Use of Smart Table in Educational Institutions to Enhance Student Learning Performance

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***Abstract*— Technology has influenced various industries, including the educational sector. SMART™ Table can be regarded as a technological tool carrying various benefits for enhancing the students and teachers classroom experience. The study has focused on the key features of the SMART Table designed by the researcher. The components of the supply chain process in the development and delivery of the device have been explained. Moreover, the benefits and limitations of the use of SMART Table in the classroom have been covered. A few of the notable benefits are ease of memorization of content, doing homework and giving presentations. The cost of SMART Table is a key challenge that can limit the integration of the device as a learning tool. Another issue that can create barrier in the adoption of SMART Table by students and teachers is the lack of readiness to adopt this technology in the classroom. As evident from the findings, a preference for white board and concern towards the lack of surety about usefulness of SMART Table in communication between teachers and students can limit its applicability in the University of Bridgeport. Nevertheless, the benefit of SMART Table in educational sector cannot be overlooked as it supports students and teachers in dealing with complex concepts and content.**

Index Terms*— *SMART Table, Education, Technology, Supply Chain

I. INTRODUCTION

THE educational institutions have focused on enhancing the capability of their students through offering them a learning environment which is conducive to knowledge acquisition and learning. Efforts have also been made to ensure that the instructors are provided with the resources that are needed to support them in effectively performing their work related responsibilities. Technology has brought changes to various fields and sectors across the globe. One such area which has been significantly influenced by technological advancements is the educational sector. On one hand, researchers have questioned the potential of technology to enhance the effectiveness of the process of education [1]. On the other hand, scholars have suggested that technology compliments education, making instructions easier to understand for students [2-4].

New technologies have emerged in the market, allowing the academic arena to integrate the newly developed devices to facilitate the learning of the students [5]. The manufacturing sector can integrate the technology in its production process, however, educational institutions follow a different path to new product development. In the case of academic organizations, new product development can manifest in the form of bringing changes in the manner in which teachers and students interact, how classroom lessons are delivered and students acquire knowledge [6]. The recent introduction of SMART Table in 2008 has been regarded as a notable example of new product development in the educational service sector. The production of SMART Table has initiated interest of both scholars and educators to identify the benefits the technology offers for students and teachers [7, 8]. The focal point of the current study is the use of SMART Table in the educational sector. A more elaborative perspective of the aim of the study is provided in the following section.

- **Aim of the Study**

The current study aims to analyze the use of SMART Table in educational institutions. More specifically, the University of Bridgeport, has identified the potential benefits it carries for teachers and students. SMART Table as an interactive technology is a recent addition in the market. As a newly introduced product, the benefits of the product are an interesting area of study as noted by researchers [9, 10]. It has been observed that students retain less than half of what they are taught in classroom. As a result, unfortunately, only half of the students'

978-1-4799-5233-5/14/$31.00 ©2014 IEEE

requisite knowledge is retained by students i.e. due to the current education delivery mechanism. Moreover, there is no mechanism which could be used to gauge class' level retention at any time during a lecture [11-13].

Additionally, new research has indicated that paper based book reading –although previously thought as a highly cognitive exercise – limits creativity and problem-solving skills [14]. The reason is that the paper based learning results in visual learning exercise. This in turn activates those parts of brain that are related to memory and aesthetic sense. Contrarily, brain activity related to problem solving is minimal in this method of knowledge transfer. In view of these findings, it is quite clear that educational institutions such as the University of Bridgeport are in need of a product that can be used to address these drawbacks of paper based learning methodology.

- **Research Objectives**

The research will be based on the following objectives:

- To discuss about the key features of SMART Table and their applicability in educational institutions.
- To outline the supply chain management of the development of SMART Table for the University of Bridgeport.
- To analyze the perception of students and teachers towards the SMART Table prototype.
- To explore the perceived limitations of SMART Table of students and teachers

- **Research Questions**

The study will focus on the research questions presented as follows:

- What are the key features of SMART Table and how they can be applied to educational institutions?
- What are the various supply chain processes involved in the development of SMART Table for the University of Bridgeport?
- How do students and teachers view the benefits of SMART Table in the University of Bridgeport?
- What are the limitations students and teachers face in the use of SMART Table in the University of Bridgeport?

