

Gender Stereotype and Motivation in Learning Statistics among Tertiary Students in Ghana

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ABSTRACT

The present study has presented the effect of gender on tertiary students' motivation, feeling of competence, relatedness and autonomy. The survey consists of cohort samples of 251 males and 78 females from tertiary institutions in Ghana. Non-parametric chi-square test of independence was used to assess the effect of gender on students' motivation in learning statistics. The study results have indicated that students' gender have no influence on the self-determination of student to learn statistics. The paper further revealed that students' gender has no significant influence on the tertiary students' need for competence, relatedness and autonomy. This study has established the fact that the tertiary students' need for autonomy, relatedness and competence in learning statistics is independent of the students' gender.

KEYWORDS

Relatedness, students' motivation, competence, Ghana, statistics

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Introduction

The field of mathematics education requires much more work on students' motivation for learning mathematics and statistics. Studies on both intrinsic and extrinsic characteristics of motivation in mathematics require attention and extension of literature in the field of mathematics education (Hannula, 2006; Pantziara & Philippou, 2014). There has been a number of mathematics educators who have contributed to the on-going discussion of students motivation in learning mathematics but these discussion have been situated under terms of motivational beliefs and interest (Hannula, 2006). The quest by mathematics educators to investigate in the influence of motivation on the

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learning outcomes has led to the observation that, student's motivation and resistance to learn mathematics as phenomena that is interrelated (Wang, 2012). Although there has been attempts by many authors to investigate the construct motivation in mathematics education, enough has not been done with the reason that many authors in the field of mathematics education adopts the approach of measuring predefined aspects of motivation without the interest of describing what motivation is. Motivation has been defined by many authors as the drive that enables us accomplishes our task, but other theories posit that motivation is a structure being described by needs and goals.

The problem of gender stereotyping in student motivation for learning mathematics and statistics requires in-depth investigation. The problem of identifying the influence of gender on student motivation as well as students' needs for competence, relatedness and autonomy require further investigation to make its relevant contribution towards the expansion of literature in motivation in mathematics education. The sections below presents the objectives, research question and research hypothesis.

Motivation

The studies in motivation have seen multiplicity of definitions from different viewpoints of literature on motivation and achievement theory. These studies adopt and concentrate on the definition presented by (Hannula, 2004) as follows. Motivation is a potential to direct behavior that is built into the system that controls emotion which manifests through cognition, emotion or behavior.

The definition of motivation suggests that for students to be motivated, they must be seen to have cognition of what is been taught, should have some level of emotional attachment to the object of investigation, to this end the subject of study. The definition further emphasizes that motivation requires behavioral commitment towards the object under study. For motivation to materialize in the students learning, it is necessary to take cognizance of some psychological needs. The need in educational research refers to specific instances of which the potential to direct behavior. The psychological needs to be able to motivate and further direct behavior include the need for competence, relatedness and autonomy. Studies in intrinsic motivation for specific subjects including mathematics and language for an elementary and junior high school posits that, there is positive correlation between intrinsic motivation and academic performance (Gottfried, Fleming, & Gottfried, 1994; Adele Eskeles Gottfried, Marcoulides, Gottfried, & Oliver, 2013). Further studies on motivational variables have shown to predict affective outcomes. For example, these studies found students with strong self-regulation and motivation enjoy academic work, showed positive emotions and satisfaction in classroom for greater achievement. (Harackiewicz, Barron, Carter, Lehto, & Elliot, 1997; Honicke & Broadbent, 2016; Stevens, Olivarez, Lan, & Tallent-Runnels, 2004)

Need for competence

The students' needs for competence refers to the ability of the student to understand how to attain various outcomes and being efficacious in performing requisite actions. (Deci, Vallerand, Pelletier, & Ryan, 1991). This further indicates that, competence may also be associated with one's feeling of being effective in an on-going interaction with social environment but more connected

to the classroom from learning perspective. The students feeling of competent will also imply that students experience the opportunities to exercise and express their capabilities. The support for competence is crucial in the developmental pathway of students; this can be done through students' engagement in optimal challenges and provision of performance feedback by subject specific teachers.

Need for relatedness

Relatedness refers to the students' ability to develop secure and satisfying connection with others in their social environment (Deci et al., 1991). This will further suggest that relatedness also refers to the students' feeling of connected to others, caring for and being cared for by others, having the sense of belongingness both with other individuals and with one's community. The students feeling of relatedness is not limited to only classroom setting but rather brings together all agents of students' motivation. The interpersonal involvement of parents and teachers as well as peers will enhance motivation especially when these agents of students motivation are supportive of students autonomy (Ryan & Lynch, 1989).

