Investigating the Pattern of ICT Utilisation for Science Teaching in Federal Unity Schools in Nigeria Using Kumar's, Subramaniam and Mukherjee Model Approach

Kolawole Akinjide Aramide
Abadina Media Resource Centre
University of Ibadan
kolaakinjide@gmail.com

Kazeem Adesina
The Polytechnic Library
The Polytechnic, Ibadan
sekesi2009@yahoo.com

Olukunle A. Osunrinade
The Polytechnic Library
The Polytechnic, Ibadan
kunlexakin@yahoo.com

Abstract

This study investigated the pattern of ICT utilisation for science teaching in FUSs in Nigeria using Kumar's, Subramaniam and Mukherjee (2005) Model. Four hundred and sixty four copies of questionnaire were administered on science teachers in 25 FUSs that were systematically selected from the 104 FUSs in Nigeria out of which only 353 copies were returned with useful responses. The questionnaire was designed to investigate the types, purpose and frequency of ICT facilities utilisation for science teaching in FUSs in Nigeria. The study revealed presentation software, online tutoring, and interactive CDs as ICT facilities being utilised for science teaching in FUSs in Nigeria. The study further revealed a low level of ICT utilisation for science teaching while also revealing a low level of ICT facilities such as virtual laboratory utilisation for laboratory-based/experiment-based activities. The study further established a significant relationship between purpose of ICT utilisation and degree of ICT facilities utilisation ($F = 86.27$, $p<0.05$).The study established that the pattern of ICT utilisation for science teaching FUSs in Nigeria is at variance with Kumar's et. al. model.

***Keywords**:* ICT utilisation, Science teaching, Purpose of ICT utilization, Degree of ICT utilisation

Practitioners Notes

What is already known about this topic

1. Science as a subject and discipline is contributing immensely to the development of societies.
2. Effective science teaching provides unique training in observation and reasoning for students and enables them to form an objective judgment

3. The teaching of science in most developing countries still follows the traditional pattern
4. A paradigm shift in the teaching of science in schools from traditional pattern to modern pattern is on-going
5. ICT facilities utilisation in the teaching of science can bring about the required changes in style and methods of teaching of science in schools.
6. ICT facilities are being used in the teaching of science in schools

What this paper adds

1. Provides insight into how ICT facilities are being used in teaching of science subject in schools
2. Provides insight into types of ICT facilities being used in the teaching of science in schools
3. Establish the pattern of ICT use in science teaching in line with Kumar et al. new of model for physics experiments.

Introduction

Science as a subject and discipline has contributed immensely to the development in our society and has helped the modern society to be able to respond effectively to changing social, economic, and environmental trends to meet sustainability goals. Olatoye (2007) emphasized that science will continue to be a tool for explaining interactions between human activities and our environment while also proffering solutions to many problems that may arise as a result of human activities.

Turner (2003) presented four arguments to support the teaching and learning of science in schools viz: economic argument, democratic/humanistic argument, skills argument, and cultural argument. The economic argument of teaching science in schools is based on the need to produce more scientists to meet the supply demands in science-related fields. The economic argument is considered as the dominant reason why science is taught especially in advanced and prosperous countries (Hassard, 2010).

The democratic/humanistic argument for the introduction of science in schools is based on the need to prepare students to be informed citizens and knowledgeable consumers while the skills argument suggests that study of science instills certain transferable skills that are important to students' understanding of science. The skills argument claims that students should be involved in hands-on activities, analyse data, and plan open-ended investigations (Turner, 2003). Therefore, in order, to achieve, the development of skills in students, teachers are expected to use inquiry-based approach to teaching and help students learn to practice inquiry. Moreover, the cultural argument of teaching science in schools suggests the need to consider the history and philosophy of science, and try and bring to students' experiences, in which they learn, how science discoveries are made.

Science teaching involves "hands-on" experience which prompts thinking about the world in which we live. This is made up of scientific techniques and procedures both in the field or the laboratory as well as scientific enquiries and investigations (SCORE, 2006). An important aspect of science teaching in secondary schools is the laboratory or practical work. Kumar, Subramanian and Mukherjee (2005) reiterated experiments or laboratory practical work as

indispensable tools in studying physics and by extension science subjects because the essence of science lies in experiencing and observing phenomenon. Therefore, teachers need to impart skills to make precise measurements, data analysis, and derivation of scientific conclusions.

