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Advancing Statistical Education using Technology and Mobile Devices

Najeeb Al-Matar
Department of Management Information Systems, Faculty of Administrative and Financial Sciences AlBaha University

Abstract: *This study explores individual differences and the effects of these differences on usage of a statistics website, especially in combination with new platforms, such as mobile devices (i.e. smart phones and iPods). Moreover, the individual differences that are explored in this study are technology acceptance, attitudes towards statistics, user satisfaction, and statistics conception. This study looks to assist in the improvement of a website for both computer and mobile device usage, and propose suggestions for similar websites.*
Keywords: *Advancing Statistical Education, Technology, Mobile Devices, questionnaire.*

I. Research Objectives & Purpose

The purpose of this study is to explore several ways to assist students in their statistical education through technology and mobile devices, such as websites, computer simulations, multimedia presentations, and more. Following are the research objectives:

- To evaluate the impact of mobile technology in advance statistical education.
- To analyze the responses of students for adoption of mobile technology in advance statistics education.

Research Hypothesis

H_1: The use of Mobile technology will significantly increase the interest of students in statistics education.
H_2: Students are inclined to adopt the mobile technology for advance statistics education.

Literature Review

New and enhanced technology is constantly being produced and for that reason the way educators teach remains in continual motion. In the past, teachers were only expected to teach in the classroom. Now in higher education, students can obtain entire degrees online through virtual classrooms. These technological advancements have been associated with some students expecting their teachers and professors to utilize some sort of educational technology (Eggers, 2007).

Fortunately for educators there are many diverse ways to cater to students' learning needs through technology, such as with multimedia and computer simulations. Furthermore, many of these new technologies can be accessed through the Internet, on computers and more recently, mobile devices. The remainder of this section will consist of a discussion of particular educational technology tools, specifically multimedia, computer simulations, and mobile devices. Each technology will be discussed as it pertains to teaching in general, and then specifically to the teaching of statistics.

Multimedia involves presenting at least two types of media, such as verbal and visual representations, to communicate the educational content of a course or subject. Multimedia can be presented in a classroom with a typical lecture along with a slide show or it can be fully integrated on a website for students' constant access to that information. Multimedia can also be used to create individualized learning atmospheres by allowing students to work independently on newly learned concepts and be able to control the learning pace. These findings strongly suggest that multimedia can be a powerful tool in helping students teaches (Snell, 1999).

Another educational technology tool is the computer simulation. This technological tool uses software to display images while allowing the user to manipulate variables to explore the interaction of the different variables. Computer simulations are excellent tools in the online learning environment because their interactivity allows students to explore new ideas, topics, and concepts.

Further, mobile devices are fast becoming popular as a new educational technology tool. Learning does not occur solely in classrooms. It occurs anywhere and at anytime. To maximize learning, ubiquitous technologies should be used to assist learning in more effective and efficient ways. Using this tool for statistics classes seem to be a logical next step, but it is conceivable that there could be problems. Nihalani and Mayrath (2010) conducted a pilot study that utilized a mobile statistics application (through Apple's Apps store, which is used to purchase applications that can be used on Apple devices such as iPhones and iPods), which a class of statistics students used throughout a semester. Nihalani and Mayrath (2010) discovered that students who

believed this application would increase their motivation and statistics ability obtained significantly higher final grades than those who believed the application would have no effect on their abilities and motivation.

Students reported increased motivation to study because the statistics application allowed for a different, informal study session (Nihalani & Mayrath, 2010). However, it could be that these students would have done well regardless of whether they used the application or not. In order to more clearly understand the impact of using mobile devices on students' leaning, further research should explore other individual differences that may have an effect on using mobile devices for learning statistics. Specifically, students' attitudes toward statistics or the acceptance of technology could have direct impacts on students' statistics performance.

To test the impacts of attitudes towards statistics, technology acceptance, user satisfaction, and cognitive absorption, I used the website titled, "Online Statistics Education: An Interactive Multimedia Course of Study" (Online Stats). This is a freely available online textbook developed by David Lane (2006). The textbook is augmented with tools to aid statistics students' learning of statistics with simulations, multimedia, and real case studies with the associated data. The multimedia on the website combines a slide show along with a spoken lecture which allows students to hear each specific section as opposed to merely reading the text. The simulations cover a wide variety of statistics topics, such as central tendency, probability, variance, etc. and are designed to help students understand difficult content by allowing them to interact with the construct. For instance, the balance scale simulation allows the student to change the shape of the distribution to discover the balance point of the distribution. In a recent study, students perceived the website and its interactive elements as very helpful in their learning of statistics.

