เครื่องมือสอนพัฒนาเชาวน์ปัญญาด้านมิติสัมพันธ์วิชาคณิตศาสตร์:
ข้อมูลสำหรับการศึกษาระดับมัธยมศึกษา

Visual Spatial Intelligence Tools-Based Mathematics Teaching:
Evidence of Preparing a Proposal for Secondary Education

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บทคัดย่อ

สาธารณรัฐประชาชนบังกลาเทศได้ให้การศึกษาตามเป้าประสงค์การพัฒนาที่ยั่งยืนโดย มุ่งเน้น
พัฒนาคุณภาพการศึกษาเพื่อปวงชนการศึกษาระดับมัธยมศึกษาเป็นรากฐานสำคัญสำหรับการศึกษาต่อ
ในอนาคต แต่ผลการเรียนของวิชาคณิตศาสตร์ ซึ่งเป็นวิชาสำคัญต่อสัมฤทธิ์ผลของนักเรียนกลับลดลง
วิชาคณิตศาสตร์นั้นเป็นวิชาหลักสำหรับการพัฒนาทักษะสำหรับศตวรรษที่ 21 ที่เรียกว่า STEM
ซึ่งประกอบด้วย วิทยาศาสตร์ เทคโนโลยี วิศวกรรมศาสตร์ และคณิตศาสตร์ สำหรับคณิตศาสตร์
ผลการเรียนส่วนหนึ่งสามารถพัฒนาได้ด้วยเครื่องมือสอนคณิตศาสตร์เรื่องเชาวน์ปัญญาด้านมิติสัมพันธ์
(VSI-Tools) เชาวน์ปัญญา ด้านนี้เป็นส่วนหนึ่งของทฤษฎีพัฒนาพหุปัญญา ซึ่งเป็นที่ยอมรับโดยทั่วไปว่า
ช่วยครูให้สอนได้อย่างมีประสิทธิภาพมากขึ้น การศึกษาวิจัยนี้มีวัตถุประสงค์ ใช้เครื่องมือที่พัฒนาขึ้น โดยเก็บ
ข้อมูลจากกลุ่มตัวอย่างนักเรียน 544 คน ครูและนักการศึกษา 37 คน จากโรงเรียนในภูมิภาคต่าง ๆ ของ
สาธารณรัฐประชาชนบังกลาเทศ 10 โรงเรียน ผลการวิจัย พบว่า ผลสัมฤทธิ์ทางการเรียนวิชาคณิตศาสตร์
ในส่วนของเชาวน์ปัญญาด้านมิติสัมพันธ์ของนักเรียนระดับมัธยมศึกษาเพิ่มขึ้น ข้อเสนอแนะ คือ
ควรฝึกอบรมครู และสร้างความร่วมมือร่วมใจระหว่างครูและนักเรียนในการพัฒนาเครื่องมือช่วยสอนเน้น
เชาวน์ปัญญาด้านมิติสัมพันธ์สำหรับการสอนวิชาคณิตศาสตร์ต่อไป

คำสำคัญ: ทักษะสำหรับศตวรรษที่ 21/ วัตถุประสงค์การพัฒนาที่ยั่งยืน / สเต็ม / ทฤษฎีพหุปัญญา /
เชาวน์ปัญญาด้านมิติสัมพันธ์

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Abstract

Bangladesh has entered Sustainable Development Goal era with commitments in education including endeavor of ensuring quality in education for all. Secondary level education is the foundation for future studies of the students. Mathematics is crucial subject as the students' success often significantly falls down from it. Mathematics is one of the key subject skills of 21st century that are included in STEM: Science, Technology, Engineering and Mathematics. Student's performance can be significantly improved with the aid of Visual Spatial Intelligence (VSI)-tools based teaching approach for secondary level Mathematics. VSI is one of the intelligences according to the Multiple Intelligence theory, which is proven to incorporate in teaching for effective learning. The aim of this research was to make an evidence of developing a VSI-tools based teaching proposal for secondary Mathematics in Bangladesh. The study was conducted with 544 students and 37 teachers and educators from 10 schools in Bangladesh. The qualitative data taken from the sample, by using researcher-suggested VSI tools for the selected chapters of Mathematics in the chosen classes, were analyzed with common statistical and analytical tools. This study showed logical reasons for proposing a VSI tools-based teaching approach that will make an improvement in effective Mathematics teaching at secondary level. Recommendations are made recognizing the challenges in the areas of teachers' training, teachers' and students' comfort, and developing appropriate VSI tools.

