

**Proposed Guidelines to Improve the Effect of Educational Technology on
Student's Performance**

Aurora P. Tolentino*, Rhueliza R. Tordecilla,
Bernadet C. Macaraig, Rene R. Magpantay
College of Information and Communications Technology,
University of Batangas, Hilltop, Batangas City, Philippines
*Corresponding Author: aurora.tolentino@ub.edu.ph

Abstract

Schools and universities are implementing and utilizing emergent technologies in the classroom which is done by integrating computers and other educational technologies as the new learning environment. For more than a decade, the UB Junior High School lives up to the institution's mission to produce students who are technologically driven and globally competitive. With the technology revolution taking place, the school acknowledges the contribution of educational technology (EdTech) in student's learning and teacher's teaching process. The main objective of the study is to evaluate the implementation of EdTech to Special Science Curriculum of UB Junior High School. Specifically, this study described how EdTech is integrated to classes from AY 2009-10 to AY 2012-13 using desktop or personal computers and from AY 2013-14 to AY 2016-17 using mobile technology such as iPad and tablet. The research described students' performance in selected courses using the two different EdTech devices. Finally, this study proposed a guideline on the application of appropriate EdTech for more effective teaching and learning. This is a combination of quantitative and qualitative research where data were gathered through documentary analysis, focus group discussion and interview with teachers and school management. Findings include that integration of EdTech is being done by continuously applying emergent technologies supporting 21st century learning. There are courses that students learn better with the help of EdTech using desktop rather than tablets or iPads and vice versa. As such, full appreciation by the learners and teachers on how and when to use the EdTech tools properly determine its positive effect to student's performance. Finally, the study recommends dissemination and training on educational technology applying its proposed guidelines on how to effectively implement the approaches in support of the 21st century education.

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Introduction

The impact of technology in the society more specifically in education is being witnessed by this generation of millennials. Educational institutions' utilization of technology is an advantage for these are powerful teaching and learning tools. From minimal integration of technology in classrooms, schools now apply hybrid strategies in integrating educational technology in their curriculum.

Implementation and utilization of emergent technologies in the classroom is now a trend in schools and universities, from the use of personal computer to mobile gadgets such as tablets. Schools now provide computer laboratories for students' so they can learn basic typing skills and have access to supplementary learning tools that can catch students' interest and provide individualized instruction (Flanagan, 2016).

The University of Batangas Junior High School Department acknowledges the contribution of educational technology in their students' learning process. EdTech is defined as the study and practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources. It is a systematic and organized process of applying modern technology to improve the quality of education (Stošić, 2015). According to International Society for Technology in Education (ISTE) (2008), EdTech has positive effect to students when implemented with adequate professional development and has strong support. The organization presented convincing evidence that technology integration in teaching and learning is having a strong positive effect on student outcomes when implemented appropriately.

To answer the question "How do students learn effectively?", the proponents deemed it necessary to look into different theories of human behavior such as cognitivism, and constructivism. These theories, which became the basis of many educational tools in the classroom today, suggest that learning should take place in a dynamic and multi-dimensional context, and in combination. Furthermore to provide optimal learning, they can be incorporated into an instructional design (Cruz, 2013).

According to Flippen (2012), cognitivism focuses more on mental processes such as thinking, knowing, memory, and problem-solving, with the goal of opening the human mind and this is where learning occurs. Cognitive theories focus on the conceptualization of students' learning processes and address the issues of how information is received, organized, stored, and retrieved by the mind (Ertmer, 1993). According Herring (2014), cognitivists believe that the thought process is a cause for behavior so cannot itself be a behavior. It focuses on the importance of the attainment of knowledge. Cognitive learning theories draw attention on how the learner attains

the knowledge of how to perform that action. EdTech and cognitive approaches should go hand in hand to form effective and efficient instruction. He added that since cognitive theories are focused on the thought process, courses can easily be tailored to reflect the best cognitive learning theory practices.

Piaget's (1954) theory of constructivism suggests that students construct knowledge through cognitive organization. Learners enter into any situation with a defined level of knowledge about the situation and each new idea is understood through this previous learning or schema. Constructivism theory emphasizes that the learners construct and build the information inside their mind based on their experiences and prior knowledge. According to Aldoobie (2015), constructivism theory has a great impact for both the learner and the instructor especially if this theory integrates with technology. This theory supports higher skills and complex and collaborative problem solving in learner's mind that will make them become very active and more responsible about what they learn.