Need for autonomy

Autonomy refers to students' ability to self-initiate a process or self-regulate their own activity (Deci et al., 1991). The need for autonomy by students has been a pre-requisite for student motivation in classroom engagement. Students feeling of motivation increases when some level of autonomy exists for students in their learning process. This implies that students' motivation declines as the students feeling of autonomy decreases, hence the positive correlation between the students' feeling of autonomy and motivation to learning a particular subject (Bargh, Gollwitzer, & Oettingen, 2010; Deci & Ryan, 2000; Krapp, 2005; Reeve & Lee, 2014). All these studies leave the gap of gender influence on the students need for autonomy and the extent to which it affects students' self-determination in learning mathematics.

Gender, Interest and motivation

The effect of gender on students' interest development process has been investigated by many authors in the field of mathematics education (Jabor, Machtmes, Buntat & Kungu, 2011). These investigations have seen consistency and finding to enrich literature in mathematics education. The effect of gender on students' mathematics interest is well established by many authors by documenting that boys are more interested in mathematics than girls (Eccles et al., 1983; Fredricks & Eccles, 2002; Frenzel, Goetz, Pekrun & Watt, 2010). There are many who believe the fact that mathematics is still a male dominated subject and females shy away from mathematics (Van De Gaer, Pustjens, Van Damme & De Munter, 2008) although some authors believe the trend is changing (Arthur, Aseidu-Addo, & Annan, 2015; Jabor et al., 2011). Their finding further explains that, though male achievement in mathematics is higher as compared to their female counterpart it is not explainable by the gender difference but some other factors contribute to these performance disparities. The story is however changing and female interest in mathematics seem to be gaining strength (Arthur et al., 2015; Frenzel et al., 2010). The effect of gender on student interest in mathematic has receive some mixed

feeling (Brown & Kanyongo, 2010; Skaalvik & Skaalvik, 2004). There are studies which see no significant difference between the gender gap in mathematics (Lindberg, Hyde, Petersen, & Linn, 2010). Further to this finding was a study by (Lubienski, Robinson, Crane, & Ganley, 2013; Van De Gaer et al., 2008) which strengthens the argument that there are mixed feelings about gender influence in student achievement in mathematics. The issue of motivation and gender is of practical relevance to the students' self-determination towards solving mathematical problems. There is the need to motivate students and hold their interest in mathematics to help tap in full their talents and potential. (Frenzel et al., 2010; Ijaz, 1975). Student motivation and interest in mathematics is a necessary condition to help build students' expertise in mathematics. These expertises in mathematics are necessary and it serves as an important tool for building strong and a better society.

Research objectives

The study sought to generally investigate the effect of gender on tertiary students' self-determination for learning statistics.

The study presented the following specific objectives research objectives:

1. To investigate the extent to which students' gender influence their motivation for learning statistics
2. To examine the effect of students' gender on their feeling of competence in learning statistics
3. To determine the extent to which students' gender affect students' feeling of autonomy when learning statistics
4. To scrutinize the effect of students' gender on the students' feeling of relatedness during statistics lessons.

Research questions

The study deduced the following research questions from the specific research objectives.

1. To what extent does students' gender affect their motivation for learning statistics?
2. Does this survey give any reason to suggest that students' gender affect their feeling of competence when learning statistics?
3. To what extent is students' feeling of autonomy in learning statistics influenced by students' gender?
4. To what extent is a student's feeling of relatedness influenced by gender of the students?

Research Hypothesis

The following hypotheses were tested to help investigate the research objectives and further respond to the research questions stated.

1. H1: Tertiary students' motivation for learning statistics is independent of students' gender.
2. H2: Tertiary students' feeling of competence in learning statistics is independent of students' gender.

3. H3: Tertiary students' feeling of autonomy when learning statistics is independent of students' gender

4. H4: Tertiary students' feeling of relatedness during statistics lessons is independent on students' gender.

Research Methodology

The present study used self-constructed structured questionnaires designed to investigate the effect of gender on tertiary students' self-determination in learning statistics. The study is purely quantitative research seeking to explore the influence of gender on students' self-determination as well as explain the effect of gender on students' self-determination. The study used simple random sampling techniques to sample 400 students from a population of about 3,500. The study used two population groups; one from Kwame Nkrumah University of Science and Technology (KNUST)-Kumasi consisting of mathematics students while the other group from University of Education, Winneba-Kumasi campus. In all, the study finally had 352 participants who answered questionnaires were fit for purposes of analysis.

