EFFECT OF INFORMATION AND COMMUNICATION TECHNOLOGY ON THE DEVELOPMENT OF HIGHER ORDER THINKING SKILLS AMONG STUDENTS AT UNIVERSITY LEVEL

Kainaat Khan[1], Aniqa Rasheed[1], and Sumera[1]

Abstract

In this era the use of information communication technology in every walk of life is not a lie especially its use in education to facilitate the process of teaching and learning. The objectives of study were to explore the practice of ICT among students at university level, to examine the level of higher order thinking skills among students at university level and to find out the effect of information communication technology on the development of higher order thinking skills among students at university level. The study contains proposed model which was based on ICT tools and HOTs. The researcher used quantitative approach, and its design was correlation which is a type of descriptive research. Population was based on undergraduate university students of social sciences of 3 universities of Islamabad. Convenient sampling technique was used. The sample was based on 10% of entire population. The results were interpreted, and recommendation were suggested. The study results showed average level of higher order thinking skills among university students. Results also showed that mean values were agree about the practice of ICT at university level. It was revealed that there was a significant effect of ICT on the development of HOTS at university level. It is recommended that through training, practice and classroom activities the students may be able to find the required information, to analyze it and to build HOTS. Universities may recruit highly skilled technical personnel in the ICT units of their institutions and create a consciousness in them to develop innovative ideas for better training of student's higher order thinking skill.

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[1] Department of Education, National University of Modern Languages, Islamabad - Pakistan

Introduction

The use of information communication technology in this era especially after the spread of COVID-19 is considered as crucial as breathing to be alive. This is This is because when every field was getting disturbed and closed including Education because of COVID, ICT was the only weapon which proved extremely helpful in running many businesses together with the Education system. ICT have an enormous effect upon all fields together with the whole teaching and learning process.

The use of ICT makes Educational institutions more effective and productive by facilitating the process of teaching and learning (Akpan, I. F., Itighise A. E. 2019). Several studies indicated the importance of ICT that it can help in facilitating the process of teaching and learning by connecting it with the real-life situations (Tinio, V. L. 2002). Tinio further explained the importance of ICT as it accelerates, polishes student's skills, increase their concentration, helps in the application of learned material, and provides economic favor to the future generation, and connects school environment with the real world. Along with all other aspects of teaching and learning the impact of ICT on students' HOTS is now capturing the attention of scholars and researchers to a great extent. (Miri, B., Ben-Chaim, D., & Zoller. 2007) Expressed that HOTS involve several processes like critical thinking, precariousness and use of different criteria's etc. The effective use of ICT tools in the classroom can help students to think constructively (Subran, D. 2013) has confirmed the efficiency of ICT in promoting HOTS. In the cognitive domain of Bloom's taxonomy, the HOTS are those which included at the upper end such as synthesis, application, and evaluation. (Barak, M., and Dori, Y.J. 2009) Therefore, from above mentioned and many other studies we can realize that ICT is becoming very important not only for all other fields but especially for Education system. We can also understand that there is some effect of the usage of ICT on the development of teaching-learning process and especially the HOTS of the students which is the main focus of current study but in a context that what actually students think about this effect whether the information and communication technology-based classrooms are nurturing their HOTS or not in other words what is their perception regarding effect of ICT on the development of HOTS.

Literary Analysis

In this era the use of ICT in every walk of life is not a lie especially after the spread of COVID-19 it is considered as crucial as breathing to be alive for every field including education to facilitate the process of teaching and learning. It has been a powerful tool to facilitate the social, political and all other fields of any country (Adedeji, O., A. 2010). According to the World Bank, ICTs as "the set of activities which facilitate by electronic means the processing, transmission and display of information" (Rodriguez, F., & Wilson, E. J.2000). The use of ICT cannot be ignored by teachers or by student because it encourages collaborative learning, provides maximum information, and facilitate in understanding difficult concepts. (Black, D. R., & Van Der Westhuizen, J. 2004) Also emphasized that, the use of ICT promotes teacher and student's connectivity and provides greater information.