Also known as 'learning by doing', constructivism has generated renewed interest in the digital era. Constructivist practices such as apprenticeships have a long history, but in contemporary classrooms they and other hands-on programs often take a back seat to teachers telling students what they need to know rather than facilitating each person's natural curiosity and learning style. Digital learning tools have the potential of being customized to fit the abilities of individual students and can engage them with interactive tasks and simulate real-life situations. On the other hand, a constructivist teaching framework helps to foster student motivation and achievement and this theory is easily paired with the use of technology. The theory of constructivism states that students need to construct their own meaning based on a learning experience (Powell & Kalina, 2009).

Over the past years, a number of studies have gained benefits from the use of technology in education. EdTech has proved to be effective for making students efficiently proficient with various subjects. Cheung et al. (2012) examined the effectiveness of EdTech applications for enhancing mathematics achievement in K-12 classrooms. Findings indicate that EdTech applications produce a positive effect on Mathematics achievement. They also reviewed the impact of EdTech on reading. The researchers concluded that EdTech generally produced small to moderate effects on reading outcomes.

For almost a decade, the UB Junior High School Department has been upholding the institution's mission to produce students who are technology-driven and globally competitive. To meet this expectation, programs such as the one-student-one computer (OSOC) and the use of e-books have been integrated to the curriculum.

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The main objective of the study is to evaluate the implementation of EdTech by the UBJHS for Special Science Curriculum classes. Specifically, this study described how EdTech is integrated to SSC classes from AY 2009-10 to AY 2012-13 using desktop or personal computers and from AY 2013-14 to AY 2016-17 using mobile technology such as iPad and tablet. The research described students' performance in selected courses using the two different EdTech approaches. Finally, this study proposed a guideline on the application of appropriate EdTech for more effective teaching and learning.

Methodology

This is a combination of quantitative and qualitative research. Secondary data were gathered from the offices of the HS Principal and Registrar. Achievement test percentage scores were collected from the record books of the concerned teachers from AY 2009-10 to AY 2016-17. Focus group discussion (FGD) was conducted with SSC teachers and interview with the Assistant Principal for Academic Affairs (APAA) was done to gather pertinent information. Documentary analysis on the publications from the HS department focusing on the same subject matter was also conducted.

Using purposive sampling, only course handled by the same teacher in AY 2009-13 and in AY 2013-17 were considered in the study. This was done because, in AY 2009-10 to AY 2012-13 EdTech learning materials were distributed electronically via desktop personal computers and in AY 2013-14 to AY 2016-17 via mobile technology such as iPads and tablets. Using this criterion, Tables 1 and 2 were presented to show the population and sample of the study. Mean and standard deviation were computed and t-test was used to test the hypothesis of no difference.

Table 1

SSC Enrollment Data (Population)

One-Student-One-Computer	1st Year	2nd Year	3rd Year	4th Year
2009-2010	120	90	94	93
2010-2011	159	89	82	91
2011-2012	159	111	74	65
2012-2013	160	116	107	74
Mobile Technology				
2013-2014	160	109	112	90
2014-2015	159	154	105	111
2015-2016	160	149	147	104
2016-2017	172	145	143	142

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Considering the criterion that only those subjects handled by the same teacher in AY 2009-13 and AY 2013-17 were considered in the study, five (5) classes in four (4) areas were identified. Class sizes are presented in Table 2.

Table 2

Class Size of Subjects with common teachers (Sample Size)

Subject Area and Subject	One-Student-One-Computer (AY 2009-13)	Mobile Gadget (AY 2013-17)
Mathematics		
Math 1	40	40
Math 4	31	30
Social Studies		
SocSci1	43	43
Science and Technology		
S&T 1	40	40
Languages		
Language 1	40	40

Results and Discussion

Schools and universities are implementing and utilizing emergent technologies in the classroom. Integrating computers and tablets in the classroom began with personal computers. Generally, students were able to access a computer lab within the school environment in order to learn basic typing skills, as well as have access to supplemental learning tools that mimicked game-like scenarios that both caught student's interest and provided individualized instruction (Flanagan, 2016). EdTech that best fits students' needs and is implemented with adequate professional development and support has strong, positive effects on student test scores. There is convincing evidence that technology integration in teaching and learning is having a strong positive effect on student outcomes when implemented appropriately.