Information communication technology resources' use in science teaching has the capability to reduce the "over dependency" on physical laboratories which is non-existent or inadequately equipped in most secondary schools in Nigeria. Because, the teaching of science at various levels in most developing countries, including Nigeria, still retains the old conservative and traditional approach (Olatoye, 2006). Therefore, Jenkins (2009) suggested that the introduction of ICT resources in the teaching of science may bring about the required change in style and of teaching science in schools. The relevance and importance of ICT in the teaching of science has been discussed and advanced at relevant fora. The National Educational Technology Standards (NETS) (ITEA, 2000), the International Society of Technology in Education (ISTE, 2000) and British Educational Communications and Technology Agency (BECTA, 2010) recommended the use of ICT in the teaching of science subjects, as a result of observation that reveals that science teachers are not using ICT for teaching and learning of science.

The University of York Science Education Group (2002) stated that there has been a shift from the use of science as a vehicle through which students learn and use IT skills to the use of ICT skills as tools to assist learning in science in recent years just as there has been growing interest in the use of ICT to support whole class teaching and learning to complement ICT based activities for individual students. This has led to greater emphasis on the role of the teacher and recognition of the need for training to help them learn operational skills to use new equipment and software and application skills to manage learning effectively using new technologies. The Group further emphasised that many ICT-mediated science tasks do not require the use of a specific classroom or laboratory.

Ramayah (2006) emphasized that ICT provides access to a huge range of resources that are of high quality and relevant to scientific learning. In some instances, the multimedia resources available enable visualization and manipulation of complex models, three dimensional images and movement to enhance understanding of scientific ideas. Bryce (2010) reiterated the capability of ICT in widening the range of materials that can be used in teaching and learning to include text, still and moving images and sound, and increases the variety of ways that the material can be used for whole class and individual learning. Therefore, science teachers have the opportunity of meeting the needs of students with different learning styles as well as to be creative in their teaching through the use of ICT.

Furthermore, ICT can be seen as a powerful tool that strengthens teaching and provides facilities for teachers' repertoire, thereby enabling them to meet individual learner's needs. In corroborating this assertion, Abolade and Yusuff (2006) concluded that ICT allows for networking among teachers, where teachers are more connected with each other to exchange ideas, share resources, and improve teaching practices as well as provide opportunity for connecting schools to the world, as learning is expanded beyond the classroom. Thus, relevant real life context can be established. With ICT, teachers can access information and resources, and they can communicate with experts and peers and make useful contributions to knowledge through electronic publications.

The use of ICT in science teaching was broadly classified into six different types of activities which include: information gathering (which involves using Internet browsers and multimedia CD ROMs), practical work.(which involves using interfaces and data-logging software), simulations (which involves virtual experiments and visual aids, simulating and helping to explain phenomena), data handling (for example using spreadsheets and graphing software to analyse data), use of mathematical models (for example exploring relationships, predicting and testing theories), and communication (for example Publishing record keeping; power point and web authoring), (Godwin, 2004).. The use of above applications in the teaching of science and mathematics can make the teaching of science subjects more effective.

Analytical Framework – Kumar, Subramanian and Mukherjee New Model for Physics Experiments

Kumar, Subramanian and Mukherjee (2005) proposed a new model for teaching of physics as a science subject which is aimed at reducing the high dependency on real laboratories. They posited that ICT use in teaching of science offers the possibility of many attractive features including interactive experience that can widen the scope of constructivist learning. The new model suggested the use of Interactive CDs, Online-Tutoring, Virtual laboratories, Self-built experimental projects, and laboratory sessions, for successful teaching of science in schools. The first three stages in the model emphasised the use of ICT-based resources in the teaching of science subjects. However, Yucel, Acun, Tarman and Mete (2010) reiterated that teachers should be equipped with the necessary skills and knowledge in order to use ICT facilities. Therefore, teachers not only have to be able to handle ICT but also to transfer skills and knowledge into classrooms which require that their ICT training has to have an element of education and pedagogy (Lawson and Comber in Yucel at al., 2010).