II. THEORETICAL CONTEXT OF THE STUDY

A. Benefits of Technology for Educational Sector

Benefits of a new technology such as smart phones are not only dependent on the actual features offered by the product, but are influenced by the perception of individuals using such devices [23]. Thus it can be inferred that the adoption of SMART Table in educational institutions will be dependent on the features such as ease of use of technology and the ability to understand its workings. In addition to this, management and teachers' attitudes towards the adoption of SMART Table in learning will also play an integral role in the integration of SMART Table in education. SMART Tables make education and learning a stimulating task for the students of young age [5]. This will however depend on the way the teacher is able to integrate SMART Table functions in to the learning process of young children. For adults, learning through interactive technology is dependent upon the instructor's support as well as their own beliefs about the usefulness of technology and the probable outcomes they expect to gain due to its use.

An important study has been conducted by [16] who concluded that difficult subjects such as mathematics and statistics can be taught more effectively if the teachers use smart technology [16]. It has been found that use of smart technology enabled the students to gain a clearer understanding about the concepts of mathematics and statistics. Furthermore, this improved understanding has enabled the students to engage in critical thinking to manage their assignments and class activities more effectively. In addition, researchers have concluded that the use of smart technology by educational institutions is a form of 'pedagogical innovation' [16].

B. Supply Chain Management and New Product Development (NPD)

New product development has an influence on the supply chain processes as the components of supply chain processes need to be structured to adapt NPD focus [17]. Product innovativeness is regarded as a key variable which tends to have profound impact on the supply chain of a firm engaging in new product development. While dealing with the manufacturing of a novel product was, another important notion in the flow of supply chain processes observed by researchers [18]. The speed of production of the required number of units is determined by the maturity level of the market. In case of the markets which have attained significant level of maturity, efficient production needs to be emphasized as a part of the organizational strategy.

Technology related products are important because of

efficient production as the supply and demand needs to be balanced in order to maintain profitability. [19] A case example of a technological product manufacturer, using "make-to-order model" for managing the supply chain and manufacturing process for its products has been provided. Such models are applicable for products that are likely to need alteration after some time. Thus the short term nature of product models makes it mandatory to adopt an efficient supply chain practice. However, make to order model is applicable in contexts where the customer highly values the company manufactured items and is willing to wait for the arrival of the finished product [20].

C. Concept Generation

The concept of SMART Table can provide more effective learning as measured by academic achievement [21,22]. Although most instructors try to deliver their knowledge effectively, students may not be able to grasp their ideas. Such limitations can be addresses through incorporating technology in the classroom, instead of focusing on traditional pedagogical methods [23,24].

There could be many reasons for this issue. Probably, the students may have a varied background education level; and hence all students may not be at par as for as their educational knowledge is concerned about the topic being discussed. Likewise, there could be many other possible reasons as well. In such a situation, it becomes necessary that the instructor is informed about such a condition being present in the class so that s/he me make necessary adjustments. Interactive technologies can improve the process of student teacher interaction [25-27].

D. Market Segmentation and Distribution

The market segment which is most likely to adopt and positively respond to this technology is well established at colleges and universities that have available resources to invest in the adoption of interactive technology in the classroom. Since this product involves cutting edge technology and applications that are being developed as we speak; it may be more costly. Moreover, the educational institutions that are open to adoption of technology in teaching also develop a part of the market segment for the product. Therefore, the focus will be on institutes of higher education such as the University of Bridgeport. The demand of SMART Table can be quite accurately identified by coordinating with the university enrollment administration.