The present study drew participants from students who took statistics and probability as borrowed courses during the second semester of 2016/2017 academic year in the University of Education Winneba, Kumasi campus as well as Mathematics students from KNUST during the second semester of 2016/2017 academic year. The students who gave their consent to participate in the study were interviewed personally using structured questionnaires.

The study used items with dichotomous responses of 'YES' and 'NO' where students were made to respond to questions as they applied to them. The study asked questions such as: do you feel motivated in any way to study statistics on your own; do you feel competent when learning or working on statistical problems; do you feel independent when learning statistics?; Do you have any sense of belonging or relatedness doing statistics lessons?.

The study deployed chi-square test of independence to analyse the survey data collected using SPSS version 16. The tables were designed using Microsoft Word by exporting the results from the SPSS results editor.

Results

The study investigated the influence of gender on students' motivation in learning statistics among tertiary students in Ghana. The study results show 254 (78%) of the total respondents were males while others were females as indicated in Table 1. The study samples had 107 (32.9%) of the respondents from the Information Technology Department and 147 (45.2%) from Mathematics and the remaining samples were drawn from fashion and catering departments. The study had a majority of its samples from the age categories of 20-23 (48.9%), 24-26 (26.2%) with the remaining samples within the other age categories as shown in Table 1.

Table 1. Demographic characteristics of respondents

Categories	Gender of respondents		
	Frequency	Percent	Valid Percent

Male	254	78.2	78.2
Female	71	21.8	21.8
Total	325	100	100
Course of study in the university			
Categories	Frequency	Percent	Valid Percent
Information Technology	107	32.9	32.9
Mathematics	147	45.2	45.2
Catering	47	14.5	14.5
Fashion	24	7.4	7.4
Total	325	100	100
Age category of the respondent			
Categories	Frequency	Percent	Valid Percent
20-23	159	48.9	48.9
24-26	85	26.2	26.2
27-30	39	12	12
31-35	31	9.5	9.5
Above 35	11	3.4	3.4
Total	325	100	100

The study investigated the effect of gender on students' motivation for learning statistics in the tertiary schools in Ghana. The result reveals that 187 male students are self-motivated to study statistics on their own while 67 of the male students had no self-motivation to learn statistics on their own. The study reveals further, for female students who were self-motivated to study statistics were 49 while 22 female were had no motivation for studying statistics. The study sought further to explain the effect of gender on tertiary students' motivation for learning statistics. The result from the chi-square test ($\chi^2 = 0.593$, $p > 0.05$) of independence among between the two variables of interest shows no significance indicating that; tertiary students' self-motivation for learning statistics is independent of the gender of the students as indicated in Table 2.

Table 2. Effect of gender on students motivation to study statistics

		MOTIVATION TO STUDY STATISTICS		Total	Pearson Chi-Square	P-Value
		YES	NO			
GENDER	MALE	187	67	254	0.593	0.441
	FEMALE	49	22	71		
	TOTAL	236	89	325		

Table 3. Effect of gender on students' feeling of competence in learning statistics

		STUDENTS FEELING OF COMPETENCE		Total	Pearson Chi-Square	P-Value
		YES	NO			
					0.424	0.515

GENDER	MALE	161	93	254
	FEMALE	42	29	71
	TOTAL	203	122	325

Table 4. Effect of gender on students' feeling of autonomy

GENDER		STUDENTS FEELING OF AUTONOMY		Total	Pearson Chi-Square	P-Value
		YES	NO			
MALE		151	103	254	3.025	0.055
FEMALE		34	37	71		
TOTAL		185	140	325		

The study further investigated the influence of gender on tertiary students feeling of competence in learning statistics. The results reveal that, 161 male students feel competent in learning statistics; however, the study found 93 male students feel incompetent in learning statistics. The result of the study reveals further that, 42 female students feels competent in learning statistics while 29 female respondents felt incompetent in learning statistics. To further investigate the effect of gender on tertiary students feeling of competence in learning statistics, the chi-square test ($\chi^2 = 0.424$, $p > 0.05$) of independence was adopted. The result from the study reveals that, tertiary students feeling of competence in learning statistics is independent on the student's gender.

The study additionally examined the influence of gender on the tertiary students feeling of autonomy when learning statistics. The results reveal that 151 male students feel independent when learning statistics; however, the study found 103 male students feel dependent on friend when learning statistics. The result of the study reveals further that, 34 female students feels independent when learning statistics, however, 37 female respondents felt dependent on their colleagues when learning statistics. To further investigate the effect of gender on tertiary students feeling of autonomy when learning statistics, the chi-square test ($\chi^2 = 3.025$, $p > 0.05$) of independence was adopted. The result from the study reveals that tertiary students feeling of autonomy when learning statistics is independent on the student's gender.

