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Research on Impact of Tablet Teaching on Understanding of Chemistry in High School Students

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ABSTRACT
The present generation has been so much influenced by technology; it allows students to take charge of their own learning. One of the recent technological tools that has fascinated and impacted student learning is Tablet-PC [hereafter 'tablet']. This research work investigates the impact of interactive tablet technology on the achievement, attitude and interest of high schools students in chemistry. The purpose of this research was also to draw a comparison between use of on screen videos and interactive simulation on tablets. The design selected for the present study was pre-test, post-test non-equivalent group design. Additionally, the qualitative part of the study aims to determine the ways in which teachers and students use tablets in classroom and how much they encourage or discourage the active participation of children in the process of teaching-and-learning. The sample constitutes of 106 students of American International School in Dubai, U.A.E. The researcher conducted pre-test and post-test on three major units of high school chemistry. Science Attitude Scale and Science Interest Inventory were also checked before and after the treatment. Students were divided into two groups, students learning with Computer-Aided Instruction: On-screen video (CAI- group-1) and Tablet Interactive Learning (TIL- group-2). The answer scripts, scales and inventory were carefully evaluated. The findings of the study indicate that group-2 [TIL] students performed significantly better in their post-test total mean scores. After the treatment, group-2 students also show increase in scientific attitude and interest. Student and teacher surveys after the treatment helped in discovering many uses and educational functions of tablets. Classroom observations show much better student participation, engagement and interaction in the experimental group [TIL]. In comparison to general on-screen video in classroom, there is a significant positive impact of tablet interactive learning on student's achievement, attitude and interest.
Keywords: Tablet-PC, Interactive learning, On-screen video, Science achievement, Science attitude scale, Science interest inventory.

"To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science."
Albert Einstein

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INTRODUCTİON

Human race owes its growth and development to science and technology. Every sphere of life is shaped by science. It will not be an overstatement to say that the degree to which human mind and society as a whole is progressing today, is in proportion to the progress made in science. Reducing poverty, increasing life span, preserving environment: each of these challenges and many more require capable scientists.
In order to achieve this, schools need quality science education which is relevant and engaging. Science should be able to develop creative and critical thinking capabilities of student's right from the primaries.

We need today education which can mobilize the energy and enthusiasm of children and kindle the flame within them. It is only then that science can progress by leaps and bounds and so would the human race be able to make its dreams a reality.

Today's generation is often called "Digital Generation". Children today not just communicate digitally but think, learn, process, analyze, devise, design, draw, review, assess, judge, evaluate; even defend digitally. Traditional teaching and learning methods are becoming less effective at engaging students and motivating them to achieve.

In recent years, tablets have offered increasingly tempting opportunities to users in industries such as health, construction and education due to their portability, ease-of-use and other features (El-Gayar, Moran, & Hawkes, 2011). Tablets have provided an opportunity for students to be at the forefront of learning with their introduction into schools. They can provide access to the internet to both retrieve information and contribute to its production, and allow students to use tools such as simulations, wikis and blogs (Moran, Hawkes, & El Gayar, 2010). Mobile technologies such as tablets and smartphones provide new modes and forms of interactions through social networking and an increased possibility of sharing information (Zhong, 2013). Tablets, which strongly aid this kind of interaction and information-sharing, can enhance the possibilities of learning within specific educational environments. Tablets can be used for many activities that support learning and the acquisition of knowledge, including taking notes during the lesson (Steinweg, Williams, & Stapleton, 2010), accessing e-books (Dundar & Akcayir, 2014), using different applications (Keskin & Kuzu, 2015), using computer-aided test instruments (Siozos, Palaigeorgiou, Triantafyllakos, & Despotakis, 2009) and carrying out research through various websites.

New and innovative methods of learning through use of tablets are creating a new model of teaching and learning that can occur anytime, anywhere and at the student's pace (Joshi, 2012).