Along with all other aspects of teaching and learning the impact of ICT on students' HOTS is now capturing the attention of scholars and researchers to a great extent. According to Bloom's taxonomy of learning, HOTS consists of three factors like, analysis, synthesis, and evaluation. Analysis is the ability of learners to break the knowledge into smaller parts and then understand the relationship of each part with another and reconstruct a new structure (Marzano, R. J., & Kendall, J. S. 2006). Cognitive skill of evaluation helps students to justify the importance of any information in a context of its relevance and consistency. Students do not take interest in any activity which emphasizes the development of HOTs due to the old concept of learning which was actually nothing more than a sequential and linear paradigm (Zohar, A., Degani, A., & Vaaknin, E. 2001). HOTS is also known as higher order thinking skills. This is the fact that there are various taxonomies are being used for the purpose of boosting HOTS in the students. It includes series of vital skill such as; learning progress in the students, critical thinking, analyze and evaluate difficult material, interlink concepts, questioning, problem-Solving Strategies.

Bloom's taxonomy was originally published in 1956 as a result of collaborative work with the cognitive psychologist at the University of Chicago. Moreover, the concepts of higher order thinking skills have an in-depth relationship with the first

domain of the bloom's taxonomy. First Cognitive domain of blooms taxonomy includes 6 steps such as; remembering, understanding, applying, Analyzing, Synthesizing, and evaluating. Additionally, in 1982 the SOLO taxonomy was developed by Biggs and Collis as an alternative to Bloom's Taxonomy. SOLO taxonomy includes 5 levels of understanding such as; Pre-structural, Unstructured, Multi-structural, Relational, Extended abstract. More comprehensively we can say that SOLO taxonomy moves forward from simple aspect to complex aspect. Further discussed the technology acceptance models (TAM) theory by (Davis, F.D.2003). which is related to technology it helps students to understand and easily measure effectiveness of particular program or system with their various components such as: Behavioral Intention, Perceived Usefulness, and Perceived Ease of use. More comprehensively the theory has advance ICTs with more specific components that explaining how a people can accept a technology over the years.

Some studies show that teachers faced difficulties in developing HOTS in students. Reason behind is teacher have a lack of knowledge and skill about higher order thinking skills. They even do not have enough knowledge about how to develop HOTS's activities.

Today society runs on digital technology, even educational institutes rely on ICT tools. Which produced an impactful outcome in teaching and learning. The facilities of technology services in private universities by the availability and utilization of ICT tools in universities to meet the demands of students (Olayemi, A., & Tofunmi, O. 2020). Researchers (Ghavifekr, S. & Rosdy, W.A.W. 2015) explains that in today's era of the 21st century, technology is considered as the knowledge transfer highway in most countries. Several studies indicated the ICT tools are the main parts in modify the country towards progress and development. (Ghavifekr, S. & Rosdy, W.A.W. 2015) Further explains the effectiveness of ICTs tools in the success of technology-based teaching and learning in universities. Because developing of HOTS among students is necessary for dealing new problems in order to give solutions of these problems. Al-though at the stage of higher education, creative thinking is considered as a core component of the learning process. However, it needs highly involvement of the teachers towards boosting higher thinking skills among university students.

The main component of 21st century is that our teachers wants their learners use HOTS. HOTS lead a student to a new step. Students need to be made use of it to grasp information and build a new ideas and facts. It would enable to them to connect with another concept. There are some strategies that enhance students HOTS.

❖ **Determine what is HOTS and how its helps**

It helps pupils to understand what HOTS is. Briefly explain to them why this skill is important for them. Help them to identify their strength and weakness.

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❖ **Connect Concept**

Help students how to connect one concept with another. By this process you would be able to know what students are already known.

❖ **Encourage Questioning**

Encourage students to ask questions freely. Motivate them so that they can ask question without any negative reaction from their teachers and peers.

❖ **Problem solving strategies**

Used these problem-solving techniques to students so they learn step by step method. This process helps them to use higher order thinking skill faster. Encourage students to solve their own problem using HOTs.

❖ **Encourage Creative Thinking**

Creative thinking will be used by students when they imagine and design their thinking. However, Research shows that when students used HOTS, their understanding level increases.

The ability for students to grasp concepts, to generate knowledge and to solve problems is the mark of their level of competency in thinking skills. Thinking skills can be discussed further through the revised Bloom's Taxonomy model that promotes knowledge and shaping of the skills through cognitive domains of remembering, understanding, applying, analyzing, evaluating and creating. It is divided into two levels of order thinking: Higher-order Thinking Skills (HOTS) and Lower-order thinking skills (LOTS). Each of the levels is connected whereby learners can obtain the highest level of skills, creating if he or she can remember and understand the concepts fully, applied its understanding by analyzing, evaluating and creating (Zaharin, N. L., Sharif, S., & Mariappan, M. 2018) HOTS is related to higher level of the cognitive domain of bloom's taxonomies upper part steps and these steps are trying to prominent in the following figure.
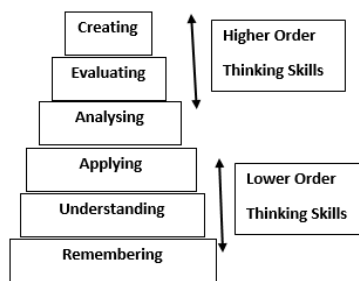