E. New Product Development and SMART Table

The idea to group together multiple applications in one product to generate multi-faceted improvements in all areas concerning education is an appealing notion. The plan of accumulating various applications in one product is primarily focused on efficiency and cost reduction, whereas, the use of 3d imagery is to improve understanding of complex topics such as statistics, econometrics, 3-D graphical models etc. Furthermore, one of the key reasons to introduce paperless books via note-pads is to discourage cramming, and enhance comprehension of study material. Various scholars have supported this notion [9, 36].

III. METHODOLOGY OF THE STUDY

The authors have used quantitative research design to conduct the study. A notable feature of quantitative study is that the researchers focus on obtaining numerical information from the respondent about the chosen area of study. In the context of current study, the researchers used survey methodology to obtain information regarding the perception of students and teachers about the usefulness of SMART Table in classrooms and learning.

IV. MANUFACTURING SMART TABLE

Since in 2008, SMART technology has been a rapidly growing segment, with its application used in the various organizations. The cost of the product remains a key issue in this regard, maintaining the problem of affordability for schools and colleges [5]. One aspect of the study will be that an affordable SMART Table will be manufactured which can be easily accessed by individuals and academic institutions. A prototype of the suggested SMART Table will be developed to measure the perception of students and teachers about its usefulness in classroom. The prototype will include all the basic features which are going to be present in the final product. For the purpose of development of the prototype, support can be obtained from engineers having experience in development of smart technologies. Their expertise can offer the needed support to develop the prototype. An important area of considerations is gaining access to raw materials and software for manufacturing of the trial product.

In order to manage the manufacturing of prototype, financial resources will also be needed apart from technical skills. Market research needs to be conducted in case of selection of the organizations interested to support the venture of SMART Table development. Universities can be contacted to offer input of technical skills through their engineering faculty and students. In the case of funding, organizations interested to promote educational institutions and effective learning of students

can be contacted to extend financial support. The manufactured SMART Table will have the following features:

1) Simultaneous Multi Touch Capability

SMART Table equipment must be easily cleaned by the user. Also, SMART Table will be made to carry out the recognition of 40 touches at the same time. This can create space for eight students to work on the smart table together. It will respond to simple movements such as rotate, toss and zoom. In order to reduce the chance of disease transfer, touch screens may be made to respond to stylus (computer pens) and specially layered gloves may be worn. Through the multi touch function the students can control what is being demonstrated on the touch screen e.g. by zooming the size of the image.

2) Extensive Content and Resources

The SMART Table will have wide range of activity packages. They can be downloaded free of charge from the SMART Exchange Website which can be availed directly from the table. There is also a smart table tool kit placed in with the table so that the smart table activities can be understood in detail. Smart notebook lessons could also be imported so that the lessons could be made easier [7].

High Quality Display

The screen attached in the smart table will have dimensions of 42 inches and 1080p that does not feature any obstructions such as shadows. This will enable the students to see the lessons on a multimedia screen that is both stimulating and fulfilling.

3) Rugged Design and Easy Set Up.

First and foremost, the SMART Table must support weight up to 90 kg so that it would not be compromised by the students working on it. It has a stand that can support the table with up to eight students working on it. This implies that the smart table is free from any damages that regular devices can undergo. The weight support of the smart table makes the technological tool suited to most class room activities.

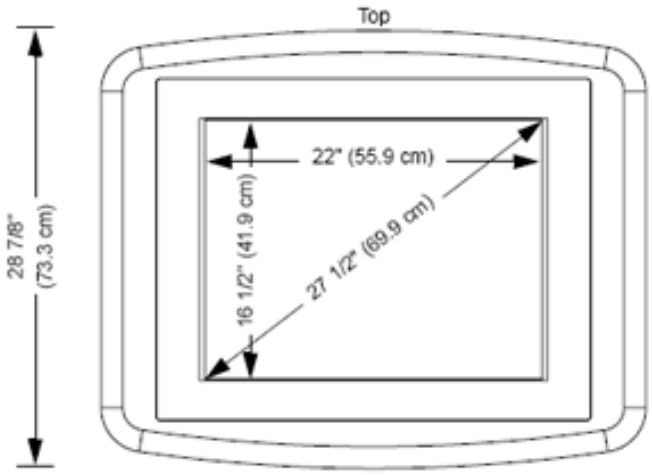

Figure 1: Schematic represses education of the proposed SMART TABLE

4) UDL Friendly

The Smart table will be configured according to the specifics of the Universal Design for Learning. This implies that the students have the flexibility to work together even if they have any difficulties such as less knowledge and material.