The use of Interactive CDs, as proposed by Kumar et al. with multimedia power can be used to communicate dynamic information more accurately than a diagram thereby helping students visualize phenomena that cannot be seen (Brennet and Brennan, 1996). The online tutoring enables the teachers to bring the students into virtual classroom environment with the intention to generate new ideas and cultivate innovation (Kumar et al., 2005). The virtual laboratories, on the other hand, provide an interactive environment for creating and conducting simulated experiments. Therefore, science experiment can be simulated close to a real world situation in a virtual environment using computer technologies. With the use of virtual laboratory students are allowed to be actively involved in the experimental process at their own pace. Teachers used virtual laboratory to expose students to various types of experiments involving sophisticated instruments without worrying about the cost of students' safety.

Kumar's model considers the incorporation of ICT resources as sacrosanct for effective teaching of science subjects. The model is in support of the paradigm shift from teacher-centred/traditional form of teaching (predominant in most developing countries) to student-centred/modern/ICT-mediated teaching which is the best practice in the world.

This study, therefore, is aimed at investigating the pattern of ICT utilisation for science teaching in FUSs in Nigeria in the light of Kumar et al. 5 – Stage model of ICT use for teaching science. Pattern of utilisation of ICT resources is focusing on the types of ICT resources being utilised,

purposes for which the resources are being utilised for and the extent of utilisation of the ICT resources are key issues to be considered. This is to ascertain the extent to which teachers in FUSs in Nigeria had conformed to Kumar's et al model in the use of ICT resources in teaching of science subjects. The study has all the teachers involved in the teaching of physics, chemistry, biology and mathematics, which are the core science subjects at the FUSs as the subjects for this study. The study adopted the Kumar's et al. model for this study as a matter of preference and relevance and this is not to say that Kumar's model is the superior model for investigating pattern of utilisation of ICT for teaching.

Objectives of the Study

The specific objectives of the study are to:

1. ascertain the purpose of ICT utilisation for science teaching in FUSs in Nigeria;
2. investigate the frequency of ICT utilisation for science teaching in FUSs in Nigeria
3. determine the relationship between purpose of ICT utilisation for science teaching in FUSs in Nigeria

Research questions

The following research questions will be addressed in the study

1. For what purposes do teachers in FUSs in Nigeria utilise ICT facilities in science teaching?
2. What is the level of utilisation of ICT for science teaching in FUSs in Nigeria?
3. What is the relationship among purpose of utilisation and frequency of utilisation for science teaching in FUSs in Nigeria?

Research hypotheses

H_{01}: There is no significant between purpose of use and frequency of use of ICT utilisation for science teaching in FUSs

Research Methodology

This study adopted the ex-post-facto type of survey method. The population of the study comprises all the science teachers in all the Federal unity schools (FUSs) spread across the thirty six states and Federal capital territory, Abuja, in Nigeria. The multi-stage sampling technique was adopted in selecting the sample population for the study. At the first stage of selecting the sample, the systematic sampling technique was used in selecting every fourth school on the list of the FUSs arranged in a serial order. Thus, twenty-five (25) FUSs were selected for the study. At the second stage of the sampling size, the total enumeration method was adopted to selecting all the 464 science teachers in the selected FUSs. The science teachers selected include teachers of mathematics, physics, chemistry, and biology.

Data Analysis and Interpretation

A total of 353 copies of questionnaire were retrieved out of the 464 administered to the respondents in FUSs in Nigeria.

Research question 1: For what purposes do the science teachers in FUSs in Nigeria use ICT facilities?

Table 3: Purpose of use of ICT facilities by science teachers

Purpose of use	Frequency	Percentage	,Mean	Std Dev
Tutorials	85	24.1	0.24	0.428
Testing	81	22.9	0.23	0.421
Presentation of new materials	74	21.0	0.21	0.408
Remediation and acceleration	65	18.4	0.18	0.388
Drill and Practice	82	23.2	0.23	0.423
Recreational and educational games	79	22.4	0.22	0.417
Enrichment activities	91	25.8	0.26	0.438
Experimentation/Simulations	63	17.8	0.18	0.383
Information access via CD-ROM	80	22.7	0.23	0.419
Authoring	59	16.7	0.17	0.374
Multimedia application	89	25.2	0.25	0.435
Problem solving	80	22.7	0.23	0.419
Collaborative learning	94	26.6	0.27	0.443

Information on the purpose of use of ICT facilities by the respondents revealed collaborative learning (Mean=0.27, SD = 0.443), enrichment activities (Mean =0.26, SD =0.438), and multimedia application (Mean = 0.25, SD = 0.435) as being of top of the list of purposes for which the science teachers use ICT facilities. Other purposes for which the science teachers use ICT facilities, as revealed from the table include, tutorials (Mean=0.24, SD =0.428) problem solving (Mean =0.23, SD=0.419), and information access is a CD-ROM (Mean =0.23, SD =0.419). This implies that the science teachers use ICT facilities mainly for teaching, learning, and classroom-based activities at the expense of experimentation and simulation activities which is a major element of science teaching.