Figure 1: Bloom's Taxonomy Model

On the basis of literature review researcher developed particular proposed model focuses on the relation that how the concepts of ICT tools are interconnected with student's higher order thinking skills. Moreover, the current study has consulted the blooms taxonomy model and tried to build a new and advance model in enhancing HOTS. As in the current learning environment, the teachers have to pass multiple barriers in conditioning the minds of the students with regards to higher order thinking skills Furthermore, to explore the effect of ICT tools on the development of students HOTS. In the present time span of educational advancement era, there is a need of need analysis or exploration and modification in the educational scenario. The particular proposed model has been meticulously interlaced with ICT tools, so, (Akpan, I. F., & Itighise A. E. 2019) The view of ICT tools includes Internet (google, yahoo and Bing etc.), Multimedia Projector, Email,

interactive tools, teleconferencing, audio tape, google classroom, computer, WhatsApp and presentation software (PowerPoint and Prezi etc.) have interrelationship constitutes on the development of students' higher order skills. However, effect of ICT tool on the development of students HOTs. A proposed model given by the current study is following.
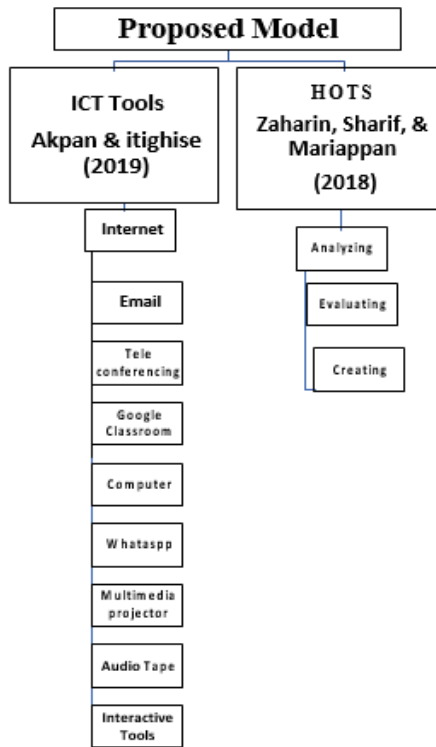

Figure 2: Proposed Model

Significance and Rationale

This is the era of modern technology which has changed the lives of people. Technology only works for specific areas its importance is increasing day by day in all aspects of human life. It has given us opportunities to improve our education

system. This study will help teachers, policymakers, school authorities and parents to understand the effect of ICT on the development of HOTs at university level. ICT development will help students to learn 21st century HOTs such as complex thinking, Creative problem- solving, and collaboration and using it as a tool for lifelong learning.

Usage of ICT is increasing day by day. Everyone is aware about its importance. It will help the Government to promulgate policies that compel academic institutions to utilize ICT tools in teaching and learning process for the development of students' HOTS. Educational stakeholders will provide financial support to utilize the bulk of ICT grants for the development of student HOTs and it will improve the quality of education as well as beneficial for the economic development of the country.

 ICT should be made compulsory in educational institutions and to inform educators about the usage of ICT tools in an academic environment. Institution sustains the usage of ICT and e-learning programs for proper training for the teachers as well as development for the students HOTS, thereby it will guide to an increase the quality of education services at university level. It will help university administrators to maintain the ICT tools usage among students through ongoing development of HOTs. Moreover, it will help to students to compete in the global economy by being part of a skill workforce and usage of ICT will positively predict HOTs. Finally, this study is likely to inspire other researchers to do similar studies in ICT on the development of HOTS at university level.

In this modern era use of information and communication technology is very important. It has a great impact on student's HOTS.

HOTS are connected to the cognitive domain of bloom's taxonomy that includes knowledge, comprehension, application, analysis, synthesis, and evaluation. However, there were following reasons to carry out this study. Firstly, we carry out this study in order to explore the importance of ICT tools specifically in the motivation of HOTS. It is very clear that the task of developing students HOTS for the teachers is very difficult so that they will be able to solve their problems, ask difficult questions, develop critique and show their inner perspectives. Moreover, many studies show that with the help of ICT-mediated

learning environment we can support these activities of inquiry, creativity, critical reflection, and dialogue among students. So, researchers were interested to elaborate impact of ICT tools on student's HOTS.