KEYWORDS: 21ST CENTURY SKILL / SUSTAINABLE DEVELOPMENT GOAL / STEM / MULTIPLE INTELLIGENCE THEORY / VISUAL SPATIAL INTELLIGENCE

Introduction

In Bangladesh, number of science students in secondary and higher secondary during the period from 2001 to 2006 has decreased at every next consecutive year (Lutfuzzaman, Niaz, & Hasan, 2006). The Bangladesh Bureau of Educational Information and Statistics (BANBEIS) time series also supports the fact with continuation. A study report published in 2005 shows that a sample of students of class nine secured the mean score of 59% in Bengali and

only 45% in Mathematics on a researcher designed test. The scores in urban schools are much better than those in rural schools (Hunt, 2005). Another study, done in 2008-2009, shows overall students' performance in Mathematics at the secondary level was not satisfactory at all (Andaleeb, Khan & Ahmed, 2011). Lutfuzzaman, Niaz, and Hasan (2006) identified one of the reasons behind receding numbers of science-students is poor quality of Mathematics teaching. Merely traditional and supposedly boring approach of teaching make the students detested of learning Mathematics and less interested to choose science group. Hunt (2005) showed through a study with 223 schools in Bangladesh that the secondary level students in Mathematics, being taught by non-trained or other-subject teachers, do not learn math properly and get dropped out from the classes. Therefore, the problem is identified as students are losing interests in math and the major reason is poor quality of teaching. The researchers are intended to find a solution to improve the situation in Mathematics teaching for secondary students in Bangladesh.

Literature and Context of the Issue

The Second Goal of the Millennium Development Goal (MDG) was to provide education for all inclusive through all of the states around the world. Bangladesh showed a satisfactory result in inclusive education by improving the primary school enrolments from around 81% to 98% during the 15-year period of MDG (United Nations, 2015). The continual progress entered the Sustainable Development Goal (SDG) era with the commitments of ensuring quality in education. The 2030 Agenda for Sustainable Development Goal include targets for ensuring quality in education in all levels. Both of equity and quality in Education helps the tertiary level be

accessible for everyone. According to BANBEIS data of 2012, 19.0 million students studied in primary level of mainstream education in Bangladesh and other 7.9 million in the secondary level. After successful quantity reach in MDG, the challenge is to guide the secondary level students in a proper way so that they can enter the tertiary education. Secondary level in educational lives is crucial right before the students choose their group of study for having a planned career and secured lives in future. At this level, students are not decided rather intended of understanding their own passion for further study. Mathematics education is more significant at this stage since this is the deciding factor of choosing STEM field in further education and career. Mathematics has always been given the highest emphasis as a subject of teaching logical reasoning and problem-solving skills to the students. The Government of Bangladesh has recognized the importance of Mathematics for Science education. The suggestions made in the National Education Policy (Ministry of Education, 2010) include,

"Since the study of science is closely related to math, special emphasis will be given to the learning of math...."

(Ministry of Education, 2010)

The condition of secondary level of Bangladesh in relation to Mathematics education is described in the following section 1.1.1. The latest National Education Policy in Bangladesh also emphasizes on the textbooks and teaching methods to be prepared in a way so that the learners gain basic knowledge about different branches of science at ease and feel comfortable in problem-solving. It is also trivial that, everyone learns on his/her own passion according to the combination of existing intelligences. It is vital to help learners by finding elements or situation in which they feel deeply

passionate (Robinson & Aronica, 2013). Identification and classification of intelligences are not very new observations though the existence of intelligences in every individual as this is trivial. In 1983, Harvard University professor, Howard Gardner revealed and institutionalized the learning instincts of individuals through his outstanding book 'Frames of Mind', the central idea of which was later popularized as the Multiple Intelligence Theory or MI Theory. A successful implementation of MI theory in preparing lesson plans and using in classrooms took place in Asia including China, Thailand and Philippines (Gardner, 1993). Another study conducted investigating the relationship between MI theory and students' performance showed that the impact of lesson plans based on MI theory positively influences the increment of students' performance (Fierros, 2004). Significance of particularly the Visual Spatial intelligence is recognized in relation with the teacher and parental understanding regarding effective teaching using appropriate support tools (Newcomb, 2010). VSI in teaching for effective learning is described in the section 1.1.2.