Research question 2: What is the level of ICT use among science teachers in FUSs in Nigeria?

(HU) highly used, (U) used, (FU) fairly used, (NU) not used

Table 4: Extent of use of ICT facilities by science teachers

Statement					Mea	S.D
Statement	HU	U	FU	NU	Mea	S.D
Use of ICT for Tutorials instructional video/audio tapes (Interactive CDs)	87 24.6 %	60 17.0 %	30 8.5%	176 49.9%	2.16	1.2 8
Use of ICT for Remediation/acceleration of instruction (Interactive CDs)	93 26.3 %	42 11.9 %	27 7.6%	191 54.1%	2.10	1.3 1
Use of ICT for Testing (Computer based testing, drill and practice, etc) (Interactive	81 22.9	55 15.6	12 3.4%	205 58.1%	2.03	1.2 9

CDs)	%	%				
ICT use for presentation of new materials(use of presentation software) (Presentation software)	187 53.0 %	38 10.8 %	32 9.1%	96 27.2%	2.12	1.3 1
Use of ICT for drill and practice (Interactive CDs)	84 23.8 %	43 12.2 %	38 10.8%	188 53.3%	2.07	1.2 7
Use of recreational and educational games (Interactive CDs)	90 25.5 %	45 12.7 %	31 8.8%	187 53.0%	2.11	1.2 9
Use of ICT in preparation of lesson notes (Presentation software)	179 50.7 %	47 13.3 %	25 7.1%	102 28.9%	2.20	1.3 3
Enrichment activities (Video and simulations, model, databases) (Interactive CDs and Virtual laboratory)	99 28.0 %	28 7.9%	33 9.3%	193 54.7%	2.09	1.3 2
Problem solving (simulations, virtual laboratory, and graphical visualization) (Virtual laboratory and simulations)	101 28.6 %	40 11.3 %	16 4.5%	196 55.5%	2.13	1.3 4
Use of ICT for information access through CD-ROMs, Internet, databases in finding and accessing information and educational) (Online tutoring)	182 51.6 %	37 10.5 %	20 5.7%	114 32.3%	2.24	1.3 7
Use of ICT for experimentation/simulation models, virtual laboratory (Virtual laboratory and simulations)	87 24.6 %	34 9.6%	14 4.0%	218 61.8%	1.97	1.3 1
Collaborative learning through Internet, wikis etc (Online tutoring)	94 26.6 %	26 7.4%	31 8.8%	202 57.2%	2.03	1.3 1
I use online communication tool such as e-mail to facilitate communication between the teacher and students (Online tutoring)	208 58.9 %	41 11.6 %	10 2.8%	94 26.6%	2.06	1.3 3
I use Webcam to monitor distant location (Presentation software)	87 24.6 %	30 8.5%	22 6.2%	214 60.6%	1.97	1.3 0
Online discussion board is used in facilitating discussion between the teacher and students (Online tutoring)	100 28.3 %	37 10.5 %	16 4.5%	200 56.7%	2.10	1.3 3
I use online database to access have access science based content online (Online tutoring)	163 46.2 %	71 20.1 %	18 5.1%	101 28.6%	2.84	1.3 0
Use of data collection probes is to collect data online (Data collection tool)	47 13.3	69 19.5	24 6.8%	213 60.3%	2.78	1.2 8

	%	%				
Weighted Average Mean					**1.95**	

Key: Highly Used +Used + Fairly Used = Used

Information on the level of ICT use by science teachers in FUSs revealed that online tutoring in form of online communication tool such as e-mail (259 or 73.4%), presentation software (257 or 72.8%), online tutoring through online databases (252 or 71.4%), presentation software through word processing (251 or 71.1%), online tutoring through Internet and CD-ROMs (239 or 67.7%), and Interactive CDs through Instructional videos/audios (177 or 50.1%) as topping the list of ICT facilities being used by science teachers in FUSs. This implies that online tutoring, presentation software and interactive CDs are being used in the teaching of science in FUSs in Nigeria. On the other hand, a low level of use of virtual laboratory in the teaching of science in FUSs was revealed. This is at variance with Kumar et. al. (2005) model that suggested the use of virtual laboratory in the teaching of science in schools. Furthermore, the weighted average estimated means of the level of use of ICT facilities by science teachers in FUSs in Nigeria is 1.95 which is lesser than the expected mean of 2.13 and it implies a low level of ICT facilities' use by the science teachers.