So, we can understand by reading various studies that there is some effect of ICT on the development of teaching-learning process and especially the HOTS of the students which is main focus of current study but in a context that what actually students think about this effect whether the ICT is nurturing their HOTS or not in other words what is their perception regarding effect of ICT on the improvement of HOTS. So here the researchers are interested to know the student's point of views in this regard and this will give a clear perception about the role of ICT in developing HOTS and by using this information stakeholders will proceed accordingly because the main stakeholders are students and their opinion matters a lot and researchers are interested to identify their opinions.

Methodology

This research finds out the effect of ICT on the development of HOTs among students at university level. Study is quantitative and correlation research design. Researcher used questionnaire as tool to collect data from the participants. Self-made questionnaire was used in this research, which is validated by the experts of education department. The face, content and construct validities of the instruments were ascertained by experts in test and measurement, while the reliability was done using Cronbach's Alpha which gave a coefficient of .892 for the Information Communication and Technology tools scale (ICTTS)and .783 for the effectiveness of the student higher order thinking skills scale (HOTSS). The researcher administered the instrument by direct contact with the respondents. Questionnaire had three sections A, B and C. Section A covered the demographic information of the respondents (the students) consists of 3 items that includes gender, class/grade, and age. Section B comes with 10 items that elicited information on the student awareness about ICT tools. Section C comes with 12 items that focused on the effectiveness of these ICT on student's higher order thinking skills at university level. The Population was based on 5000 undergraduate university students of social sciences in 3 universities of Islamabad

including 1. International Islamic University, Islamabad, 2. Air University, Islamabad and 3. National University of Modern Languages, Islamabad. Convenient sampling technique was used. The sample was based on 10% of entire population, which was 500 undergraduate students. Researcher wanted to find out the effect of ICT on the development of HOTS among students at university level.

❖ **DATA ANALYSIS**

Statistical package for the social sciences (SPSS) version 23 was used to analyze the data collected from the respondents. Frequency mean and linear regression of Descriptive and inferential statistics were employed to analyze the data. 0.05 level of significance was employed to test the hypothesis of study.

Table 1: Demographic Details of the Respondents (N=500)

Variables	Categories	Frequency	%
Gender	Male	234	47
	Female	266	53
Age	21-25	150	30
	26-30	284	57
	31-35	66	13
Class	BS	437	87.
	MS/MPhil	49	9.8
	Ph.D.	14	2.8

Table 1 shows the Demographic details of the respondents which was 47% of male and 53% female students involved during data collection. The total number (frequency) of students was Five Hundred (500). There were 234 male respondents and 266 females. The total number/frequency of students aged 21-25 years was 150 with percentage 30%. The total frequency of student's aged 26-30 years was 284 with percentage 57% the total frequency of student's age 31-35 years

was 66 with percentage 13%. From class BS there were 437 with percentage 87.4% students who participated in this study.49 students with percentage 9.8% were from M.Phil. Class and 14 students with percentage 2.8% was from Ph.D.

Table 2: Practices of ICT among students at University Level (N=500)

Variable	n	Mean	Status
Internet	500	4.09	Agree
Email	500	4.17	Agree
Teleconferencing	500	4.12	Agree
Google classroom	500	4.22	Agree
Computer	500	4.14	Agree
WhatsApp	500	4.05	Agree
Multimedia	500	4.09	Agree
Audio tape	500	4.00	Agree
Interactive tools	500	4.04	Agree

Table 2 shows the practices of Information and Communication Technology among students at University Level. The analysis of the result indicated mean value of variable. Total number of students were 500 while the highest mean score was found of Google Classroom (4.22) and lowest score was found of audio tape (4.00).

Table 3: Examine the level of HOTS among students at University Level (N=500)

Scoring	Status	No. of Students	%
22-51	Below	26	5.2%
52-81	Average	396	79.2%
82-110	Above	78	15.6%

Table 3 showed that the level of Higher Order Thinking Skills among students at University Level. The higher order thinking skills scoring is categorized into three categories such as Below Average (22-51), Average (52-81) and Above Average (82-110). The result show that 26 (5.2%) students had laid in first group 22-51 that status was below average, 396 (79.2%) students had fallen in second group 52- 81 that scored average level of higher order thinking skills among students and 78 (15.6%) students had fallen in third group 82-110 that status was above average. Majority (79.2%) those responded had average level of higher order thinking skills among students at University Level.