Furthermore, this exploration will help to improve the website for the learning of statistics and to advance the website for use with new platforms, like mobile devices (i.e. smart phones and iPods). If students' attitudes towards statistics are related to their comprehension of statistics, it would suggest that the website should include information on the importance of statistics.

To explore how statistics education is related to the acceptance of technology, attitudes towards statistics, and cognitive absorption, this study collected data from students who used the Online Statistics website over the course of two semesters, both using a web browser and an iPod touch. Researcher chose to use iPod touches as an additional technology available for the students because they are light weight mobile devices that may be appealing to students. They are convenient to carry around and utilize for studying in various places. This new mobility may help some students, but may hinder others. We need to understand how the use of technology to teach statistics impacts students' attitudes, comprehension and performance.

There are a few models that can be used to measure and help explain an individual's acceptance or rejection of a technology, but the Technology Acceptance Model (TAM) is one of the better known models (Wixom & Todd, 2005). Wixom and Todd's (2005) study used the TAM as the basis for their measure of technology acceptance. The multiple items used in the current study to measure technology acceptance were modified from Wixom and Todd's (2005) study. Participants were asked to rate statements on a seven-point Likert scale with 1 being "strongly disagree" and 7 being "strongly agree." The TAM statements were modified to fit the Online Stats website, and some example statements are: "Using the online statistics website improves my ability to make good decisions about statistics." and "I intend to use the online statistics website at every opportunity over the next year."

To measure user satisfaction, I used items modified from Wixom and Todd's (2005) study. There are multiple items pertaining to how satisfied the participants are with the website and these items were rated on a seven-point Likert scale 16 with 1 being "strongly disagree" and 7 being "strongly agree." "The online statistics website is easy to use" and "The online statistics website allows me to get my work done more quickly" are example statements from the user satisfaction survey. Similar to the TAM, a total user satisfaction score was calculated for each participant after the instrument was given at the end of the course.

The iPod Touch provides the capability to browse the Internet, play games, listen to music, send emails, and other similar things. The students received second generation iPod Touches that ran on the iOS 5 operating system. During class the students used desktop computers that ran on the Windows 7 operating system, and equipped with Internet Explorer 8 (Schepers et.al, 2007, 90-103).

Further researcher wanted to know if relationships existed between Computerized Assessment Of Statistics (CAOS) and Scholastic Aptitude Test (SAT), and if individual components of the attitude scale could explain that relationship. Additionally, researcher wanted to know if relationships existed between CAOS and technology acceptance, user satisfaction, and cognitive absorption. Researcher also wanted to look at the same relations between SATS and technology acceptance, user satisfaction, and cognitive absorption. Similarly, Researcher wanted to see if any relationships that existed for the use of the Online Statistics website using the computer also existed when students were using the mobile technology (iPod Touches). Furthermore, I wanted to see the relationships between certain demographic variables and statistics literacy and attitudes toward statistics (Rumsey, 2002).

On average, the change in students' CAOS scores from pre to post, which demonstrates statistical literacy, did not change significantly. This is surprising as researcher expected to see that the scores would increase, but the CAOS showed that some students did not improve. Indeed some had a lower score on their post-CAOS than their pre- CAOS. A review of the literature (delMas, et al, 2007) reveals this lack of change or change to a lower score is a common occurrence among participants' who have taken pre and post-CAOS. The CAOS measures statistics literary rather than just statistics computations, so perhaps statistics courses are geared more towards doing statistics (computations) and less towards gaining statistical literacy. This is quite unfortunate because for some students, statistical literacy may be the most important knowledge students can gain from an introductory statistics course.

II. Methodology

Researcher has conducted this research through quantitative strategy by taking a close ended survey for acquiring primary data from the sample of 100 students which were selected through random sampling technique. Researcher's intention is to combine the hypothetical design of research, which is a fact that using the hypothetical method of research enables the researcher to get hold of the information which is quantifiable and makes the investigation easier with the help of gaining responses for meeting the aim of the dissertation. Therefore, for this research study specifically, the researcher has a rationale to assimilate research for advancing the statistical education using technology and mobile devices (Eggers, 2007).