Secondary Level Mathematics in Education of Bangladesh

In 2007, the Campaign for Popular Education administered a rigorous research on a sample of 2887 high school graduates from 246 schools, 148 head teachers and 1472 teachers and finally published the periodical Education Watch 2007 report titled "The State of Secondary Education: Quality and Equity Challenges". The results of this report show that the students performed lowest in Mathematics comparing to other three subjects; General Science, Bengali and English. Students identified Mathematics as the most difficult subject, which is followed by English (Nath et. al., 2008). A report on Education Household Survey done in 2014 by the Bangladesh Bureau of

Statistics (2015a) shows that 60 percent of parents agreed in favor of the commentary question, "Almost all of the teachers should be very good in quality". The sentence in the quotation marks is translated from the original language, Bengali, to mean an urge of improvements in teachers' quality. Mathematics teachers are no exceptions, rather they are at the center of importance as the subject is one in the STEM field. The Government of Bangladesh addressed the deficiency of Mathematics, besides English, learning and has decided to take crash programs to train up subject teachers (Science and ICT Ministry, 2002). Teaching Quality Improvement (TQI) project was started in April 2005 by the government of Bangladesh for providing training to teacher trainers, curriculum experts and practicing teachers in secondary level. The first phase of TQI project ended in September 2011 and restarted with its second phase from July 2012 for up to June 2017. The four components of the second phase TQI are: 1. Strengthen teacher development, and institutional and organizational capacities, 2. Enhanced teacher training programs and delivery systems, 3. Targeted support for inclusive education, and 4. Quality project management (TQI-II, 2012). Unfortunately, the MI theory or any of its components were not included in the training materials for improving the quality of teachers towards augmentation of effective learning at secondary level.

Visual Spatial Intelligence in Teaching

Visual Spatial Intelligence is the innate quality of an individual that drives being comfortable and learning spontaneously with the space. Objects that are seen and the space that is been with are the supporting tools of teaching to help effective learning of Mathematics. Everyone has a certain combination of all multiple intelligences (Gardner, 1983). People with strong

Visual Spatial Intelligence (VSI) are typically very good at visualizing and mentally manipulating objects, and are often proficient at solving puzzles. They have a strong visual memory. Gardner accentuates two claims: 1) All individuals possess the full range of intelligences, and 2) No two individuals, not even identical twins, exhibit precisely the same profile of intelligences. This constitutes the principal scientific claims of the MI theory (Davis, Christodoulou, Seider & Gardner, 2011). A person learns effectively when the subject content and/or the teaching method coincide with the existing intelligence of the individual. American educator Edgar Dale suggested in 1946, later improvised and popularized as Dale's Cone, using teaching tools or some arrangements during teaching are more effective for the students to learn. Students understand deeply when they investigate authentic problems, rather than simply recite back isolated facts on standardized tests (Weber, 2006). Teachers' actions were recognized for practical implementation of MI theory. Emphasis was given to teachers that they are the key persons about creating a proper lesson plan for their classes where activities with multiple intelligences will be incorporated deliberately for achieving the expected outcome from the class (Gardner, 1993).

VSI tools are the objects or spaces that help learners proper utilize their own Visual Spatial Intelligence during learning. In Mathematics teaching, for a certain subject topic or chapter, specific VSI tools can be developed. Some physical objects or digital contents or motion pictures or simply the natural places including the classrooms and institutional premises can be considered as VSI tools, appropriateness of which are only ensured by their utilization and intension of the subject teacher. Cost of technological devices and software tools has a sharp downward trend since many years from now. As a result, easy availability of hardware and software has made the endeavor