Table 4: To find out the effect of ICT on the development of HOTS among students at University Level (N=500)

IV	DV	R^2	β	t	Sig.
ICT	HOTS	.78	.88	23.42	0.00

*P<0.05

The table 4 showed the effect of Information and Communication Technology (ICT) on the development of Higher Order Thinking Skills (HOTS) among

students at university level. The R square value .78 which explains that ICT had 78% variation in HOTS and the remaining is due to other elements. While the Beta value (β=.88) indicates that the level of significance is 0.00 which predict the positive effect. Therefore, hypothesis No. 1 There is no significant effect of Information and Communication Technology (ICT) on the development of Higher Order Thinking Skills (HOTS) among students at university level is rejected.

Discussion

The present study was conducted by researchers to find out whether ICT effects the higher order thinking skill of university student.in order to accomplish the results researchers developed objectives and employed a SPSS software version 23 for analysis of data. Mean and regression tests were employed to ascertain whether one variable has an effect on another variable. The findings were discussed below:

The study of Table 2 data revealed that the students are familiar with internet, email, WhatsApp, audiotape, google classroom, multimedia etc. This demonstrates how important these skills are for effective learning in the era of ICT. This supports the finding of a study conducted by [14]) that students have a foundational understanding of ICT abilities, including familiarity with Microsoft Word, Microsoft Power Point, searching and surfing the internet, among other things. This may be the result of the fact that ICT has been identified as the engine of this modern era and improves learning. According (Aishah Siddique, Z. S. 2017) technological advancement has opened new opportunities for innovation and increased the need for teacher and student collaboration. Considering the afore mentioned, there is a widespread movement to effectively utilize ICT technology.

According to current study most of the students were at average level of higher order thinking skill. This finding is supported by a study (Jung, I. S. 2005) that there were substantial disparities between high group and low group of learners' uses of ICT in term of assistance, training, and confidence in their ability to promote HOTs in their lessons. A variety of teaching strategies had an impact on HOTs teaching practices, according to lecturers from all demographic groups.

Additionally, the current study revealed that university students consistently incorporated various ICT into their teaching and learning activities. This suggests that university students depend on modern ICT to successfully complete their academic work. Similarly, (Ali, S. N. 2012) (Yemothy N.E. 2015) claimed that all academicians desire to incorporate ICT in their classrooms in order to give lectures and provide students with useful information. The study's conclusions demonstrated how the usage of ICT promote HOTS was influenced by students' attitudes regarding ICT. A student's enthusiastic use of ICT will encourage them to spread the word about HOTS. This research finding was supported by the findings (Ghavifekr et.al. 2016) who found that a positive attitude about using ICT has an impact on how successfully technology is incorporated into teaching and learning to support HOTS.

Researchers concluded from current study that digital literacy and computer literacy can boost up student's higher order thinking skills. A study (Meerza, A.& Beauchamp, G. 2017) supported this finding that there are certain factors that can affect instructors' capacity to create HOTS-based assessments. One of the elements affecting high school and vocational high school mathematics teachers' capacity to create HOTS-based assessments is their level of digital literacy. The concept of HOTS-based evaluation can be better understood by instructors if they have adequate digital literacy abilities. Many high school and vocational teachers still lack a solid understanding of ICT at this time. One of the reasons teachers haven't been successful in creating HOTS-based assessments is because of lack of digital literacy.

Recommendations

- Higher education commission may support educational technology. For this purpose, offer short courses, seminars, workshops, conferences and online system to enhance student's Critical thinking skills and prepare them for career development.
- Teachers may encourage students to utilize online learning tools, resources and digital communication applications for self-directed learning and improved their critical thinking skills.

- Modern Technology like SMART boards, smart video cameras and online textbooks may enhance the student's higher order thinking skills.
- It is recommended that problems in accessing ICTs tools may be reduced for students by universities. Access to internet may be improved for students so that they can enhance their critical thinking skills and knowledge by using the educational literature, references, encyclopedia, collaborative projects, databases and dictionaries.