5) Mobile Design

Smart table will be designed so that it can be moved from class room to class room. This is because they can fit in the doorways very easily and can be easily moved from one place to another.

6) Share SMART Table Content With the Whole Class

Another feature is that the SMART table content could be shared with the whole class through the means of class room management software and its SMART board interactive white board. This suggests that the whole class can participate in the smart table activities and can stay quiet while the selected students interact on the smart table. The instructor will be able to use the device as a tool supporting the delivery of lecture, thus enhancing the effectiveness of teaching. It can also be used to give presentations as the features include the ability to use it as a projector.

7) Virtual User Group

The SMART Table will have a virtual user group that connects through the internet and can share experiences regarding the smart table. The students will be able to connect with other students, engage in discussion about class topics, share lecture notes with each other and learn through class discussion.

8) Built in Wi-Fi

There will be a built in Wi-Fi in the SMART table so that there is no limit to communication. The students can search online for content related to classroom topic, as

well as search material for conducting the assignment.

V. Survey Sample

Since the researcher intends to explore the perception of both university teachers and students about the use of SMART Table in the university, both segments of the population are included in the study. The study used purposive sampling for selecting the students and teachers. Undergraduate students enrolled in full time programs at the University of Bridgeport were included in the study. A total of 100 respondents were a part of the sample, comprised of students and teachers. The students were selected from diverse classes of Leadership, Finance and Logistic management.

VI. Survey Data Collection and Analysis

The study included collection of primary as well as secondary data. In the case of primary data, a questionnaire with 15 questions was developed (refer to the appendix). Participants provided their opinion about the application, benefits and limitations of SMART Table in learning. They were introduced to the concept of the prototype to gain familiarity with the product in order to respond to the research questions in a better manner. The response categories in the questionnaire were developed using a five point scale, with the responses ranging from: 5= Strongly Agree, 4= Somewhat Agree, 3= Not Sure, 2= Somewhat Disagree, 1= Strongly Disagree (5 being the highest score and 1 being the lowest).

The evaluation of primary data was conducted by using frequency and percentage to identify the ratio of responses in each response category. Moreover, graphs and charts will be used to illustrate the frequency of responses. To support the findings of the study, the researcher used secondary data as well. It was accessed through already published material available in the form of peer reviewed journals articles and books. An important point to consider here that researches between 2008 and 2013 were included in the study as the evolution of smart technology and interactive teaching and learning is a recent development.

VII. Survey Findings

The data obtained was calculated using frequency, bar, and pie charts. They have been developed to graphically illustrate the ratio of respondents in each response category. The table with responses for each of the questions is provided in the appendix. A few of the key findings and their graphs are presented as follows:

The first question in the survey asked about the usefulness of SMART Table for teachers and students. As shown in the following graph, a significant number of respondents (72 people) strongly agreed with the idea that SMART Table can help students and teachers in the classroom.