Mobile Learning and its applications have been utilized widely in the field of education; however, a recent UNESCO report on Mobile Learning in Africa and the Middle-East (AME) acknowledged "the dearth of evidence-based research and the limited credibility and trust worthiness of available information on mobile learning in the AME region" while it recommended "case-building and evidence-development on mobile learning in support of teachers, teaching and teacher development" (Shafika Isaacs, 2012)

While the use of computers in the classroom is becoming widespread and investments in this area are increasing, studies on computerization and educational outputs are limited (Bebell &
O'Dwyer, 2010). It has been suggested that further research is required to assess tablets' effectiveness in learning environments (Nguyen, Barton, & Nguyen, 2015).

This study therefore aims to contribute to the field of educational technology by seeking the extent of impact tablet teaching has on student achievement. Drawing comparison between on-screen video and simulations on tablet aims to reveal the potential difference between these educational tools. Through this research, I plan to test the potential of tablet technology by considering both an instructional point of view and a learning point of view. In terms of instruction, android tablets offer many advantages such as inclusion of complex digital media, customized application installation facility. The teacher can make their thinking visual by maintaining a real-time mixture of difficult physical science concepts and expert annotations. In addition, the instructor will be mobile, would face the class and would not obstruct the view of the material as it is presented. In terms of learning, a student's comprehension is bound to be enhanced due to use of variety of media and simulations.

Need of the Study:

"Continuing low levels of student engagement in school science, and the downward trend in studying science beyond the compulsory years, strongly suggests that the traditional school science curriculum has become outmoded".(Goodrum et al., 2001; Hassan & Treagust, 2003).

The National Focus Group of NCERT has enlisted many suggestions for Education Technology and one of them is to examine the possibilities of mobile technologies for learning purposes. My Research is focused on doing exactly this. By conducting this research I would like to explore the possibilities of impact of smart devices on classroom instructions.

Numerous reports and research findings document problems and shortcomings associated with teaching and learning in science. Challenges and issues range from declining interest of children in primary to lack of knowledge in teachers.

Surveys by international groups such as the "European Commission" (2007) found that schooling in science was often related to learning information rather than to understanding concepts and

investigating them. Use of ICT and Tablets is the need of the hour which can help in increasing the scientific interest and attitude of our learners, who will build our future.

Specific objectives of this study are:

- To examine the ways in which Tablets can function as a communicative tool in the teacher-pupil interaction at high level.
- To study the ways that the use of the Tablets appear to encourage or discourage the active participation of children in the process of teaching-and-learning.
- To study the extent to which potentially valuable affordances of the Tablets are, or are not, used by teachers to pursue their learning goals.
- To evaluate the overall level of achievement of tablet technology on the understanding of chemistry in American system, high schools in Dubai.
- To study the effect of tablet based learning on the scientific attitude and interest of high school students.

Hypothesis: The present study was conducted with the following hypothesis:

- There is a significant difference in the achievement levels of grade 10 students studying through Tablet interactive learning [TIL] and Computer Aided Instruction [CAI].
- There is a significant difference in the Science Attitude Scale of grade 10 students studying through Tablet interactive learning [TIL] and Computer Aided Instruction [CAI].
- There is a significant difference in the Science Interest Gain Scores of grade 10 students studying through Tablet interactive learning [TIL] and Computer Aided Instruction [CAI].
- There is significant difference in the retention of the concept as per the delayed achievement test levels of grade 10 students studying through Tablet interactive learning [TIL] and Computer Aided Instruction [CAI].

Limitation:

1. The study is restricted to sample chosen only from Dubai, UAE.
2. The investigation is restricted to high school students of American Curriculum Students.
3. The pre-test and post-test achievement tools are prepared by the researcher.

DESİGN OF THE STUDY:

Since the intention of the study was to study the impact of Tablet teaching on understanding of Science, Experimental Method was found to be the best to conduct the study. As this method provides much control it helps to establish a systematic and logical association between manipulated factors and observed effects. It is the most sophisticated, exacting and powerful method for discovering and developing an organized body of knowledge.