of digitization around the world a great success. Finding from a study suggests a proper lesson plan regarding use of computers and other necessary digital devices can mitigate the gap between availability and unavailability of digital supports (Hudson, 2012). The lesson plan navigates the use of technological devices as appropriate and as possible. Another study, by Becker (2000), shows the level of achievements in Mathematics is higher than others when the students have opportunities to use computer and digital resources at home. Digital resources are the most common repositories of VSI tools for learning Mathematics better. Access to technology has impacts on the learning attitudes, career planning and individual abilities (Becker, 2000). Gardner explained how the Asians took the MI theory in their education practices through his personal experiences in China, Thailand and Philippines. In another book published in 2009, edited by Cheng, Moran and Gardner, we have seen much elaborated experiences of implementing MI theory in Asia Pacific regions. Details of experiences, assessment and challenges are identified for individualities in China and Korea (Cheng, Moran & Gardner, 2009). In Bangladesh, there was no big initiative taken so far that was successful in implementation of the MI theory in regular educational practices. UNICEF supported one project in early 21st century where MI theory features were adopted for primary education in Bangladesh. Thomas Armstrong exaggeratedly cited the story in his book Multiple Intelligences in Classroom published in 2009 that the government policy makers were taking decisions on implementing MI features in primary education in Bangladesh. In 2013, Tithi and Arafat wrote about the challenges of implementing MI in primary education in Bangladesh. Continuation of the UNICEF initiative was not visible enough because of unwillingness of the government and/or school administrators and teachers. The persons who will be mostly responsible for the implementation are necessary to become

ready for the approach with appropriate training. The tools and support materials necessary for incorporating multiple intelligences of students at their learning were not adequate or available (Tithi & Arafat, 2013).

Objective

The researchers administered this research for contributing in the endeavor of improving the teaching condition at the secondary level Mathematics in Bangladesh. Thus, the objective of this study is to build up a logical reason based on the effectiveness of the approach to ultimately develop proposal of effective teaching of Mathematics.

Design and Methodology

There were evidences of successful implementation of VSI tools in teaching especially for Mathematics, and at the secondary level in different countries. Such similar experiences may help determine the effective applicability of the VSI-tools based Mathematics teaching approach for secondary level education in Bangladesh.

Design

This was a deductive research as a result of which a proposal of effective teaching could be justified to be implemented in the context of Bangladesh education for secondary Mathematics. The researchers made some lesson plans on selective chapters of Mathematics for class VII and class IX in the main stream education in Bangladesh. The lesson plans were prepared based on the application of VSI tools. Specific VSI tools were suggested in both physical and digital formats. The classroom math teachers were briefed with the teaching approaches suggested in the lesson plans and their opinions were collected thereafter for making the formal proposal of effective teaching.

Methodology

This research analyzed qualitative data. The researchers interviewed thirty-seven (37) teachers and school administrators through a structured format of questions. Each teacher and school administrator were interviewed for around thirty minutes after the briefing of the theoretical features of MI theory, VSI, and the lesson plans. Classes were selected according to head of the school. All students in the class were taught a specific topic of the academic subject Mathematics by using VSI tools suggested by the researchers. VSI tools include online free resources, digital images, commonly available handy objects, classroom and playground. Subject teachers were briefed with the teaching approach with VSI tools. Classes were observed along with the reactions of the students. Students were personally asked to give opinions on their experience of learning Mathematics through VSI tools. Ten schools (secondary institutions) were selected from different geographical locations. Bangladesh has eight administrative units, spread over the country, called divisions. Taking at least one school from each division with the researchers' convenience the sample size was five hundred eighty-one (581) including students and subject teachers and school administrators. The table 1 shows the sample.

Table 1 Sample distribution among schools

School Number	Division Name	Teachers & Educators	Student respondents	
			Female	Total
1	Dhaka	4	43	88
2	Mymensingh	5	31	58
3	Chittagong	3	27	51
4	Khulna	2	56	56
5	Khulna	5	36	78
6	Dhaka	5	24	45
7	Rangpur	4	12	29
8	Sylhet	5	30	60
9	Barisal	2	0	20
10	Rajshahi	2	36	59
Total =		37	295	544

Analysis and Finding

Analysis and findings of the qualitative data are described in this section followed by the argument of the proposal of VSI-tools based Mathematics teaching system for secondary students.

Analyses

Students were from a specific age group: thirteen to fourteen years while chosen from class VII, and fifteen to sixteen years while chosen from class IX. Eight schools had co-education system, that is, boys and girls were taught in the same school though in separate sections of the class. Around 54% of the students were girls. The family income levels were not same. But the general trend is monthly income level is higher in urban areas than that in rural areas. According to the Government of Bangladesh data, as in May 2017, the per capita GDP of Bangladesh was USD1,602, which was USD1,466

