Aspiring Mathematicians:

Students’ Views Regarding What it Takes to be Successful in Mathematics

By

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Abstract
This article explores junior high school students’ views regarding what it takes to be successful in mathematics. Qualitative and quantitative methods were employed to collect and analyse data, describe and interpret junior high school students (12-14 years) perceptions about what it takes to be successful in mathematics. 22 students from four (two urban and two rural) selected junior high schools were interviewed and the individual responses were transcribed, summarised, quantified and presented graphically. The results revealed that students acknowledge the importance of student-centred approaches to learning, the importance of group work in the understanding and acquisition of mathematical skills and concepts. However, despite the wide spread recognition of the importance of student-centred teaching and learning approaches, most students consider following the teacher’s approach as the key to effective learning. The results also suggested that the teacher is an active participant in the teaching and learning process, as his/her actions are considered to be triggers for students’ learning. It is therefore proposed that a new approach of teaching and learning where the teacher and the student are considered as partners in the teaching-learning process is desirable in bridging the gap between theory and practice in mathematics classrooms.

Key Words: Aspiring Mathematicians, Teaching Methods, Learning Experiences
1. Introduction

The strength of a nation is built on human resources developed by its educational institutions which train the brains, provide skills and open a new world of opportunities and possibilities to the nation for economic growth, social justice and poverty alleviation (Lauder, Brown, Dillabough, and Halsey, 2006; Adentunde 2007). In all educational systems, students are introduced to a variety of subjects in all disciplines and programmes for both academic and professional purposes. However, mathematics holds a key position in the school curriculum and in practically all countries it is a core component. It is also seen as a pivotal subject, both in its own right, and also because of its important connections in diverse fields such as the natural sciences, engineering, medicine, and the social sciences (Keith, 2000).

It is upon this that reflections on the importance of mathematics, and the process of the teaching and learning involved has been a long-standing issue in almost every part of the world for a considerable length of time (Blum, 2002; Törner & Sriraman, 2006). The importance of mathematics in all realms of life, and the recent debate regarding the falling standards of students’ achievement in mathematics has triggered the growing attention for researchers, parents and education authorities in their quest for the way forward over the last two decades (Blum, 2002). There is a general perception that a good result in mathematics is not only a good measure for entering into an institution of higher learning, and being accepted onto a ‘good’ programme, but also a requirement for the majority of jobs. As a result, college and high school students have been spending hundreds of hours in mathematics classes both at school and at home to pass their mathematics examinations (Blum, 2002).

However, according to Agudelo-Valderrama (1996) most students are not successful in achieving this and a number of students still find it difficult entering institutions of higher learning due to poor grades in mathematics. In Ghana, research by Eshun (2004) and Eshun-Famiyeh (2005) has also shown that mathematics continues to be the most difficult subject in the school curriculum; this general perception is reflected in students’ performance over the years. For example, a Criterion Reference Test (CRT) conducted in 1996 and 2000 established that only 1.8% and 4.4% of primary year six students nationwide obtained a mark of 55% respectively (MoE, 2002). Agudelo-Valderrama (1996) further added that, the way mathematics is conceived, taught and learnt has not only contributed to many students not realising their full potential; but most students not realising the importance of the mathematics they learn at school. That is that a greater proportion of students find mathematics difficult and they are not
able to apply what they have learnt to their real life situations because of the way the subject is taught (Eshun-Famiyeh, 2005; Anamuah-Mensah & Mereku, 2005).

There has been considerable interest in the study of improving students’ learning of mathematics for a number of years now. Recent assessments indicate that the teaching and learning of mathematics has gone through a number of restructuring processes coupled with the introduction of a new school curriculum. The evolution of these new school curricula and its accompanied new teaching methods is rooted in finding ways of empowering students to learn to do mathematics (Thomasenia, 2000). In order to understand and explore ways of improving students’ learning and understanding of mathematics, researchers have advocated for the need for a holistic view of changing the teaching-learning process in schools. One way that these ideas have been conceptualised in the mathematics classroom is the shift from the teacher-centred approach of teaching with its accompanying rote learning, to the student-centred approach which helps students to generate their own meaning and understanding of mathematical concepts (Ampiah, Akwesi, Kutor, and Brown-Acquaye, 2000; Anku, 2008; Boaler, 2006).