Integration of Educational Technology to Science HS Curriculum of UB

The SAMR model can be used to classify and evaluate student learning activities when integrated with technology. According to Romrell, Kidder & Wood, (2014), evaluating the extent to which of each of the four levels of SAMR are implemented in an instructional setting may serve as an indicator of increase in student learning. Flanagan (2016) stated that the more activities are labeled as Modification or Redefinition, the greater the possibility that student learning has been affected as compared to learning without the device and if a substantial number of activities are labeled as Substitution or Augmentation, then learning has not likely increased as compared to learning without the technology.

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Starting AY 2009-10, the management of the University of Batangas identified EdTech as an innovative learning tool that would provide SSC an edge to sustain students' good academic performance. The management got ready for its implementation by preparing the teachers, facilities, and other support services. FGD with teachers and interview with the management revealed how the school systematically started with integration of EdTech to 1st year SSC.

AY 2009- 2010 to AY 2012-2013. In AY 2009-10, teachers handling SSC subjects attended trainings in the use of technology in the classroom. They trained on how to use productivity software in development of test, assessment and instructional materials in preparation for the implementation of EdTech to subjects in the 1st year level. Likewise, students were provided with desktop computers having internet access. Classes were held in the laboratory rooms converted as classrooms. Teachers converted the old flipcharts of lectures to presentations which are distributed to the students' computers. Students follow with the lecture by opening the presentation (lectures) in their individual desktops while teachers elaborate on the topic using projected lessons. Teachers likewise created exercises and activities for the students to work within their computers. They developed short and long tests using productivity software and administered these exams using desktop computers.

In AY 2010-11, to maximize the use of Internet in the classroom, students and teachers were provided with email addresses using ub.edu.ph domain. A web-based application called eBrahman was developed to improve collaboration between teachers and students. Teachers' training included the use of Google apps and other open source applications. With teachers' continuous training on the use of emergent technologies and with their skills in creating, using and managing materials developed using technology, EdTech, supported by one desktop computer per student, became the new learning environment.

The teachers who joined the FGD commented that from the beginning, they eagerly welcomed the approach except for some senior teachers, majority of the mentors though digital immigrants, fully accepted EdTech as the means to 21st century education. They enjoyed the training as well as the workshops when they started developing their teaching materials. This supported the report of ISTE (2008), that EdTech must be implemented with adequate professional development on the part of the teachers. The school even allowed them to acquire computers for personal use. Truly, the project was launched with teachers' excitement and enthusiasm.

The project was implemented initially for freshmen SSC students. These digital natives accepted the process without hesitations. In the interview with teachers, they revealed that using EdTEch tools, students started to construct knowledge as they explore the information gathered from various digital references. Students' study

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habit is likewise improved as they learn to collaborate with classmates in doing projects and during lesson reviews. They noted that students become more focused on class activities showing their interest to explore and learn more.

Effective integration of technology is achieved when students are able to select technology tools to help them obtain information in a timely manner, analyze and synthesize the information, and present it professionally. The technology should become an integral part of how the classroom functions -- as accessible as all other classroom tools. However, teachers reported that students exhibit difficulties in taking exams using computers. The teachers developed short and long exams which are distributed to the students via their individual computers. Used to pen-and-paper tests, students find it cumbersome taking exams using desktop computers.

AY 2013-2014 to 2016-2017. Technology evolves and so with EdTech processes and resources. Teachers continue to be trained on new technology for integration and the university sustains its investment for facilities and other support services.

Starting AY 2013-14, SSC opted to replace the desktop computers with iPads and tablets for the purpose of using eBooks rather than printed books. With eBooks students were relieved of carrying heavy books and other materials. With mobile technology, students practically can study anywhere and anytime since they have their books and references in their handy gadgets. This practice has been in effect until AY 2016-17.