Conclusion

On the basis of results the researchers found in this study the following conclusion was made:

The current study was designed to measure the effect of information communication technology on higher order thinking skills of students at university level. There were three main objectives of the study and the first one was; to explore the practice of ICT among university students and it was analyzed by identifying mean score of the collected data and the results revealed that only one indicator google classroom was having highest mean score which means from all other ICT indicators the use of google classroom is comparatively high at university level. Then the second objective was to examine the level of HOTS of university students which was analyzed by using scoring key and the results showed that majority of the students had an average level of higher order thinking skills. Then the third objective was to measure the effect of ICT on the development of higher order thinking skills among university students and it was analyzed through one-way regression analysis and the results showed that there is a significant positive effect of information communication technology on the development of higher order thinking skills among university students.

Therefore, the overall conclusion of the study indicated that the use of ICT facilitates the development of student's higher order thinking skills.

References

1.   Akpan, I. F., and Itighise A. E.2019. Students' Perception of Lecturers' Utilization of Information and Communication Technology (ICT) Tools for Instructional Delivery in Science Education Programme. Journal of Education and Development, 3(2).

2.   Tinio, V. L. 2002. ICT in Education: UN Development Programme. (Retrieved from http: www.eprmers.org on August 2022).

3.   Miri, B., Ben-Chaim, D., & Zoller. 2007.Purposely Teaching for the Promotion of Higher- order Thinking Skills A Case of Critical Thinking. Research in Science Education, 3, pp. 353–369.

4.   Subran, D.2013. Developing higher-order thinking with ICT. Retrieved from http://hdl.handle.net/2139/157 01

5.   Barak, M., and Dori, Y.J. 2009. Enhancing Higher Order Thinking Skills among In-service Science Teachers via Embedded Assessment, Journal of Science Teacher Education, 20:5, pp 459-474.

6.   Adedeji, O., A. 2010. The Development of Modern Information and Communications technology in Ibadan: Creative Educational Publications Ltd, pp58.

7.   Rodriguez, F., and Wilson, E. J. 2000. Are Poor Countries Losing the Information Revolution? Info Dev. Retrieved August 2, 2022. from: http://www.infodev.org/library/working.htm

8.   Black, D. R., & Van Der Westhuizen, J. 2004. The Allure of Global Games for "Semi- Peripheral" Polities and Spaces: A Research Agenda. Third World Quarterly, 25(7), pp. 1195–1214.

9.   Marzano, R. J., & Kendall, J. S. 2006. The new taxonomy of educational objectives, 2nd Edition, Corwin Press.

10. Zohar, A., Degani, A., & Vaaknin, E. 2001. Teachers' beliefs about low-achieving students and higher order thinking. Teaching and Teacher Education, 17(4), pp. 469–485.

11. Davis, F. D. 2003. Acceptance of Information Technology. MIS Quarterly, 13(3), pp. 319-339.

12. Olayemi, A., & Tofunmi, O. 2020. User Acceptance of Information Technology: Toward a Unified Model. Interdisciplinary Journal of Education, 2(2).

13. Ghavifekr, S.& Rosdy, W.A.W. 2015. Teaching and learning with technology: Effectiveness of ICT integration in schools. International Journal of Research in Education and Science (IJRES), 1(2), pp. 175-191.

14. Zaharin, N. L., Sharif, S., & Mariappan, M. (2018). Computational Thinking: A Strategy for Developing Problem Solving Skills and Higher Order Thinking Skills (HOTS). International Journal of Academic Research in Business and Social Sciences, 8(10), 1265–1278

15. Aishah Siddiquah, Z. S. 2017. The ICT Facilities, Skills, Usage, and the Problems Faced by the Students of Higher Education. EURASIA J Math Sci Tech Ed, (13)8, pp. 4987-4994.

16. Jung, I. S. 2005. A comparative study on the cost- effectiveness of three approaches to ICT Teacher training. Journal of Korean Association of Educational Information and Broadcasting, 9 (2), pp 39-70.

17. Ali, S. N. 2012. Malaysian polytechnic lecturers' teaching practices with ICT utilization to promote higher-order thinking skills. Iowa State University ProQuest Dissertations.

18. Yemothy, N.E.2015. Improving Educational Technology Integration in the classroom.

19. Ghavifekr et.al.2016. Teaching and Learning with ICT Tools: Issues and Challenges from Teachers' Perceptions. Malaysian Online Journal of Educational Technology, 4(2), pp 38-57.

20. Meerza, A. And Beauchamp, G. 2017. Factors Influencing Undergraduates Attitudes towards ICT: An Empirical Study in Thesis. TOJET: The Turkish Online Journal of Educational Technology, 16(2).