in the last year. Considering this trend, the researchers collected the income level data of students on the benchmark of USD150 per month. Only 38% of the students in this study were from the families with income level less than USD 150 per month. Another parameter was the experience of using information technology through internet. Nearly 58% of the total students told that they previously used internet through computer or laptop or tab or mobile phones. The students' demographic data are summarized in the figure 1 with three bar charts.
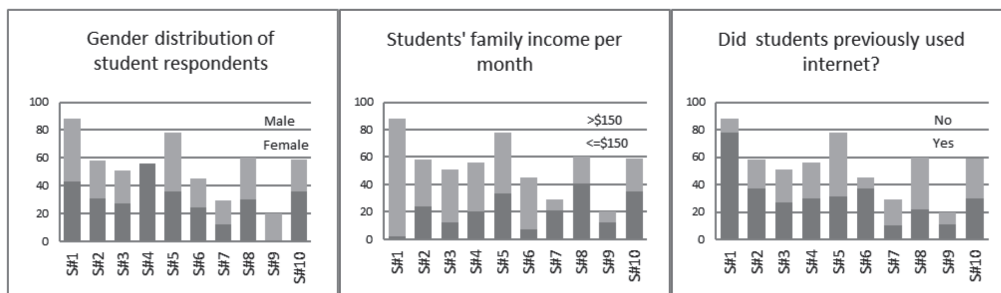

Figure 1 Data distribution of student respondents

On the other hand, the three factors of demographic distribution of the educators were gender, qualification at graduation level, and teaching experience. Little more than 43% teachers in this study were female. In nine schools, there were teachers who teach Mathematics at secondary level without having academic degree in Mathematics. Almost 41% of the total teachers were not academically qualified in Mathematics at their graduation level. But the teachers were experienced with teaching for quite a long time. Nearly 71% of the teachers were experienced for more than five years in teaching. The educators' demographic data are summarized in the figure 2.
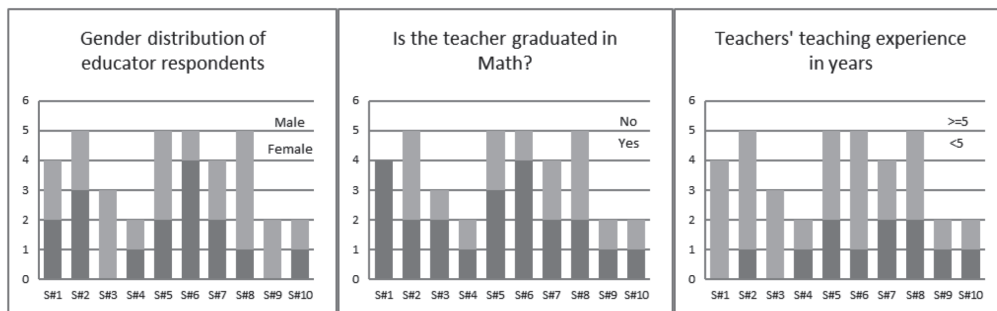
Figure 2 Data distribution of educator respondents

Irrespective of demographic differences, most of the educators and students agree that the VSI-tools based Mathematics teaching approach can be implemented. In their opinions it will help students learn Mathematics better at secondary level. More than 86% of the students and nearly 84% of the educators think that the VSI-tools based teaching approach need to be implemented for better learning of Mathematics at secondary level. Both of the groups agree that there are many challenges of implementation. Some are very hard to manage, and some are manageable with difficulties. But most of students and teachers think that the initiative can be successful as the system helps students learn better in an important subject like Mathematics. The figure 3 shows the comparisons between students' and educators' responses.
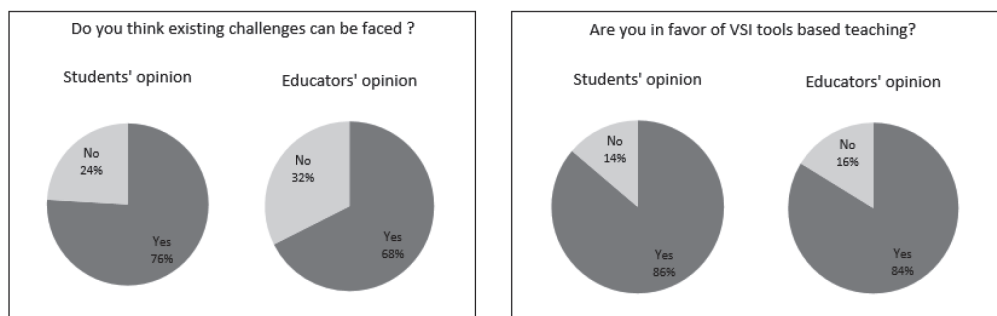