The study investigated the effect of gender on students' feeling of relatedness during statistics lessons in tertiary schools in Ghana. The result reveals that 191 male students' feels related during statistics lessons although 63 male respondents does not feel related during statistics lessons. In addition to the above findings, 53 female students felt related during statistics lessons however, the study further found 18 female who felt unrelated during statistics lessons as shown in Table 5.

Table 5. Effect of gender on tertiary students' feeling of relatedness

GENDER		STUDENTS FEELING OF RELATEDNESS		Total	Pearson Chi-Square	P-Value
		YES	NO			
MALE		191	63	254	0.009	0.518
FEMALE		53	18	71		

TOTAL	244	81	325
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The study sought further to explain the effect of gender on the tertiary students' feeling of relatedness during statistics lessons. The result from the chi-square test ($\chi^2 = 0.009$, $p > 0.518$) of independence among between the two variables of interest shows no significance indicating that; tertiary students' feeling of relatedness during statistics lessons is independent on the gender of the students as indicated in Table 5.

Discussion

Self-determination variables have been empirically verified as well their effect on the students' motivation. The student self-determination to study will although lead to desired outcomes, it is however not the case that, students need of competence, relatedness and autonomy will be influence by the students gender. This argument may be true (Kenrick, Neuberg, Griskevicius, Becker, & Schaller, 2010) since students from both genders require motivation being intrinsic or extrinsic motivation. These basic needs are inherent in human life as students effectively make use of these inherent characteristics will enhance their self-determination (E. L. Deci, 1992; R. Ryan & Deci, 2000). The study further expresses agreement with the self-determination theory that, conditions for motivation, performance and development of mathematical skills will be maximized with social context that provides opportunity to satisfy students' needs and these needs are not gender dependent. Though the students' need for autonomy is independent on gender this study is inconsistent with the study by (Van De Gaer et al., 2008) however this result is consistent with (Arthur et al., 2015; Jabor et al., 2011), it is however worth noting that, involvement of students' from opposite sex at the early part of their school life is found to be somewhat difficult since opposite sex naturally repel at their early stages in life. The study however presents different views for the students in the tertiary institutions since students from tertiary schools are mature and developed enough to independently decide on what can help them succeed in their academic pursuit.

Conclusions, Implication and Recommendations

The study concluded on the objectives stated as follows:

For the investigation into the extent to which students' gender influence their motivation for learning statistics, the study concluded that, students' gender does not influence their motivation for learning statistics. The quest for the researchers to examine the effect of students' gender on their feeling of competence in learning statistics, the study concluded that, students' feeling of competence in learning statistics is independent of the gender of the student. The study further concluded on the extent to which students' gender affect students feeling of autonomy when learning statistics: students' gender does not affect their feeling of autonomy in learning statistics. The study finally concluded for study objective on the effect of gender on students' feeling of relatedness during statistics lesson. It was concluded that students need for relatedness is independent on the students' gender.

This empirical study has conclusively indicated that gender stereotype does not provide any statistical significance to influence students' motivation. The

study recommended to mathematics educators in teacher education institutions to pay attention to the ways in which students' motivation to learn mathematics and statistics would be enhanced. The study also recommended for both educational leaders and teachers of mathematics to integrate teaching methods that boost students' motivation in learning mathematics. The study recommended for further studies, the predictive strength of the psychological needs variables on students' motivation for learning mathematics and statistics.