Research Hypothesis: There is no significant relationship between purpose of ICT utilisation and frequency of ICT utilisation in FUSs in Nigeria

Table 6: Summary of Relationship between Purpose of Use and Degree of Utilisation for Science Teaching in FUSs in Nigeria

Model	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig**
Due to Regression	86.27	1	86.273	83.596	.000
Due to Residual	188.86	352	1.032		
Total	275.14	353			

$r = 0.560$, $r^2 = 0.314$, Adjusted $r^2 = 0.310$, Std Error Estimate = 1.016

From Table 5 it was observed that there is a significant relationship between purpose of ICT utilisation and degree of ICT utilisation for science teaching in FUSs in Nigeria ($F = 83.596$, $p<0.05$). Therefore, the null hypothesis is rejected. The findings further revealed a positive relationship between purpose of Utilisation and degree of utilisation of ICT facilities for science teaching ($r = .560$). This implies that the degree of importance attached to ICT utilisation for a particular purpose would determine the frequency at which ICT would be used for that particular purpose. In other words, the higher the degree of importance attached to ICT utilisation for a particular aspect of science teaching, the higher the frequency of utilisation.

Discussion of Findings

The findings of the study revealed online tutoring, presentation software, and interactive CDs as ICT resources that are being utilised in science teaching in FUSs in Nigeria. This finding is partially in line with Kumar et al. model that suggested the use of interactive CDs, online tutoring, and virtual laboratory as ICT facilities that can be used in mediating science teaching in

schools. However, the study revealed low utilisation of virtual laboratory which is at variance with Kumar's et. al model suggestion. The use of virtual laboratory in science teaching is to ensure safety of students and reduce level of injury and casualty which usually accompanied the use of sophisticated instruments in experimentation. The virtual laboratory is to prepare students well for the actual experiment which is done in the laboratory. With virtual laboratory teachers are able to impart in the students the necessary skills and knowledge needed in handling sophisticated laboratory equipments.

The findings of the study further revealed a general low level of ICT utilisation among the science teacher in FUSs in Nigeria. This is evident from the fact that less than one-third ($^1/_3$) of the science teachers affirmed the use of ICT facilities for one purpose or the other. The study further revealed a low level of use of ICT facilities for experimentation/simulation activities which is core to science teaching. Majority of the science teachers make use of ICT facilities basically for classroom-based activities (i.e tutorial, enhancement activities, multimedia application use in classroom, and collaborative learning) at the expense of laboratory-based activities (i.e experimentation /simulation).

Moreover, findings from the study on the extent of use of ICT facilities among the science teachers revealed that they make regular use of ICT basically for tutorial, presentation of new materials, information access via CD ROM, internet, and database, and online communication via e-mail. This implies that the regular use of ICT facilities for science teaching based activities among the science teacher in FUSs in Nigeria is very low. In all the low use of ICT facilities among the science teachers in FUSs in Nigeria is established through the findings from this study. The low level of use of ICT facilities among science teachers in FUSs in Nigeria corroborates Al-Zaidiyeen et.al. (2010) findings that reported low level of ICT use for education purpose among teachers.

Summary and Conclusion

The study investigated the utilisation of ICT for science teaching in FUSs in Nigeria. The findings of the study revealed the following:

1. Online tutoring tools, presentation software and Interactive CDs are being used by in science teaching in FUSs in Nigeria.
2. There is a low level utilisation of virtually laboratory facilities, simulations and modeling, and graphical visualizing tools for science teaching among the science teachers in FUSs in Nigeria
3. Science teachers in FUSs make use of ICT facilities for classroom based teaching activities at the expense of laboratory and experimentation based activities.
4. Overall, there is a low level of use of ICT facilities by science teachers in FUSs. This low level of use may be due to problem of ICT access.
5. The model of science teaching in FUSs follows the pattern of class presentation using presentation software, laboratory session, self-built projects, utilisation of interactive CDs and online tutoring. This model puts more emphasis on traditional talk and chalk methods of teaching than ICT-mediated method of teaching, which is currently the best practice in the world.