Researcher get the information from the internet by using search engine as Google and get the information related to advancing statistical education using technology and mobile devices from the research papers, articles & books providing sufficient information about current status of the technology and mobile devices and statistical education. For the purpose of collecting data, researcher will be used the secondary sources to obtain information using resources that are reliable.

Furthermore, researcher's intention is related to the inclusion of the secondary data which helps in enhancing the understanding of the issues that are investigated. Additionally, researcher uses secondary data which complements the results of the information that is a part of the study. Intention of the researcher is to take into consideration to statistical education using technology and mobile devices that are discussed in the entire (Eggers, 2007).

The criteria for selection is an important aspect which need to be discussed during the start of the dissertation that what must be included in the research study and what must not be incorporated in it. It must also be taken into consideration that the intention which the criteria of the research is chosen for the research study must ensure inclusion of information that is relevant, reliable and is of high quality. Therefore, the following is the exclusion and inclusion criteria of the study.

III. Analysis and results

The data was obtained from the 100 randomly selected students through a structured questionnaire (*see Appendix*), then it has been analyzed through using SPSS. The frequency distribution tables below are representing the responses in tabular and graphical forms:

Table 1: Statistics is a difficult subject

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	1.0	1.0	1.0
	Disagree	3	3.0	3.0	4.0
	Neutral	23	23.0	23.0	27.0
	Agree	44	44.0	44.0	71.0
	Strongly Agree	29	29.0	29.0	100.0
	Total	100	100.0	100.0	

It is analyzed that most of the students think that statistics is a difficult subject.

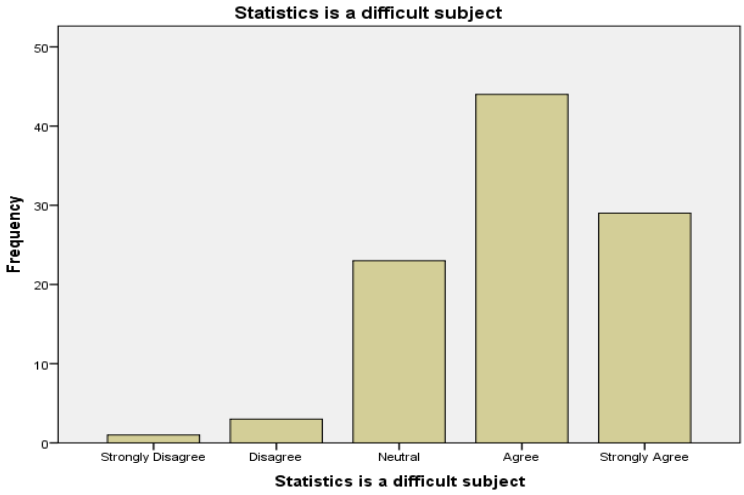


Table 2: Statistics needs advance computing machines

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	1.0	1.0	1.0
	Disagree	7	7.0	7.0	8.0
	Neutral	18	18.0	18.0	26.0
	Agree	48	48.0	48.0	74.0
	Strongly Agree	26	26.0	26.0	100.0
	Total	100	100.0	100.0	

It was analyzed from the responses that statistics education needs computing machines, as most of the responses are in favour.

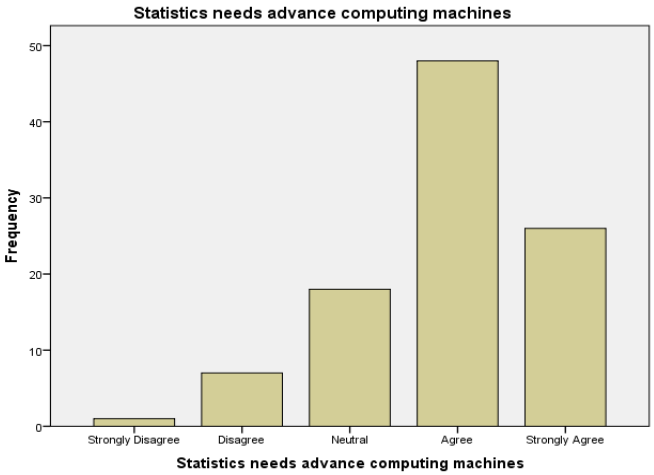


Table 3: Technology usage in Statistics education is a good idea

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	4	4.0	4.0	4.0
	Disagree	4	4.0	4.0	8.0
	Neutral	19	19.0	19.0	27.0
	Agree	42	42.0	42.0	69.0
	Strongly Agree	31	31.0	31.0	100.0
	Total	100	100.0	100.0	