Figure 3 Comparisons between students' and educators' responses

Findings

Students are enthusiastic to adapt a new way of learning in classrooms. They are excited about using computers, other electronic devices and internets in classrooms. They are welcoming for the changes in teaching methods. Students are not reluctant to use technology at school and at home. They are very fond of participating in group activities and out-of-class activities. Hands-on works and field trips are very successful tools to implement the proposed VSI-tools based teaching approach. Most of the students do not have access to computer with internet connections at home but they are willing to use mobile phones with internet connections; because, they have seen digital versions of VSI tools that are available through internet connection facilities. In students' observations, many teachers are not cooperative and dedicated in teaching. Students think, the teachers do not allow every student to participate in class activities, only the better students get chances. Most of the students believe, Mathematics is a hard subject, and it is not suitable for everyone in a class. Many of the students have learned for the first time that 'making mistakes is not a crime or sin, rather it is welcomed; and making mistakes is the foundation of doing something right in future.' General perceptions on Mathematics and other subjects were not built from the experiences only from schools but also from the family environments. Students liked VSI-tools based teaching approach to be introduced for Mathematics and expected similar improvements in other subjects, especially in the subjects under science group.

Teachers are also enthusiastic about using VSI-tools based teaching approach for Mathematics and possibly other subjects. But they see many difficulties to adapt this new method. They think the most difficult task is to

arrange appropriate VSI tools. The researchers observed that, this was because of lack of understanding on the visual spatial intelligence as a concept. Teachers think they need computers, other digital devices and internet connections in classrooms for using VSI tools. The Government is distributing computers for the secondary school classrooms with internet connection facilities, which will take time to reach all schools. Teachers want to wait for that day to start with. Adequate knowledge on the Multiple Intelligence theory and a level of motivation in teachers can make a big difference. For a motivated and dedicated pool of skilled teachers, governmental supports are necessary. Many teachers' training programs are going on throughout the year for various level of education where the Multiple Intelligence based idea is absent. According to many teachers' words, the readymade tools are expected to be provided by the Government and NGO's. Most of the teachers think that the institutions can be of a big support to develop tools and use in classrooms. Institutional authorities should approve the improved idea of teaching. Classrooms need to be well equipped accordingly. Some teachers, comparatively who are young in age, are very comfortable in using computers and internets. These skilled teachers may help others in a school through in-house skill development workshops.

Study Evidence in Bangladesh

The focus of the research works on MI Theory in Bangladesh was mostly on the primary education including training programs for practicing teachers nationwide. MI Theory was merely included in such programs initiatives. One of the successful projects that relates with the main theme of implementing MI theory based teaching approach of this research was conducted in Bangladesh for primary education supported by UNICEF and

adopted with the MI theory was called Multiple Ways of Teaching Learning, which reported a positive change in the students' performances when taught by the presence of intelligences (Tithi & Arafat, 2013). Another study shows that there are significant improvements in Mathematics performance at the secondary level education in Bangladesh when the students are taught with the aid of VSI tools comparing to the traditional lecture method of teaching. Students scored 33% more in secondary Mathematics when they were taught with VSI-tools based teaching approach (Das & Cleesuntorn, 2017).

Discussions

Finding of this study coincides with the quantitative evidence of performance improvement of students in Mathematics at secondary level that was done by Das & Cleesuntorn (2017). Another study conducted for investigating the relationship between MI theory and students' performance showed that the impact of lesson plans based on MI theory positively influences the increment of students' performance (Fierros, 2004). Gardner (1993) also depicted the successful implementation of MI theory in preparing lesson plans and using in classrooms in Asia including China, Thailand and Philippines. Results of this study also support the findings by Karamikabir (2012) in Iran, Gouws & Dicker (2011) in South Africa, and Wares (2013) in the USA.

