers helped them make sense of what they were learning (x_{29}) and co-learnt with each other (x_{30} and x_{31}). Co-learning here is characterized by students being supportive of one another or their academic and social goals being endorsed when collaborating on projects as well as laboratory exercises. All the responses given by students, x_{28}-x_{31} illustrate a positive working relationship between the students and peers, thereby engaging students with learning tasks when experiencing positive and collaborative working relationships and being able to make sense of their learning. This finding is grounded on achievement motivation (Nelson & DeBacker, 2008)

arising from productive interaction within a responsive social context (Mahatmya, Lohman, Matjasko, & Farb, 2012).

On the other hand, it is more probable females than males to illustrate a link between x_{17} (better learning progress when working with peers) and x_{32} (communication beneficial to the learning process), with $r=0.467$, $p<0.01$. Both x_{17} and x_{32} compose the theme about engaging students with learning tasks and sustaining students' interest in learning. Communication is not merely for verbal exchanges between students, but also for building interpersonal relationships if its content is around expressing their views more explicitly and/or mediating their conflicting views, thus ensuing to promote a sense of social being within groups (x_{33}). The correlations between x_{17} and x_{16} as well as between x_{17} and x_{32}, which are relatively high and statistically significant probably manifest that communication within groups of students is beneficial to their learning process and peers making the learning process more fun has a positive relationship as achieving a social interaction goal. These responses are within a social context; peers played a supportive role in learning in conjunction with collaborative interaction and communication.

In general, most students held positive responses, x_{16}, x_{17}, x_{22}, x_{23}, and x_{32} which related to cognitive issues. Interstingly, female students inclined to peer collaboration was conceived by the students as the factors relating to perceived benefit, where "benefit" was expressed as learning progress, i.e., x_{17} and the factors relating to student interaction and talk (expressed as communication, i.e., x_{32}). Learning is social in nature and usually demands talk and interaction with peers or a teacher (Vygotsky, 1978), even undoubtedly, in the situation which learning takes place in an IT environment (Goos, 2009). To maintain students' interest in learning, it is probably about communication eliciting classroom interaction and talk, so following to identify which of the responses among x_{32}-x_{53} are related to communication (x_{32}) is a matter of current interest.

Notably, x_{32} (peer communication beneficial to a learning process) positively correlates with x_{45} (teacher's intervention benefical to a learning process); the positive correlation is found in female responses ($r=0.441$, $p<0.05$) but not in male responses. The correlational evidence consistent with Wentzel (2012) in relation to a learning situation suggests that female students would demand the teacher to intervene at the time they were stuck in a learning process or they confronted peers with conflicting views. During the teacher's intervention, the teacher would mediate their conversations to resolve the disputes so as to willingly make a sustained effort to grasp statistical concepts or manage learning tasks.

VI. LIMITATIONS

There are a number of issues worth noting here. First, there is a post hoc fallacy, i.e., the probable relationships between two responses may only arise in this set of survey data. Second, the findings here reported inductive in nature with correlational evidence achieving at 5% of Type II error, i.e., making a false claim. Third, significant correlations present probable links between two variables but cannot show any causation effect, i.e., a

change in a variable may not directly affect another variable. Fourth, there is spurious association among the survey data, i.e., an association does not arise from the relationship between two variables but the third variable is causing the two variables to be associated. Fifth, the findings deduced students' responses given to the open-ended questions might be over-interpreted or under-interpreted. Further, the interpretations of the above correlational evidence based on the theories of educational psychology might be overstated or understated.

VII. CONCLUSION

The present study concerning student motivation shows the links between the theoretical basis and empirical findings. The overall findings showed socio-cultural contexts are important for motivating students to learn. Both male and female students would achieve a better learning progress when working with groupmate(s) given that they worked collaboratively and treated each other fairly.

More interestingly, there are different motivational orientations between male and female students within the context of classroom learning. There is a positive relationship between female academic motivation (x_1) and an experience of peers making learning fun (x_{41}). This is substantiated from Skinner & Pitzer (2012) who argued that students became more involved or participative in classroom activities when having fun or enjoyment in learning. Similarly, x_{32} (peer communication beneficial to a learning process) is probably associated with x_{17} (better learning progress when working with peers) and x_{45} (teacher's intervention beneficial to a learning process). Female students' were more inclined than their male counterparts to comment highly on the significance of the teacher's intervention in their learning process and the merit of being secure and productive when working with peers in relation to peer communication. The teacher's intervention would improve peer communication in order to resolve divergent or conflicting views when group debates had reached an impasse, thus achieving learning progress. Peer communication here is facilitative of verbal interactions that would foster interpersonal relationships so as to collaborate on learning tasks.

Digital learning tools (x_9 and x_{10}), a positive working relationship (x_{17}), social reciprocity (x_{22} and x_{23}), and interpersonal relationships (x_{28}) have a certain influence on male academic motivation (x_1). After taking a deeper look, social reciprocity and interpersonal relationships that would achieve mutual benefit from learning centered around a positive working relationship.

The implications for statistics classroom teaching and learning are thus deduced. A teacher should establish a community of collaborative inquiry in the classroom where he/she initiates and moderates discussions. The teacher should encourage peer learning during which he/she takes up the scaffolding, facilitating, and managing roles. The learning tasks demanding problem analysis and formulation, as well as interpretation and reporting of statistical findings should be designed such that students would form small groups to collaborate on learning tasks through verbal exchanges and social interactions.

The teacher ought to monitor group learning regularly to ensure successful peer collaboration which is crucial to motivating students to learn for two reasons. First, female students demand the teacher's intervention in order to offer scaffolding assistance or mediate in group disputes. Second, male students would seek the teacher's assistance when confronting the issue of reciprocal relationship or division of labour.

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