It is analyzed that most of the students are in favour of the above statement

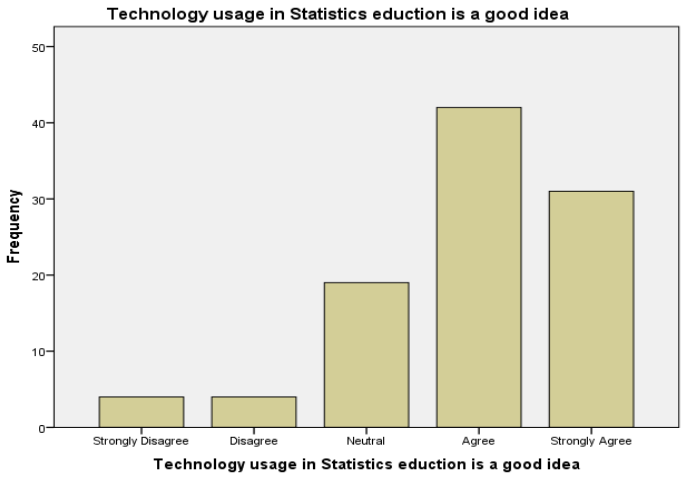


Table 4: Use of technology and mobile phones in Statistics education will impact the grades

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	1.0	1.0	1.0
	Disagree	4	4.0	4.0	5.0
	Neutral	11	11.0	11.0	16.0
	Agree	49	49.0	49.0	65.0
	Strongly Agree	35	35.0	35.0	100.0
	Total	100	100.0	100.0	

It is analyzed that most of the students are in favour of the above statement

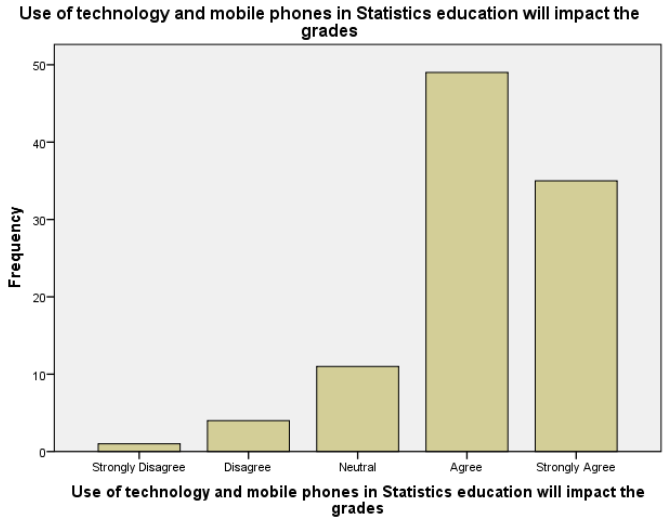


Table 5: Calculations will become easy by mobile technology

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	1.0	1.0	1.0
	Disagree	9	9.0	9.0	10.0
	Neutral	20	20.0	20.0	30.0
	Agree	39	39.0	39.0	69.0
	Strongly Agree	31	31.0	31.0	100.0
	Total	100	100.0	100.0	