This is in support to the findings of Lovászová, Michaličková, & Cápay (2015) that tablet technology is useful for education because it is portable. Students can use the device anywhere and not limited by restricted space of the classroom. According to Chou, Block, & Jesness (2012), tablet devices cater to the needs of the 21st century learning focusing on collaboration, communication, graphics and visual arts creation and instant gratification.

Based on FDG, teachers favor use of desktop computers over mobile gadgets. This may be because of their personal experiences or lack of it, in using this wireless technology. They mentioned in the interview that there was not enough training for them to maximize its application in the classroom. With such limitation, teachers have not developed enough supplementary materials for the subjects. They rely heavily on eBooks and some sites which are sometimes difficult to access via the Internet. Further, once given Internet access, curious students sometimes lost focus and tend to be distracted by browsing other sites. If classroom management posted daily problem, bringing the mobile gadget at home is another struggle where students tend to download games and other applications they find fancy with. According to teachers, these are distractions to their studies.

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In general, from AY 2009-10 when SSC started the implementation of EdTech, the university continuously adopts with the changes brought about by the dynamic field of technology. The learning environment brought about by EdTech continuously caters to the need of the 21st century learning providing venue for easy collaboration, digital literacy, critical thinking and problem solving leading toward students' lifelong learning. Both teachers and students explored this innovative process of learning transformation. As such, based on SAMR model, the integration is being done through modification and redefinition of the process of learning through the use of EdTech.

Student's Performance on Selected Subjects using EdTech

Table 3 presents the summary of statistics characterizing the students' performance in selected subjects using the results of achievement tests.

Table 3

Results of Statistics on Students' Achievement Test Scores (in Percent)

Approach in EdTech	Subjects	Min	Max	Mean	Std.Dev.
One-Student-One-Computer (AY 2009-13)					
	Science & Technology 1	11	61	33.90	11.84
	Language 1	42	75	58.68	9.09
	SocSci 1	47	69	59.94	5.83
	Math 1	24	65	47.37	10.63
	Math 4	24	71	40.00	10.65
Mobile Gadget (AY 2013-17)					
	Science & Technology 1	48	84	69.83	8.64
	Language 1	55	91	70.88	8.43
	SocSci 1	35	72	53.46	9.25
	Math 1	31	92	50.29	12.91
	Math 4	48	93	69.04	11.43
Results of t-test					
Science & Technology 1		15.87**			
Language 1		6.38**			
SocSci 1		-3.43**			
Math 1		0.30ns			
Math 4		10.27**			

Note: ** = Highly Significant; ns=Not Significant

In AY 2009-13, using one-student-one-computer approach, students of Science and Technology 1 (S&T 1) got an average percentage score of 33.90 with 11 as minimum and 61 as maximum scores. On the other hand, in AY 2013-17, S&T 1 students got an average percentage score of 69.83 with 48 minimum and 84 maximum

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scores. When statistically tested using t-test, the t-value of 15.87 was found to be highly significant showing that scores of students using mobile gadget are significantly higher than those using desktop computers.

The same finding was revealed in Language 1 and Math 4. Students using tablets and iPads performed significantly better than those using desktops. For Language 1, t-value of 6.38 was found highly significant indicating that through the use of iPads and tablets, students learn better as shown by their mean percentage score in the achievement test of 70.88 with minimum score of 55 and maximum of 91, compared with 58.68 when using desktop. In Math 4, the mean percentage score of 69.04 was found to be significantly higher than 39.71 as indicated by t-value of 10.27 which was tested to be highly significant at one percent level. According to the teachers in the FDG, this may be attributed to numerous web-based references that are included with the eBook. Students appreciate and understand the lessons better when supported with audio, videos and other multimedia which they enjoy using very well.

On the other hand, findings with SocSci 1 and Math 1 are different from the abovementioned subjects. In SocSci 1, students using desktop computers perform significantly better than those using iPads and tablets. The t-value of -3.43 revealed that the percentage score of 59.94 with 47 minimum and 69 maximum scores in the achievement test when desktops were used is highly significantly higher than the 53.49 scores of students using iPads and tablets. Moreover, in Math 1, students using EdTech through the use of desktops and those using mobile gadgets posted no significant difference based on their achievement test scores. The percentage mean values of 50.29 and 47.37 were not significantly different with t-value 1.04 tested at five percent level of significance. This implied that students' performance is the same when using any of the EdTech tools. In the interview, teachers elaborated that the use of EdTech certainly supports teaching and learning, but important also is full appreciation on how and when to appropriately apply these tools.