These student-centred learning approaches are underpinned by the principles of constructivism which advocates for students active participation in the teaching-learning process to develop their own knowledge and understanding. Active learning approaches involve a process through which the individual student develops an understanding of a mathematical concept through a series of investigations and trial and error activities, with support from the teacher (Elbers, 2003; Boaler, 2009). Boaler (2009) added that active learners are allowed to make mistakes and encouraged to perform further investigations to explore their mistakes, rather than always aiming to achieve the right answers. In addition to this, Stevenson and Stigler (1992) in their comparative analysis of American and Asian mathematics classrooms, suggest that in most classrooms students’ mistakes are regarded as an index of what still needs to be learnt. Students are always given the opportunity to use different approaches and methods to solve a particular problem, thereby developing a deeper understanding of that concept.

The acknowledgement and adoption of constructivist principles is thanks to the numerous advantages associated with constructivism. For example, according to Buerk (1994) since the introduction of constructivism into mathematics classrooms, the thinking and perception of mathematics has been changing. Caprio (1994) in his comparative study observing a traditional classroom and a constructivist classroom, has established that students in the constructivist
classroom were more confident of their learning and took responsibility for their own learning, when compared to their colleagues in the traditional classroom. In addition, Peters, Jones, and Peters (2008) states that whether we are able to provide all the teaching and learning materials needed for a particular lesson, or choose to adopt the latest technology or maintain the traditional “chalk talk” methods of teaching, affects what students do and how they learn which plays a crucial role in the teaching and learning process. That is, the individual student’s ability to learn and understand a particular concept or skill depends on how the individual is able to use what he/she encounters and their existing knowledge to construct pieces of information for possible assimilation and accommodation. Students are able to conceptualise and give meaning to new encounters if they are able to assimilate their fresh events with their previous experiences.

Felder (1993) argues that individual students learn differently and require different teaching methods. Felder further added that “students whose learning styles are compatible with the teaching styles of the course instructor tend to retain information longer, apply it more effectively and have more positive post-course attitude toward the subject than their counterparts who experience learning/teaching styles mismatched” (p. 286). According to Mercer (1995), apart from presenting information in diverse ways to meet the individual student’s way of learning, promoting students’ active participation, classrooms in which the proportion of input from students is higher than that from the teacher show active participation is desirable. Mercer further argues that, in such classrooms, students’ contributions are much higher than in a class in which the student has less input. Boaler (1998) explains that giving students the opportunity to express their views and thoughts and to be heard does not only promote active participation in the teaching-learning process, it also motivates students and encourages independent learning among students.

A broad number of researchers (e.g. Boaler 2009; Eshun 2004; Eshun-Famiyeh 2005; Mereku 2003; Willis 2010) have explored mathematics classroom practices. However, little is known about students’ views regarding what it takes to be successful in mathematics. While there are of course important exceptions (e.g. Bishop 2003; Op’t Eynde, and De Corte, 2003; McCallum, Hargreaves, and Gripps, 2000; Perger, 2007) students voices regarding the teaching and learning of mathematics is largely missing from this important discussions especially within the Ghanaian context. This study addresses the gap in the research literature by examining students’ views regarding what it takes to be successful in mathematics and identifies their preferred methods of learning. The study was guided by the following research questions:
a) What are students’ views regarding what it takes to be successful in mathematics?
b) What are students’ preferred ways of learning mathematics and why do students’ prefer these ways of learning mathematics?

2. Methods

2.1 Sample Selection
This study was situated in four (two rural and two urban) junior high schools in the Cape Coast Metropolis of central region of Ghana. The Cape Coast Metropolis was chosen because Central Region is a representative mix of rural and urban districts and the Metropolis exhibits some of these characteristics (Hedges, 2002). It was anticipated that 48 students that is 12 from each school (four students each from JHS 1, JHS 2 and JHS 3) would take part in the study. However, the first school that I visited was a new school with only two classes (JHS 1 and JHS 2). In all 22 students from the 11 classes in these four schools were selected for this study.