The design selected for the present study was pre-test post-test non-equivalent group design. This design is often used in classroom experiments when experimental and control groups are such naturally assembled groups as intact classes, which may be similar.

In order to assess and examine the students understanding and progress in science, the study would use *pre test and post test* with valid and reliable scales of assessments. The sample consists of 106 students of grade 10 from American International School, Dubai.

Collection of Data: This study employed various methods to collect student response: Diverse Assessment tools, interviews; classroom observations; and a questionnaire measuring student attitudes towards, and interest in science. Data collection instruments for this study were as follows: Attitude Scale, Science Interest Inventory, Online surveys for students and teachers, various achievement tests, classroom observations.

The reformulated test paper was administered to all 106 students based on three major units of Chemistry namely: Atomic structure and Isotopes, Molecular Bonding and Shapes and Balancing of Chemical Reactions. Pre-test was conducted along with Attitude Scale and Interest Inventory before teaching every unit.

Students were divided into two main groups. Control group, [CAI] using Conventional Computer Instruction [Video] method of teaching where students learnt through on screen video while Experimental group, [TIL] taught using Tablet –PC which was basically tablet interactive learning. After the teaching of every unit Post-test was conducted and later after a month Delayed post-test was conducted. Two different student surveys were done to collect their experience and opinions firstly about the use and functions of tablet-pc and secondly about their experience and opinion about the complete teaching process during this study. All the science teachers were also asked to share their experience and give their opinion about the use and function of tablet-pc.

All the answer papers were carefully evaluated and scores obtained from all the thirteen assessments were systematically tabulated. After both the treatments more than 120 students and 27 science teachers were surveyed to collect their opinions and experiences with tablet-pc.

Analysis: The entire data collected to study the impact of Tablets on understanding of chemistry was rigorously analyzed with respect to method of teaching and gender. The data was analyzed using mean, standard deviation and t-test. Descriptive analysis was carried out based on all the objectives and hypotheses of the study. Online statistical analysis tool, "Graph pads" and MS Excel data analysis application was used to perform all calculations and data analysis.

All the survey was conducted online through "Google-Forms". The final analysis of the survey were collected and studied to interpret their results and implication on teaching and learning.

RESULTS AND DİSCUSSİON

The tables below show that there is a significant difference between the post test and delayed post test retention scores of control and experimental groups' achievement tests. There was also a significant increase in the Scientific Attitude and Scientific Interest of the experimental group which was not seen in the control group. Analysis of student and teacher survey responses shows that majority of the students and all the teachers have a firm belief that tablets have multiple uses and functions to improve classroom instructions. Also those interactive lessons taken through tablet-pc help in understanding difficult concepts and make learning fun.

Table 1: Consolidated Post-test results with respect to the method of teaching.

Combined Post Achievement test in Advance Chemistry Total Scores	Method of Teaching	
	Control [CAI]	**Experimental [TIL]**
N	**53 [148]**	**53 [155]**
Mean	**17.88**	**23.22**
SD	**6.32**	**5.87**
SEM	**0.52**	**0.47**
Un-Paired t-test value	**7.6218**	
Significance	**Extremely Statistically Significant**	

The above table shows that there is significant difference in the post test total mean score of the students studying through Computer Aided Instruction [CAI] and Tablet interactive learning [TIL]; at 0.05 level of significance.

Table 2: Consolidated Delayed Post-test retention scores with respect to the method of teaching.

Combined **DELAYED** Post Achievement test Total Scores	Method of Teaching	
	Control [CAI]	**Experimental [TIL]**
N	**53 [94]**	**53 [98]**
Mean	**23.27**	**34.34**
SD	**11.80**	**16.53**
SEM	**1.22**	**1.67**
Un-Paired t-test value	**5.3212**	
Significance	**Extremely Statistically Significant**	

The above table shows that there is significant difference in the delayed post test total mean score of the students studying through Computer Aided Instruction [CAI] and Tablet interactive learning [TIL]; at 0.05 level of significance.