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

- Arthur, Y. D., Aseidu-Addo, S. & Annan, J. (2015). Student mathematics interest in Ghana: The role of parent interest, gender, basic school attended and fear of basic school mathematics teacher. *Advances in Research*, 5(5), 1–8.
- Bargh, J. A., Gollwitzer, P. M. & Oettingen, G. (2010). Motivation. *Handbook of Social Psychology*, 2, 268–316.
- Brown, L. I. & Kanyongo, G. Y. (2010). Gender differences in performance in Mathematics in Trinidad and Tobago: Examining affective factors. *International Electronic Journal of Mathematics Education*, 5, 113–130.
- Deci, E. L. (1992). The relation of interest to the motivation of behavior: A self-determination theory perspective. *In The Role of Interest in Learning and Development* (pp. 43–70).
- Deci, E. L. & Ryan, R. M. (2000). The “What” and “Why” of Goal Pursuits: Human Needs and the Self-Determination of Behavior. *Psychological Inquiry*, 11(4), 227–268.
- Deci, E., Vallerand, R., Pelletier, L., & Ryan, R. (1991). Motivation and Education: The Self-Determination Perspective. *Educational Psychologist*, 26(3), 325–346.
- Eccles, J., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M. & Meece, J. et al. (1983). Expectancies, values and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives: Psychological and Sociological Approaches* (pp. 75–146). San Francisco: Freeman.
- Fredricks, J. A. & Eccles, J. S. (2002). Children's competence and value beliefs from childhood through adolescence: Growth trajectories in two male-sex-typed domains. *Developmental Psychology*, 38(4), 519–533.
- Frenzel, A. C., Goetz, T., Pekrun, R. & Watt, H. M. G. (2010). Development of Mathematics Interest in Adolescence: Influences of Gender, Family, and School Context. *Journal of Research on Adolescence*, 20(2), 507–537.
- Gottfried, A. E., Fleming, J. S. & Gottfried, A. W. (1994). Role of parental motivational practices in children's academic intrinsic motivation and achievement. *Journal of Educational*, 86, 104–113.
- Gottfried, A. E., Marcoulides, G. a, Gottfried, A. W., & Oliver, P. H. (2013). Longitudinal Pathways from Math Intrinsic Motivation and Achievement to Math Course Accomplishments and Educational Attainment. *Journal of Research on Educational Effectiveness*, 6(1), 118-131.
- Hannula, M. S. (2006). Motivation in mathematics: Goals reflected in emotions. *Educational Studies in Mathematics*, 63(2), 165–178.

- Harackiewicz, J. M., Barron, K. E., Carter, S. M., Lehto, A. T. & Elliot, A. J. (1997). Predictors and consequences of achievement goals in the college classroom: Maintaining interest and making the grade. *Journal of Personality and Social Psychology*, 73(6), 1284–1295.
- Honicke, T. & Broadbent, J. (2016). The influence of academic self-efficacy on academic performance: A systematic review. *Educational Research Review*, 17, 63-84.
- Ijaz, M. A. (1975). Motivating students. *Physics Today*, 28(12), 60-61. <https://doi.org/10.1063/1.3069253>
- Jabor, M. K., Machtmes, K., Buntat, Y. & Kungu, K. (2011). The Influence of Age and Gender on the Students' Achievement in Mathematics. In *International Conference on Social Science and Humanity*, 5, 304–308.
- Kenrick, D. T., Neuberg, S. L., Griskevicius, V., Becker, D. V. & Schaller, M. (2010). Goal-Driven Cognition and Functional Behavior: The Fundamental-Motives Framework. *Current Directions in Psychological Science*, 19(1), 63–67.
- Krapp, A. (2005). Basic needs and the development of interest and intrinsic motivational orientations. *Learning and Instruction*, 15(5), 381–395.
- Lindberg, S. M., Hyde, J. S., Petersen, J. L., & Linn, M. C. (2010). New trends in gender and mathematics performance: A meta-analysis. *Psychological Bulletin*, 136(6), 1123–1135.
- Lubienski, S., Robinson, J., Crane, C. & Ganley, C. (2013). Girls' and Boys' Mathematics Achievement, Affect, and Experiences: Findings from the ECLS-K. *Journal for Research in Mathematics Education*, 44(4), 634–645.
- Pantziara, M. & Philippou, G. N. (2014). Students' Motivation in the Mathematics Classroom. Revealing Causes and Consequences. *International Journal of Science and Mathematics Education*, 7(2), 1–27.
- Reeve, J. & Lee, W. (2014). Students' classroom engagement produces longitudinal changes in classroom motivation. *Journal of Educational Psychology*, 106(2), 178-189.
- Ryan, R., & Deci, E. (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology*, 25(1), 54–67.
- Ryan, R. M., & Lynch, J. H. (1989). Emotional Autonomy Versus Detachment: Revisiting the Vicissitudes of Adolescence and Young Adulthood. *Child Development*, 60, 340–356.
- Skaalvik, S., & Skaalvik, E. M. (2004). Gender Differences in Math and Verbal Self-Concept, Performance Expectations, and Motivation. *Sex Roles*, 50(3), 241–252.
- Stevens, T., Olivarez, A., Lan, W. Y., & Tallent-Runnels, M. K. (2004). The Journal of Educational Research Role of Mathematics Self-Efficacy and Motivation in Mathematics Performance Across Ethnicity. *The Journal of Educational Research*, 974, 208–222.
- Van De Gaer, E., Pustjens, H., Van Damme, J. & De Munter, A. (2008). Mathematics participation and mathematics achievement across secondary school: The role of gender. *Sex Roles*, 59(7-8), 568–585.
- Wang, M.-T. (2012). Educational and career interests in math: A longitudinal examination of the links between classroom environment, motivational beliefs, and interests. *Developmental Psychology*, 48(6), 1643–1657.