Before the selection of the participants for the study, the students were made aware of the purpose of the research and were informed that their participation was voluntary and that the information they gave would not have any effect on their school work. They were also assured of confidentiality of their responses. In the first class there were seven students in that class and two volunteered to take part. For the purpose of consistency and easy analysis of the data two students each were selected from each class. In classes where more than two students volunteered to take part, simple random sample method was used to select two of them.

2.2 Data Collection Instrument
After the students had been selected, each student was interviewed to determine their views regarding what it takes to be successful in mathematics. The interview questions also probed into students’ preferred ways of learning and their reasons behind these preferences. For the purposes of uniformity, consistency and to structure the conversations, the interviews were conducted using an interview guide. The interview guide had 10 structured and unstructured questions categorised into three sections. The first section had four structured questions used for eliciting the students’ demographic data. The second section had three open-ended questions aimed at gathering information about students views regarding how often they learnt mathematics, how often they answered or asked questions during mathematics lessons and what happened when they gave a wrong answer to a question. The third section had three open-ended questions aimed at eliciting students’ views regarding what it takes to be successful in mathematics, their preferred style of learning and why they preferred a particular learning style.
2.3 Data Analysis

The result presented in this study was drawn from the audio recordings and field notes gathered during the interviews. The analysis of the interview data was carried out in two phases: In phase one, all the individual interviews were transcribed after which the individual transcripts were analysed using the interpretational analysis method. This technique involved the reading and re-reading of the transcripts to determine any themes or patterns which could be categorised to form initial emerging themes (Patton, 2002). In other words, after transcribing each recorded interview, I read through each transcription again and again to determine the common themes from the transcripts. Then the interview data from the individual transcripts were grouped and the results were quantified and presented graphically. This was to present a holistic picture of the students’ responses to the interview questions, rather than an individual picture of the students’ views.

3. Findings and Results

3.1 Research Question 1:

What are students’ views regarding what it takes to be successful in mathematics?

In finding answers to this research question, the 22 students who were interviewed were asked to list the things they have to do in order to be successful in mathematics. The summary of the responses are presented in Table 1. These individual responses were also collated and quantified and the result is shown on Figure 1.

Table 1: Students’ Interview Responses about what it takes to be successful

<table>
<thead>
<tr>
<th>Question</th>
<th>Categories and Descriptions</th>
</tr>
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<tbody>
<tr>
<td>What does it take to be successful in mathematics?</td>
<td>Practicing- following teachers’ methods</td>
</tr>
<tr>
<td></td>
<td>Attention – paying attention in class and following the teacher’s instruction</td>
</tr>
<tr>
<td></td>
<td>Sharing Ideas- working together with colleagues</td>
</tr>
<tr>
<td></td>
<td>Methods – looking for different methods of solving a problem</td>
</tr>
<tr>
<td></td>
<td>listen- listening to the teacher and follow his method</td>
</tr>
<tr>
<td></td>
<td>working with colleagues from other schools – to learn</td>
</tr>
<tr>
<td></td>
<td>different ways of solving problems</td>
</tr>
<tr>
<td></td>
<td>Other methods – looking for alternative methods</td>
</tr>
<tr>
<td></td>
<td>serious and hardworking- they think one has to be serious to be</td>
</tr>
<tr>
<td></td>
<td>successful in maths</td>
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</table>
The common themes which came out from the interview transcripts were: practising, paying attention in class, following the teacher’s instruction and looking for different methods of solving problems. It is evident from Table 1 and Figure 1 that the interviewees have divergent views regarding what it takes to be successful in mathematics. However, most of them reported that practising the teacher’s method, paying attention and listening to the teacher are the best ways to be successful in mathematics. That is the learning experiences of these students are to a large extent influenced and directed by their teacher’s actions. This suggests that these students rely on their teacher’s approach in developing their understanding without necessarily looking for different approaches of solving problems.

However, it was also interesting to note that, despite the important role that the teacher plays in shaping students learning experiences as reported by most of the students, students see their active participation as paramount in developing new knowledge. Similar to the findings of Boaler (1998) some of the students reported that to be successful in mathematics goes beyond the mere imitation of the teacher’s approach to the finding of different methods in solving a problem. In general, the results suggest that most of these students have the belief that following the teacher’s instruction and procedures will automatically lead to having a correct answer. That is students do not have the confidence of using their own methods in solving problems because they may get or provide wrong answers. This result therefore challenges
teachers in creating conducive learning environment free of fear and intimidation where students mistakes are considered as part of the learning process as suggested by Willis (2010).