In general, based on the results of statistical analyses in Table 3, it may be gleaned that there are courses which students learn better with the help of EdTech using desktop and there are courses which students understand better using tablets or iPads. Students agree that EdTech supports the whole learning process same with that teachers and management are one in appreciating the benefits of using EdTech in teaching.

Guidelines to Effectively Implement EdTech

According to National Education Association (2014), the most important skills for the 21st century learners are creativity, critical thinking, communication and collaboration, known as the Four Cs. These skills are essential to prepare students for

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the future. Technology is a perfect vehicle for facilitating the 4Cs. These guidelines provide practical suggestions and ideas on how to create environments where students can develop the 4Cs through the use of technology. Presented below are six most common educational technologies that may be effectively used inside the classroom. These may be done using desktops and mobile gadgets provided that the hardware requirements are satisfied. These are presentation, podcasting, online collaboration and discussion, use of blogs and wikis, creating WebQuest, use of Infographics.

Presentation. Presentations are visual displays and explanation regarding a specific topic through the use of different objects such as texts and images.

Creating a PowerPoint Presentation

- Choose a template that is free from distracting items such as borders and shading.
- Choose color combinations that make it easy for the audience to read your slides (Carr, 2010). Use contrasting colors for text and background. Use light text on a dark background.
- Always use fonts that are 24-point or larger. Use fonts at least 28-point for body text and 38-point for heading text. Select a sans serif font like Helvetica, Trebuchet or Arial instead of a serif font like Garamond and Times New Roman. Use Italics or color rather than underline to emphasize a point.
- Simplify and limit the number of words on each screen. Use key phrases and abbreviated sentences and include only essential information. The standard limit is either 7 x 7 (seven lines, no more than seven words each) or 5 x 5 (five lines, no more than five words each) on each slide. Limit the number of slides. A good rule of thumb is one slide per minute.
- Include high quality photos, images or diagrams that support your topic.
- Use bullet points carefully. If using bullet points, be sure they are less than six words long (Carr, 2010).
- Keep the room lights on and avoid showing slides in a dark room for more than 15 minutes (Zhu, 2011).
- Create a handout to accompany your presentation (Carr, 2010).
- For inserting video, select clips with contents that match instructional goals and are appropriate for the students. Limit the length of video clips. No matter how interesting they may be or how motivated students are, video clips longer than 10 minutes may fail to hold students' attention (Zhu, 2011).

Podcasting. Students might use podcasting to conduct interviews, create a podcast book review, engage in debates, storytelling, role plays, create a timeline

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podcast (history), create and share their own Math and Science problems and stories and create songs, poems and riddles (Stewart, 2010).

Creating a Podcast

- **Tools.** The following tools are needed in podcasting: a. Audio software for recording and editing like Audacity, Garage band, Podomatic and Odiogo, b. Microphone, c. Headphones and d. Computer or tablet.
- **Planning & Scripting.** Students may write a script for their podcast. Students may create an outline or some sort of organizer to keep track of what they will discuss. Start with the objectives and concentrate on the concept and content.
- **Recording.** Record the audio for your podcast. Read the scripts. Talk in a consistent pace and show passion in your topic. Record your podcast in a room that is as quiet as possible. Podcast should not be longer than 40 minutes, with 20 minutes being the average. Include background music if appropriate.
- **Editing.** Editing your podcasts allows you to add your introduction, conclusion, sound effects, and remove unwanted sounds, gaps of dead air or any mistakes you might have made during your recording.
- **Publishing.** Podcasts can be submitted to the public podcast directory services such as iTunes Music Store, Podcast.net , Stitcher., SoundCloud and YouTube.

Online Collaboration and Discussion. Online collaboration allows group of people to communicate and collaborate over the Internet. There are various online collaborative tools available on the internet such as Google Apps, Skype, Prezi and Asana. Teachers and students can use these tools to perform a wide range of tasks, such as online meetings and discussions, file sharing, surveying, designing, project management, multimedia resources and document sharing.