It is analyzed that most of the students are in favour of the above statement

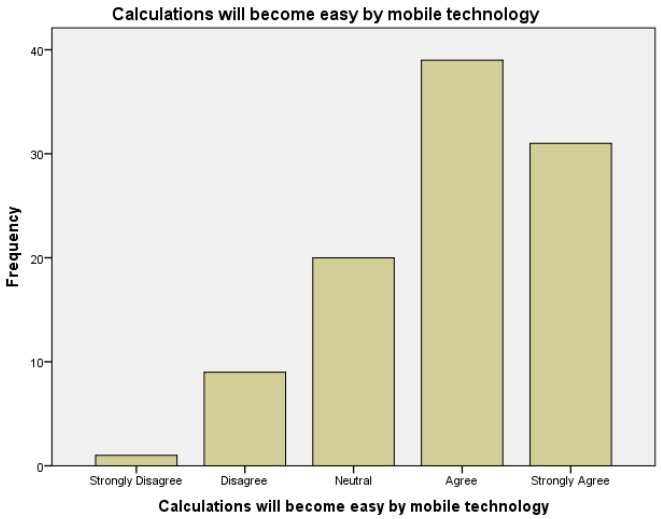


Table 6: Students' interest in Statistics will be developed by mobile usage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	4	4.0	4.0	4.0
	Neutral	17	17.0	17.0	21.0
	Agree	34	34.0	34.0	55.0
	Strongly Agree	45	45.0	45.0	100.0
	Total	100	100.0	100.0	

It is analyzed that most of the students are in favour of the above statement

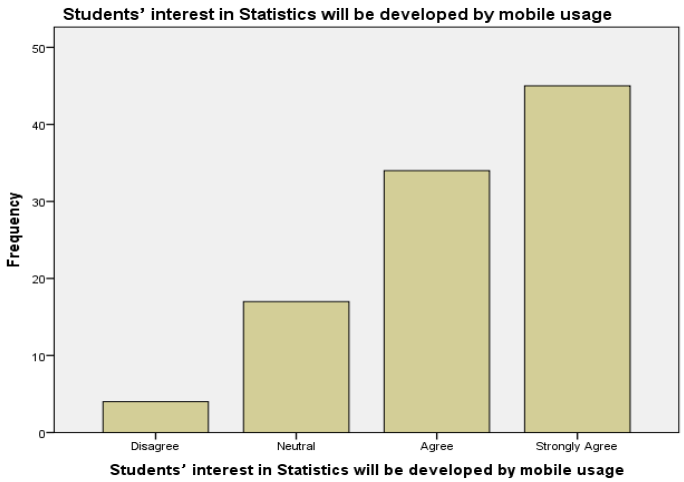


Table 7: Use of mobile phone will assist the students to better understand the math

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	5	5.0	5.0	5.0
	Neutral	22	22.0	22.0	27.0
	Agree	41	41.0	41.0	68.0
	Strongly Agree	32	32.0	32.0	100.0
	Total	100	100.0	100.0	

It is analyzed that most of the students are in favour of the above statement

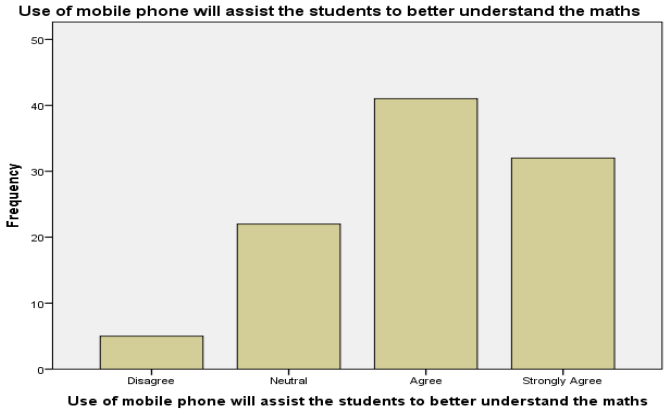
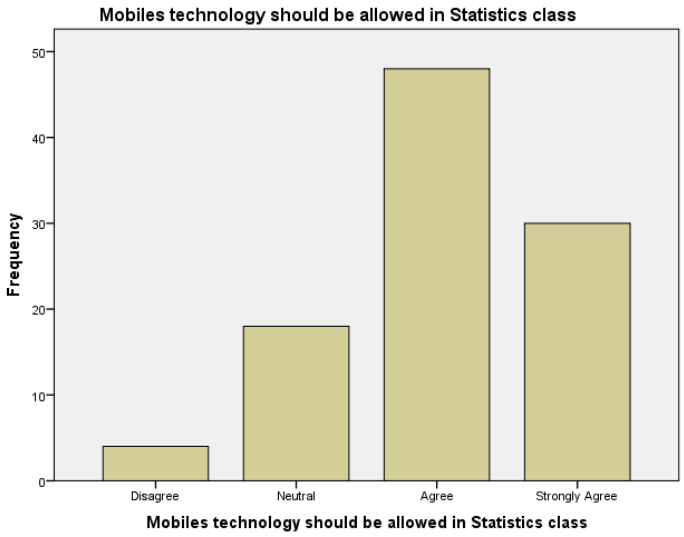