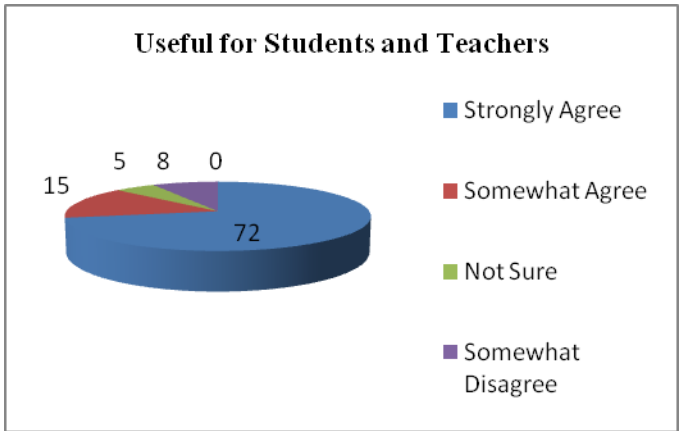

Figure 2: Usefulness of SMART Table for students and teachers

Other questions related to the usefulness of SMART Table have yielded similar results as demonstrated in the following graphs. There are 68 respondents who strongly agreed with the idea that SMART Table can help students in identifying important points during lecture. On the other hand, small ratios of people have disagreed with the usefulness of the device in its benefit of recording lecture notes.

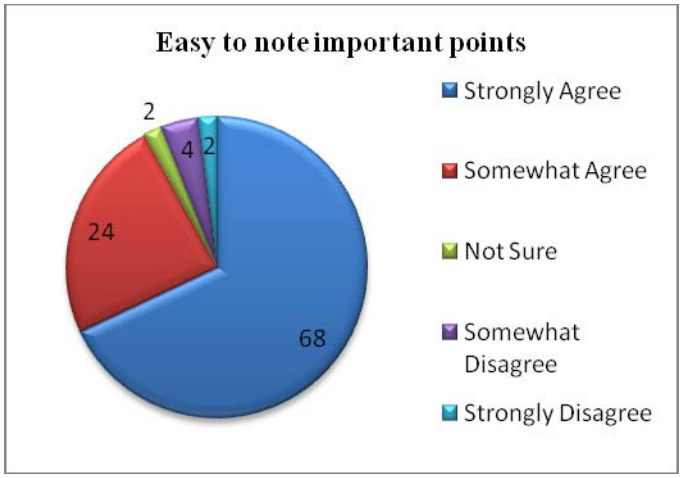

Figure 3: Easy to note important points during lecture

In response to question 3, it can be seen that a large number of respondents believe that SMART Table can facilitate students in grasping difficult concepts being taught in the classroom, as shown in the following pie chart. It can be seen that there are 79 respondents who have indicated that SMART Table has the potential to help the students in learning complicated concepts in the classroom. [36] have expressed similar ideas,

supporting that computer assisted teaching increases the level of fluency students' gain for mathematics related concepts. [33] explored the usefulness of technology in explaining the geometrical concepts to students. It has been concluded that students who exhibit limited attention spans can greatly benefit from use of technology.

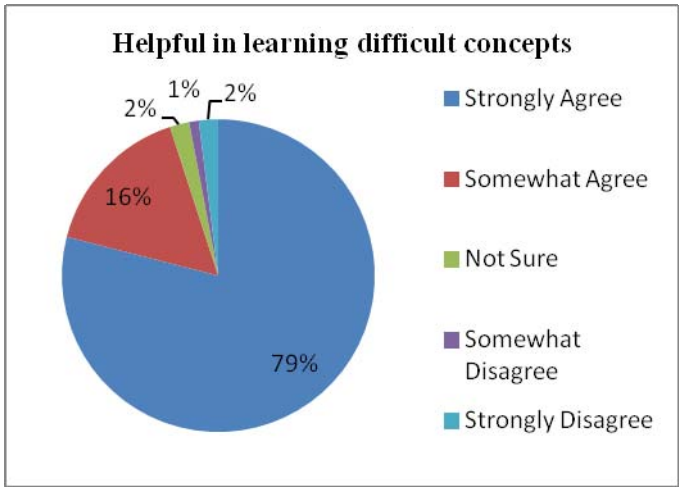

Figure 4: helpful in learning difficult concepts

Another important finding of the study is that SMART Tables have been found to be useful in memorizing the content and themes covered in the classroom (as seen in question 6). As depicted in the figure 4, there are 59 respondents who have strongly agreed while 28 respondents have somewhat agreed with this notion. SMART Table can offer them with a portable device that can be used for retaining class lectures, learning the concepts and memorizing them by repeatedly reviewing the available information.