Recommendations

The following recommendations were made based on the findings of the study:

1. The school management and government should ensure the provision of relevant technologies that would enhance effective teaching and learning of science subjects in FUSs. This would enable the teachers to use the technologies in meeting the different learning styles of the students in science.
2. Government should also make provision for science-based ICT applications such as simulations, modeling, virtual laboratory and graphic visualizing tools that do make teaching meaningful and real. Science-based ICT applications ensure the replacement of the abstract nature of teaching that characterized traditional teaching with meaningful and real teaching.
3. Science teachers should endeavour to use ICT facilities for laboratory-based and experimentation activities.
4. More emphasis should be placed on the use of ICT facilities for teaching science subjects by science teachers.
5. There is need for science teachers in FUSs in Nigeria to adopt ICT-mediated model of science teaching for effectiveness and clear delivery of instruction.

References

Abolade, A. O & Yusuf, M.O. (2005). Information and communication technologies (ICTs) and the Nigerian teacher education programme. *African Journal of Educational Studies* 3(1), 1-19.

Al-Zaidiyeen, N., Mei, L., & Fook, F. (2010). Teachers' attitudes and levels of technology use in classrooms: The case of Jordan schools. *International Education Studies*, *3*(2), 211-218.

Bennett, S.J., & Brennan, M.J. (1996). Interactive multimedia learning in physics. *Australian Journal of Education Technology*, *12*(1), 8-17.

British Educational Communications and Technology Agency (BECTA). 2010. *Leading next generation learning*. Retrieved from http://www.education.gov.uk

Godwin, S. (2004). Whole-class technology for learning mathematics: the case of functions and graphs, *Education, Communication & Information*, 4(1), 131-152.

Hassard, J. (2010). Why do we teach science? The art of teaching science. Retrieved from artofteachingscience.org/2010/11/25/why-do-we-teach-science/on 13/11/2012

International Society for Technology Education. (2000). National education technology standards for teachers. Eugene OR. *International Society for Technology in Education Projects*. Retrieved from http://onets.iste.org/index3.html

International Society for Technology in Education. (2003). *National Educational Technology Standards*. Retrieved October 20, 2007, from http://www.iste.org/AM/Template.cfm?Section=NETS

International Technology Education Association (ITEA). (2000). *Standards for technological literacy*. Content for the study of Technology. Reston, Virginia

Jenkins, D.R. (2009). Computer literacy, access, and use of technology in the family and consumer sciences classroom. *A Master's Theses submitted to University of Kentucky*. Retrieved from http://uknowledge.uky.edu/grads_school_theses/515

Kumar, P.R., Subramaniam, T, & Mukherjee, T.K. (2005). Issues in physics practicals in an open and distance learning environment. *Asian Journal of Distance Education*, 3(1), 1-5. Retrieved from www.AsianJDE.org.

Lawson, T. and Comber, C. (2000). Introducing ICT into schools: blurring boundaries. *British Journal of Sociology of Education,* 21(3), 419-433.

Olatoye, R.A. (2006). Raising the standard of science teaching for great and dynamic economic development in Nigeria, *Journal of Qualitative Education*, 2(1), 39-46.

Osborne, J., & Hennessy, S .(2001). *Literature review in science education and the role of ICT: promise, problems and future directions*. Available at http://www.restafuturelab.org/research/reviews/se01.htm. Accessed 12/06/2009.

Ramayah, T. (2006). Course website usage: Does prior experience matter. *WSEAS Transactions on Information Science & Applications*, 2(2), 299-306

The University of York Science Education Group (2002). *ICT support of science education: A practical user's guide.* Layerthorpe: York Publishing Services Ltd. Retrieved from www.yps-publishing .co.uk

Turner, J. H. (2003). *Human institutions: A theory of social evolution*. London: Rowman & Littlefield.

Yucel, C., Acun, I., Tarman, B. & Mete, T. (2010). A model to explore Turkish teachers' ICT integration stages. *The Turkish Online Journal of Educational Technology,* 9 (4), 1-9. Retrieved from www.editlib.org/p/53409