Table 8: Mobiles technology should be allowed in Statistics class

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	4	4.0	4.0	4.0
	Neutral	18	18.0	18.0	22.0
	Agree	48	48.0	48.0	70.0
	Strongly Agree	30	30.0	30.0	100.0
	Total	100	100.0	100.0	

It is analyzed that most of the students are in favour of the above statement



IV. Discussion

Statistics is an extraordinarily important subject and essential for students seeking a higher education. Many introductory statistics instructors agree the course should elevate the student's understanding of data, figures, and numbers while simultaneously training the student for a profession in today's job market.

Once students have successfully completed a statistics course, they should be able to think critically about material they encounter from media sources and come to logical, well-informed decisions about the information. The acquisition of statistical literacy is crucial and the main reason undergraduate programs require students to complete the course as part of their degree plan (Rumsey, 2002).

In recent years there have been significant changes in the use of the Internet through mobile devices. For example, dramatically increased the number of people using mobile devices to access social networks, and also increased use of smart phones in Asia (Moore, 1997, 123-137).

The plates are likely replacement computers than other mobile devices. So when people come to the Internet using the tablet, they visit 70% more sites than when they come from a smart phone. As a result, despite the fact that the world is currently much more smart phones than tablets have more traffic to the plates (Moore, 1997, 123-137).

Researcher look at the statistics of shopping in online stores, researcher can see another confirmation of

the fact that tablets are replacing computers. Low percentage of said purchases from smart phones that likely people continue and complete the purchase process is already using a computer (where the screen is larger, and better keyboard), even if it started on the mobile device (Moore, 1997, 123-137).

Implications for Theory & Practice

The results indicate that students' who have a higher SATS scores at the beginning of the semester have more statistical literacy at the end of the class and gain more statistical literacy throughout the course. The relation between pre-SATS and CAOS (post and change) suggests that having the instructor focus on aspects of a positive attitude in statistics at the beginning of the semester (and possibly throughout) may improve the students attitudes towards statistics immediately and thus improve their acquisition of statistical literacy throughout the course (Rumsey, 2002).

Given the positive relation between pre-SATS and overall math performance, instructors may need to be aware that those students who have a negative attitude towards statistics may have performed lower in the past and may need additional support than those who have a positive attitude. This makes the fact that cognitive competence did not explain the variability in CAOS all the more surprising since that is the item that asks directly about ability to do statistics.

Students who have higher attitudes towards statistics at the end of the class gained more statistical literacy throughout the course and had more literacy at the end of the course. The relation between post-SATS and CAOS (post and change) suggests that improving attitudes throughout the course can be helpful in gaining statistical literacy. Indeed, it may be beneficial for instructors to continue instilling positive attitudes about statistics to students throughout the course and not just at the beginning of the course. Similar to the relation between pre-SATS and CAOS (post and change) more research needs to be conducted to see if an increase in post-SATS would results in higher post-CAOS scores (Rumsey, 2002).

V. Conclusion

There are several findings in this study that are compelling with regard to statistical education advancement. Implications of CAOS and SATS relations will be discussed, along with considerations for CAOS and SATS in relation to technology acceptance, user satisfaction and cognitive absorption. Preliminary results from the mobile technology variables will also be discussed along with thoughts for future research (Rumsey, 2002).

Statistics performance was not related to technology acceptance, user satisfaction and cognitive absorption. The lack of a relation between cognitive absorption and statistics performance was particularly surprising, since it would seem that students who were more absorbed in the technology would be more likely to perform better.

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Appendix

The following set of statements relate to your feelings about use of technology for math. For each of the following statements, please indicate your perception of technology usage in mathematical education by circling one of the numbers below:

1= Strongly Disagree, 2= Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

S#	Statements	1	2	3	4	5
1	Statistics is a difficult subject					
2	Statistics needs advance computing machines					
3	Technology usage in Statistics education is a good idea					
4	Use of technology and mobile phones in Statistics education will impact the grades					
5	Calculations will become easy by mobile technology					
6	Students' interest in Statistics will be developed by mobile usage					
7	Use of mobile phone will assist the students to better understand the maths					
8	Mobiles technology should be allowed in Statistics class					