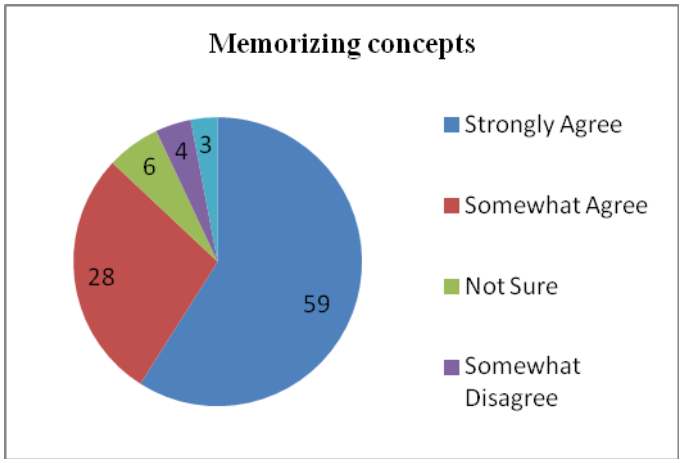

Figure 5: Memorizing Concepts

The bottom-line principle behind this idea is that while studying, students make notes and use highlighters to mark important material. This tendency, unintelligibly and unintentionally, makes students memorize stuff rather than grasp concepts [24]. The facility of bookmarking, however, will be provided in our application as well. Hence, by eliminating papers, the researcher can provide students a platform where they can use their minds and cognitive abilities to learning concepts freely and efficiently.

One of the key limitations of SMART Table identified in the survey was the cost of the product. As noted in question number 3, a large number of respondents (82 people) have disagreed with the idea that the device is cost effective. This perception indicates that the users of SMART Table are seeking technological devices that are affordable; otherwise they will be discouraged or unable to buy the product due to its high price. The figure number 5 illustrates the responses.

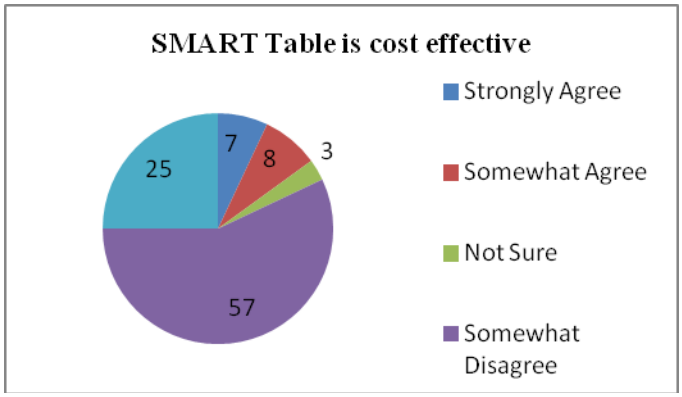

Figure 6: cost effectiveness of SMART Table.

An interesting finding of the study can be seen in question number 10. It can be seen in figure 6 that 45 respondents are of the opinion that white board is more effective than use of technological tools such as SMART Table in classroom. On the other hand, 46 participants disagreed with the idea, showing a positive attitude towards the use of SMART Table. There is a minor difference between the ratios of respondents which suggests that it will take time to integrate SMART Table as a learning tool in the classroom at Bridgeport University.