Table 3: Scientific Attitude Scale Comparison of Experimental and Control Group.

Science Attitude Scale Total Scores	EXPERIMENTAL Group		CONTROL Group	
	Pre-test Score	**Post-test Score**	**Pre-test score**	**Post-test score**
N	**50**	**51**	**50**	**48**
Mean	**48.6**	**53.16**	**49.72**	**49.44**
SD	**7.95**	**8.22**	**6.31**	**6.81**
SEM	**1.12**	**1.15**	**0.89**	**0.98**
Paired t-test value	**3.5981**		**0.5335**	
Significance	**Extremely Statistically Significant**		**Not Statistically Significant**	

The above table shows that there is a significant difference in the Science Attitude Scale of grade 10 students studying through Tablet interactive learning [TIL] while no significant increase in attitude the of those studying through Computer Aided Instruction [CAI].

Table 4: Scientific Interest Comparison of Experimental and Control Group.

Science Interest Inventory Total Scores	EXPERIMENTAL Group		CONTROL Group	
	Pre-test Score	**Post-test Score**	**Pre-test Score**	**Post-test Score**
N	**50**	**50**	**51**	**48**
Mean	**153.78**	**166.62**	**165.10**	**164.13**
SD	**30.83**	**31.40**	**28.99**	**34.58**
SEM	**4.36**	**4.44**	**4.06**	**4.99**
Paired t-test value	**4.1027**		**0.5276**	
Significance	**Extremely Statistically Significant**		**Not Statistically Significant**	

The above table shows that there is a significant difference in the Science Interest of grade 10 students studying through Tablet interactive learning [TIL] while no significant increase in the interest of those studying through Computer Aided Instruction [CAI].

Table 5: Consolidated post-test results with respect to gender.

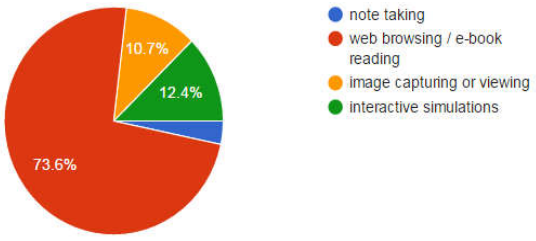
Gender Based Combined Post Achievement test Total Scores	**Gender**	
	Girls	**Boys**
N	**52 [153]**	**54 [150]**
Mean	**20.88**	**20.33**
SD	**6.65**	**6.66**
Un- Paired t-test value	**0.7181**	
Significance	**Not Statistically Significant**	

The above table shows that there is no statistical significance in the post test total mean score of girls and boys; at 0.05 level of significance.

1. Comparing the post-test scores of the students studying through Computer Aided Instruction [CAI] and Tablet interactive learning [TIL], it is found that TIL group performed much better and showed a superior understanding and retention of concepts.
2. Comparing the Science Attitude and Interest scores of the students studying through Computer Aided Instruction [CAI] and Tablet interactive learning [TIL], it is found that TIL group showed significant increase in scientific attitude and interest while the CAI group didn't show any significant increase in both.
3. Comparing the Delayed post-test retention scores of the students studying through Computer Aided Instruction [CAI] and Tablet interactive learning [TIL], it is found that TIL group showed significant increase in their retention while the CAI group didn't show any significant increase in retention.