Guidelines to Integrate Online Collaboration and Discussion in the Classroom

- Identify the specific type of course content, concepts or issues should be targeted and selected for collaboration.
- Provide clear assignment instructions, participation guidelines, etiquette guidelines and grading criteria (Rocca, 2015).
- Break students into groups and assign roles and responsibilities. Guide students through team communication and collaboration.
- Ask students for feedback on teamwork projects and exercises.

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- Closely monitor, facilitate, and provide support (Rocca, 2015). Respond to some of the posts, offer suggestions, and give credits when appropriate. Post websites, anecdotal information, and the like that is specific to the teamwork thread. Encourage students to use online collaborative tools.
- Define clear goals and objectives for the online discussion (Zhu, 2011).
- Provide detailed instructions for students, including student roles and responsibilities (Zhu, 2011).
- Establish rules for appropriate and inappropriate behaviors before starting discussions (Zhu, 2011).
- Hold students responsible for posting responses by a certain deadline.
- Create an outline of different types of activities for the online discussion. Establish a clear starting and ending time for each discussion topic (Zhu, 2011).
- Energize the online discussion if needed (e.g., using role-plays, simulations, pros and cons).
- End the online discussion with closure through synthesis and summary.

Blogs and Wikis. Blogs contain posts, sometimes similar to journal entries, from a person or a group and are dated and listed in reverse chronological order. A wiki is a Web site that enables users to collect team knowledge, plan events, or work on projects together (Microsoft, 2007).

Guidelines to Integrate Blogs and Wikis in the Classroom

- Set clear goals and objectives for class blogs and wikis (Zhu, 2011).
- Connect the blogs or wikis to other learning activities in the course (Zhu, 2011).
- Collectively create ground rules for appropriate behaviors for the class blogs and wikis.
- Avoid plagiarism. All outside sources used in posts should be properly cited and quoted (TAFE NSW, 2006).
- Require students to provide comments and feedbacks to other blogs and wikis.
- Posts or comments must be well written. Students should add quotes or links to other works to strengthen their response. Criticize constructively.

Creating WebQuest. Torres (2005) defined WebQuest as a constructivist learning activity that uses resources from the Web and presents authentic tasks in context, encouraging students' participation in an autonomous and collaborative way.

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- **Introduction:** Orient the students. Tell students background information and their role in the quest. Discuss the topic with the students. Know their interest and knowledge.
- **Task:** Describe the final output. Provide students with different assignments that they have to complete within the particular WebQuest. Provide a description of any reports, charts, graphs or timelines that the students are required to produce and online tools or software that should be used.
- **Process:** Provide strategies, steps and perspectives that students should use to complete the task. Provide also the Internet links. Find as many .net, .gov, and .edu sites as possible and avoid sites that have questionable sources and with a lot of ads and confusing layouts.
- **Resources:** Provide all the links and resources you have selected for the students to complete the task.
- **Evaluation:** Evaluate the results of the activity.
- **Conclusion:** Summarize what the students have done and encourage them to reflect on its process and results.

Infographics. Infographic is a visual representation of information, data or knowledge that uses words and pictures to make a point or tell a story.

Guidelines to Integrate Infographics in the Classroom

- Create your own infographic. Excel, PowerPoint, Photoshop and online tools like easel.ly, and infogram can be used to create a great infographic.
- Make your infographic attractive. Colors and graphics can help make it attractive.
- Create context on why the graphic is important. Ensure that the information that you are conveying is accurate.
- Ask students to analyze and make interpretations based on an infographic.

Conclusion

Based on the foregoing findings the following conclusions were derived:

- Integration of educational technology to Special Science Curriculum is being done by continuously applying emergent technologies supporting 21st century learning
- Application of educational technology alone does not determine students' performance; full appreciation by the learners and teachers on how and when to use the tools properly decide its positive effects to learning.

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- A proposed guideline on the implementation of appropriate educational technology may be based on a constructivist approach that students build understanding and knowledge by utilizing the environment provided for by computer technology.

Based on the conclusions, the following are recommended: v

1. As form of research utilization, a training/workshop implementing the proposed guidelines involving teachers as participants may be done
2. A brochure of the guideline may be reproduced and distributed to teachers and students for better implementation of educational technology

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