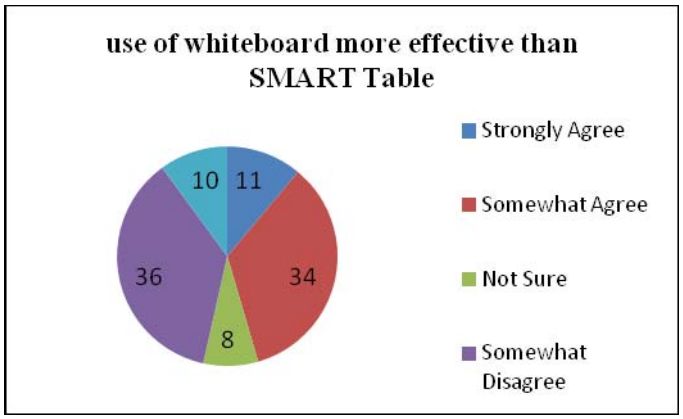

Figure 7: Use of white board for teaching more effective than SMART Table

Another primary feature of SMART Table was linking the class with the instructor in such a manner that the student could use smart table application and convey messages to the instructor during the lecture. The instructor may choose to clarify or elaborate on the concept even further. In this way teaching and learning both could be made more productive. However, it is imperative to note that in the responses obtained from the participants for question number 15, there has been minor difference between the ratios of respondent who regard it as an effective means of communication and those who disagree with this idea.

As presented in figure 7, there are 55 respondents who have agreed with its effectiveness, while 43 have disagreed with its usefulness. There were 2 respondents who were not sure about the usefulness of SMART Table in enhancing effective communication between instructor and students in classroom.

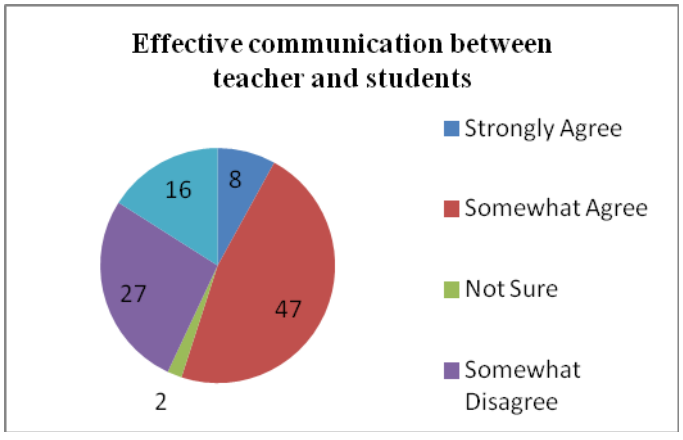

Figure 8: Effectiveness of Communication between teachers and students.

The focal point of the current study is to identify how the students and teachers at the University of Bridgeport can use the technology of SMART Table to gain improved learning outcomes. The idea of SMART Table is actually to create a collaborative work environment, sharing ideas and developing a sense of collaborative learning. Moreover, SMART Table applications intend to indicate a sense of societal interaction among users. However, adoption of the technology and getting comfortable with using it will take time.

VIII. CONCLUSION

Interactive technology in education has been a focus of attention in the recent literature. The current study intends to explore the applicability of the development of a SMART Table for the students and teachers of University of Bridgeport. The basic idea behind this approach is to provide the teachers and students with a SMART Table technology that fulfils their needs of creating a learning environment that results in increased output. There is a need to develop new modes of classroom teaching, propelling the shift from traditional teaching to the adoption of interactive technology based teaching. The development of SMART Table is such a transformation of classroom teaching technology integration. There is a significant need to integrate new technologies in the classroom and University of Bridgeport can greatly benefit from the inclusion of SMART Table as a part of teaching. It can be therefore concluded that SMART Table can certainly serve as a means of facilitating learning, specifically in subjects such as mathematics, statistics, geometry, economics as their complex concepts are difficult to grasp. The SMART Table is also expected to support the students who have short attention span in keeping track of the instructions delivered by the teacher in the classroom. Information about the perception of students and teachers related to benefits and limitations of use of SMART Table can further support the authors' research in refining the features of the product, ensuring that it fulfills the needs of the target market, thus, supporting the researcher in providing a product that is aligned with the classroom needs of teachers and students. It is also important to point out that the university management may also gain from the use of SMART Table in classes as the learning capacity of students can be effectively managed and improved. In summary, the academic performance of student can be enhanced by the use of SMART Table.

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