3.2 Research Question 2:

What are students’ preferred ways of learning mathematics and why do students’ prefer these ways of learning mathematics?

To find answers to this research question, the interviewees were asked to indicate how they learn mathematics in their respective classrooms and indicate whether they prefer learning alone or in groups. The summaries and categories of descriptions of the individual responses are presented in Table 2. The individual responses were quantified and the results are presented in Figure 2.

Table 2: Students’ Interview Responses about their ways of learning

<table>
<thead>
<tr>
<th>Question</th>
<th>Categories and Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why do you prefer to learn alone?</td>
<td>Use to- have been learning alone from primary school</td>
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<tr>
<td></td>
<td>Confident- feels confident working alone</td>
</tr>
<tr>
<td></td>
<td>Examination- during the final examination there is nothing like group work</td>
</tr>
<tr>
<td></td>
<td>Confuse- The get confused when working in a group</td>
</tr>
<tr>
<td>Why do you prefer to learn in groups or with colleagues?</td>
<td>Confidence- they are not confident of themselves and working with colleagues boosts their confidence level</td>
</tr>
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<td></td>
<td>Compare- so that they can compare notes and ideas</td>
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<tr>
<td></td>
<td>Solve more questions- they are able to solve more questions as a group</td>
</tr>
<tr>
<td></td>
<td>Correction – they can be corrected by their colleagues</td>
</tr>
<tr>
<td></td>
<td>Variety of ideas- can learn from each other and get new ideas</td>
</tr>
<tr>
<td></td>
<td>understating- they understand well when they learn together</td>
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</tbody>
</table>
Discussions among students and working in groups promote and extend learners’ mathematical understanding and students are able to retain their knowledge for a longer period of time when they interact or learn from one another (Elbers, 2003). From Figure 2, it is evident that almost all interviewees preferred and appreciated the importance of group work in developing new ideas and knowledge. However, a considerable number of the students also indicated that they learnt and preferred to learn alone; this suggests that individual students learn differently and therefore calls for the use of different teaching methods to stimulate individual students’ learning desires (Felder, 1993).

With reference to the results from Figure 2 the interviewees were asked to explain why they preferred a particular method of learning and the results were puzzling. From Table 2, it was interesting to note that although the students recognised the importance of learning in groups, some of them believed working alone was desirable. All the seven students who indicated that they prefer learning alone explained that although learning together helps them to learn new ways of solving problems and discovering new ideas from their colleagues, they preferred to work alone. All the students indicated that group learning affected them during their final examinations because they do individual work during these examinations. This calls for, guidance sessions for students on the importance of group work as a tool for promoting effective learning. Likewise, this calls for a second look at the competitive nature of the Ghanaian school curriculum to help students develop the attitude of learning mathematics for
its utilitarian values in solving real life problems rather than just to pass examinations. This suggests that assessment has an impact on how students learn. In situations where the national curriculum is results driven and only good results and correct answers are acknowledged, students turn to procedural and individual learning with the prime aim of providing correct answers and passing their examinations.

4. Discussion
Despite the introduction of new curriculum reforms underpinned by the principle of constructivism in the late 1980’s in most parts of the world, the results from this study suggests that the underpinning principles of these reforms have not been understood by a number of students. That is, in as much as students appreciate and acknowledge the importance of underlining principles there have been little change in the students’ perception of teaching and learning. Most students see the teacher as the custodians of knowledge. Students with such beliefs are normally not confident of themselves and always have the impression that their success in mathematics depends on their ability to follow their teacher’s instructions and approaches of solving problems.

This study therefore proposes a new approach of teaching and learning where the teacher and the student are considered as partners in the teaching-learning process. In such classrooms the teacher does not only act as facilitator in the teaching-learning process but working in partnership with students to develop new knowledge. Through this approach, the teacher can encourage students to develop the habit of taking responsibility for their own learning and considering the making of mistakes as part of the learning process as suggested by Willis (2010).
References


Willis, J., (2010). *Learning to love math: Teaching strategies that change student attitudes and get results*, USA, ASCD.