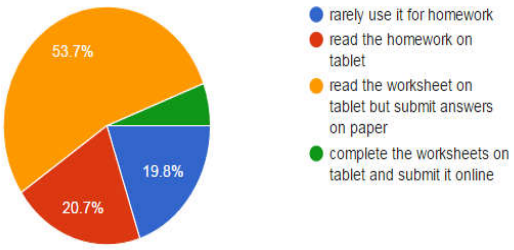
Student Survey: Figure 1

Which function of tablet do you mostly use in class? [121 responses]



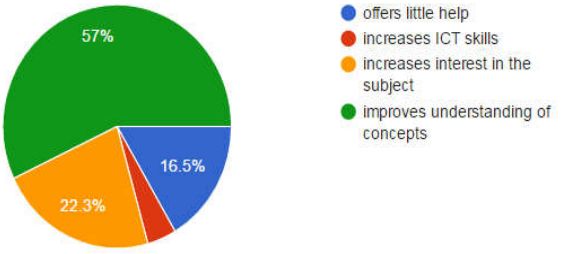
Student Survey: Figure 2

How do you use tablet for completing your homework? [121 responses]



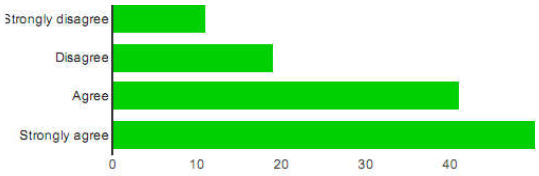
Student Survey: Figure 3

How does tablet help you in class? [121 responses]



Student Survey: Figure 4

Tablets help students perform better in class. [121 responses]

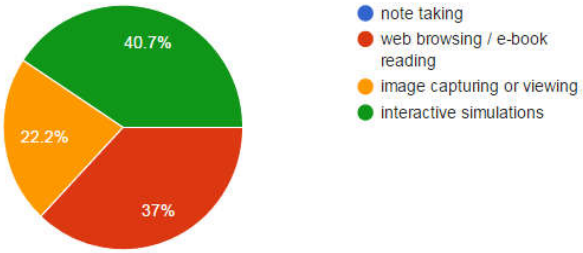


Strongly disagree	11	9.1%
Disagree	19	15.7%
Agree	41	33.9%
Strongly agree	50	41.3%

4. Analysis of the Student survey shows many important functions and uses of tablets. Few of them are shared here:
   a. More than 73% students consider Web browsing and e-book reading as the major use of tablet [Fig. 1].
   b. More than 53% students use tablet for checking their homework and competing it [Fig. 2]
   c. 57% of the students believe that tablets help in better understanding of concepts [Fig. 3].
   d. More than 75% either agree or strongly agree that tablets help perform better in class [Fig. 4].

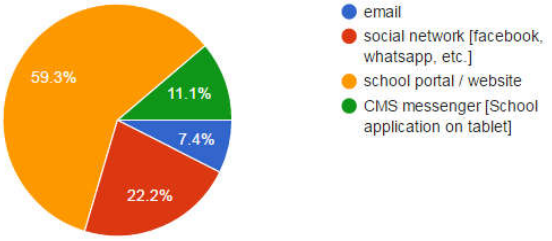
Teacher Survey: Figure 5

Which function of the tablet do you mostly use in class? [27 responses]



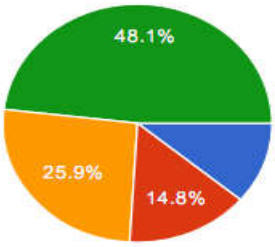
Teacher Survey: Figure 6

How do you communicate with your students using tablet? [27 responses]



Teacher Survey: Figure 7

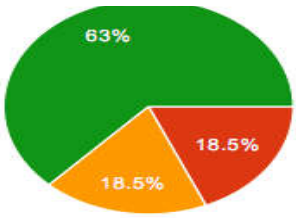
Which tablet feature do you think mostly helps your students in their studies? [27 responses]



ease of handling [size]	3	11.1%
touch interface	4	14.8%
wifi or data connectivity	7	25.9%
multifunctional capacity	13	48.1%

Teacher Survey: Figure 8

Which type of media helps best in building concept knowledge? [27 responses]