Students are enthusiastic to adapt the new way of learning in classrooms. They are excited about using computers, other electronic devices and internets in classrooms. They are very fond of participating in group activities and out-of-class activities. All these findings from students' comments directly support the findings of Weber (2006) through a study done for MI Research Center. In this study, it was found that, sharing knowledge amongst students through the group works and other out-of-class activities immensely

supported the learning process. This finding exactly coincides with the findings in Tanzania where a study was conducted for secondary students on interaction between multiple intelligences and performance of learners (Kafanabo, 2006). There is chance to enhance students' access through internet resources at home. This students' expectation coincides with the survey findings in the Report on Education Household Survey done in 2014 (Bangladesh Bureau of Statistics, 2015b). According to the students' comments, most of them believe, Mathematics is a hard subject and it is not suitable for everyone to learn easily in a class. This realization exactly coincides with the comment made by (Lutfuzzaman et. al., 2006).

Teachers are willing to use VSI-tools based teaching approach for Mathematics and possibly in other subjects. They see many difficulties to adapt this new approach mainly because of unavailability of appropriate VSI tools. Inadequate knowledge, scarcity of materials, and lack of institutional supports are the main challenges. The major challenges described by the teachers in Bangladesh are similar to those in China and Korea in 2009. In a book edited by Cheng, Moran and Gardner, the experiences of implementing MI theory in classroom around the world were described with analyses and comments regarding the challenges and effectiveness in learning. Teachers think the lack of understanding on the MI theory and VSI tools might be the most significant reason. Teachers suggested to use computers, other electronic devices and internet connections in classrooms. These observations of Bangladeshi teachers coincide with the facts in Malaysia as the researchers Sulaiman, Abdurahman & Rahim (2010) suggest of combining the teaching strategies and MI theory for effecting teaching of Mathematics and Science in schools. However, Bangladesh is changing with the world and rapidly moving towards the time when there will be computers in all secondary

classrooms with internet connection facilities. Many teachers think that the institutions can be of a big support to develop VSI tools and use in classrooms. The latest National Education Policy in Bangladesh also emphasizes on the textbooks and teaching methods that will be prepared to help learners gain basic knowledge about different branches of science and make them feel comfortable in problem-solving. Thus, it is expected that the institutional authorities will approve the improved idea of teaching.

Recommendations

The researchers have put together the following recommendations for different stakeholders of the situation that the study was taken out. Recommendations are formulated on the basis of findings from different data sources as stated below.

Policy: The Bangladesh Government is requested to include the MI based teaching method in the National Education Policy as an improved teaching pedagogy of present world. In particular, VSI-tools based teaching method should be suggested to teach Mathematics for secondary students in Bangladesh. An ordinance can be made for the educational institutions and local educational authorities under the Ministry of Education to take necessary actions for introducing VSI-tools based teaching method.

Training: The Government is to organize training for the concerned teachers at secondary level; or otherwise, adopt MI based teaching techniques in the ongoing training programs for the secondary teachers around the country. NGO's and donor agencies may provide training for secondary teachers regarding preparing and utilizing appropriate VSI-tools for better learning of Mathematics and other probable subject areas.

Development: A number of NGO's and donor agencies, in Bangladesh, work for improvement in education qualities. They may support more research activities in the sector related to the MI theory in secondary education. NGO's and donor agencies may also design the training and develop materials with the help of subject experts and following the exact subject topics of the class according to the national curriculum.

Institution: The institutional authorities are invited to accept the new ideas of teaching incorporating teaching tools such as the VSI-tools for teaching Mathematics. They should be open and welcoming the technology into education for making their students competent to the 21st century.

Further Research: More research can be done for the secondary level education in Bangladesh in relation to the MI theory and VSI tools. With the growth of literacy rate and economic improvement in the country the secondary education sector is coming into focus. Researchers should take the secondary education into their account of further research activities as this level of education is the bridge between just literate and educated people.

Conclusion

The short-term impact of this research is to ignite students' attitude towards learning process in the subjects being taught, and Mathematics in particular. Teachers' are also directly influenced by the activities taken through the whole research process. The long-term impact of the research is huge subject to the recommendations are met by the respective stakeholders. The researchers are convinced to declare that an effective teaching proposal can be made for secondary Mathematics. As a result, the long-term implication will have positive influences in higher studies about subject selection and overall performance. The prospective secondary

students will not hesitate to choose Mathematics in their study through the groups of science and engineering.

On the other hand, research-and-development for designing and producing appropriate teaching tools will be of great demands in future. Educational institutions are expected to play a big role of developing VSI-tools and implementing such tools through MI theory based teaching approach in classrooms of secondary students in Bangladesh to support effective learning for Mathematics in particular and other subjects in general.

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