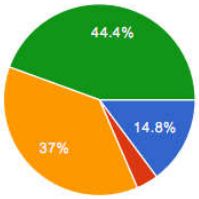
audios	0	0%
images / texts	5	18.5%
videos	5	18.5%
interactive simulations	17	63%

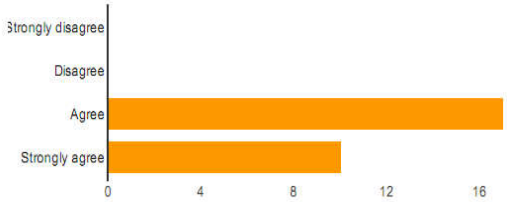
Teacher Survey: Figure 9

Which resources are mostly used to supplement teaching? [27 responses]

Teacher Survey: Figure 10

Tablets make learning more fun. [27 responses]





online video content	4	14.8%
online community or discussion forums for teachers	1	3.7%
online articles tied to instruction	10	37%
web-based interactive games or activities	12	44.4%

Strongly disagree	0	0%
Disagree	0	0%
Agree	17	63%
Strongly agree	10	37%

5. Analysis of the Science Teacher survey shows numerous uses of tablets in classroom instructions and learning. Few of them are shared here:
   e. 41% teachers use interactive simulations, while 37% use image capturing or viewing as a main function of tablet [Fig. 5].
   f. 48% science teachers feel that the multi-function capacity of a tablet-pc is the most useful one, and 63% feel that simulators are the best to improve conceptual knowledge of students [Fig. 6].
   g. More than 44% teachers feel that web based interactive-activities are mostly used to support teaching, while 37% feel that online articles tied to instructions can do this job [Fig. 9].
   h. Almost all the teachers [100%] either agree or strongly agree that tablet makes learning more fun [Fig. 10].

Educational Implication:

1. The present study shows that use of interactive tablet technology in classroom has much more positive impact than the use of On Screen videos. Achievement of high school students depends a lot on the method of teaching and instructional strategies used. As such, to improve overall quality of teaching and learning in science and other subjects, schools should provide more opportunity for interactive tablet technology usage.
2. The tablet technology would reduce the dependency on teachers as the only source of knowledge and information. Students will be more self-dependant and would eventually take the responsibility of their own learning.
3. Fun based and web based teaching-learning would inspire our students more and more into science. It will also help teachers and parents to be effectively involved in the learning process anywhere, anytime. So it is necessary to make our teaching-learning more web-based and interactive to make science a joyful experience.
4. The present study shows that students have a more concrete understanding of concepts when they comprehend the cause and effect relationship between scientific concepts and principles. This results into a learning which is solid and long lasting.
5. This study reveals that use of simulation, videos and online learning tools are the most widely used features of tablets. Moreover, students and teachers have a strong agreement on the impact and use of tablets in classroom. Hence there is a need to create easy access to tablet technology in all schools.

CONCLUSION

The use of Simulations on Android based Tablets would increase the ability of students to have an in depth understanding of science thus increasing their attitudes and interest in science. This is because tablets unlike laptops or PCs, are much easier to use and children learn best at their own pace and space, with the tools they have in their hand and when they have many opportunities to initiate, plan, carry out, and discuss their actions and ideas. Technological changes and challenges faced in science education need school's attention. Schools need complete understanding of the impacts of hand held devices [Android based tablets] and its effective use on education and in particular on science. I believe that if used appropriately, tablets could provide effective and concrete learning which will be long lasting and life changing.

Ultimately, we are obliged to find ways to teach so that opportunities to learn are maximized. The changing needs of children demand that teachers expand their role beyond purveyors of information, to become facilitators, co investigators, guides, and coordinators. These changes are taking place rapidly,

against a backdrop of the shift from an industrial economy to one based on the instantaneous, global traffic of information. Teachers and school leaders today must, as Tony Wagner puts it, "rebuild the airplane while they're flying it" (Wagner, 2006).

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