

# TECHNOLOGY INTEGRATION FOR MATHEMATICS EDUCATION IN A DEVELOPING COUNTRIES WITH A FOCUS ON UNITED KINGDOM.

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## **Abstract:**

The present study focused on the Technology Integration for Mathematics Education in a Developing Countries. This paper classified the educational status between United Kingdom and Australian educational context. The main objective of this study to find out the educational outcomes in developing countries in present context. The methodology of the study is qualitative and quantitative methods are applied. The study is a mixed type involving interpretative, analytical study of documents, interview and study both primary & secondary sources, like books, university news, expert opinion, articles, journals, thesis and websites, etc.

**Keywords:** *Australian Education, Developing Countries, ICT, Mathematics Education, Technology Integration, United Kingdom.*

## **Introduction:**

Technology has the potential to improve student learning and to provide opportunities in teaching that were not previously available (Gulati, 2008). Technological development worldwide has encouraged academics to integrate technology into education to support all forms of learning. The main highlight of teaching and learning experiences are based on interactive learning environments. Learning and communication technologies (ICT) are a fundamental piece of daily life, which include the teaching-studying process (Das, 2021a). The combination of the internet, websites and e- learning systems provide new directions for education, facilitating students' access to learning resources and their interaction with peers and teachers, allowing learning in their own time and space. It has enabled learners to access and interact with peers in ways not envisioned even a decade ago. Students in western classes have access a wide variety of software expanding the possibilities for learning with modern technologies showing their effectiveness in providing a new

approach to mathematics education. These statements are particularly applicable to students in developed nations, not so for students in some developing countries. For staff in developing nations faced with limited professional development, little use of technology and limited resources to purchase technology it is difficult to imagine what is possible (Gulati,2008). Research suggests that an e-learning system is one solution to bridge the education gap. However, there is an increasing and extensive awareness that the pedagogical and technical expertise of the teacher is extremely critical (Hennessy, Harrison &Wamakote, 2010).

The upsides of on line materials include get admission to without community programming establishment, simplicity of dispersion and fresh for engineers, and everlasting accessibility for customers so long as the internet is available (Das & Das, 2020).From the advancement of developed nations, this is aimed to find ways to bridge the educational gap, by skipping the long learning curves undertaken in western nations and introducing staff in developing countries to current best practices in education. This research investigates what is best practice in developed nation, and in particular mathematics education with a view to identifying ways to capitalize on lessons learned through educational developments that have been tried and tested. The outcome would be to deliver an advanced starting position for staff and students in the developing nations of UK who are beginning their exploration of what is possible.The countries like Netherland, United Kingdom and Malta have recognized the importance of technical support to help teachers to use ICT within the classroom.(Yang & Wang, 2012).Right now, there's a deficiency of exploration that caused the usage of automated degrees for learning science. Learning and communication technologies (ICT) are a fundamental piece of daily life, which include the teaching-studying process (Das, 2019a).

### **Purpose and Objective:**

The purpose of this research is to identify ways to develop tertiary level mathematics and statistics capabilities in UK. The efficient introduction of technology into developing countries of UK is dependent upon the availability and accessibility of hardware, software and communications infrastructure. However, the real challenge for educationists is how to utilize the potential of ICT to complement the role of the teacher as an effective tool in supporting teaching and learning in a learner-centered environment, instead of within a more traditional pedagogy.

Institutional technology research in higher education is conducted for many reasons. For example, it may relate to the provision of access to higher education for people otherwise disenfranchised by traditional delivery system or on finding innovative approaches to employing technology to enhance the quality of teaching and learning. All instructional technology research focuses on questions of how people learn and perform, especially with respect as to how learning and performance are influenced, supported, or perhaps even caused by technology.

The introduction of technology to developing countries was undertaken with a view to improving mathematics learning and hence questions as to how students are taught and how

they learn mathematics and perform in ICT rich environments need to be explored. In order to investigate best practice and what is possible it was necessary to develop understanding of:

- The issues confronting nations in terms of integrating ICT into education;
- Theories of learning as they relate to the integration of technology into teaching and learning
- Best practices in using technology to create blended learning (face to face teaching combined with e-learning sites) such as;
- The infrastructure, available in developed nations to enable the adoption and adaptation of e-learning;
- The rationale such as the desired educational outcomes for the selection of technologies and practices used in modern online mathematics learning environments.
- The provision of, or the needs of staff for professional development in relation to technologies readily available, both generally and specific to mathematics.

The research objectives examined ways to improve mathematics education through the use of technology and to identify ways to introduce these technologies into the UK. In particular, the intent is to;

- Develop, trial and evaluate an effective template, or structure, for embedding mathematics learning support into e-learning site;
- Adapt best practice, in terms of technology use as developed in an Australian context, to meet the needs of the nations;
- Develop, implement and evaluate effective professional staff development processes for the use of technology in these developing countries.

**Table 1.1. Research questions and issues in secondary level.**

Overarching research question	
How can tertiary mathematics education in United Kingdom enhanced through the integration of technology into teaching and learning?	
In the Australian educational context	In developing countries

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To examine best practices, it was important to firstly determine that the selected learning outcomes for the chosen subject were positive. This was undertaken through addressing the questions:

How effective is the selected subject MATH subject in terms of impact on student's confidence or perceived competency?

How effective are the offline resources and the online learning provided in terms of usefulness in helping students understand?

How effective is the design of the e-learning site in terms of its provisions of attributes such as clarity or good access to materials?

To examine the possibility of introducing technology along with effective practices to mathematics students in developing country, the following questions was asked?

What is the current state of access to technology in a mathematics department in a developing countries? Especially, what is the access to computer laboratories software, hardware and the internet? How and why are they used?

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In the terms of the provision of mathematics education development what strategies, may be applicable to education in the developing country context?

Ho can professional development be used to introduce current technology to United Nations mathematics staff?

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### **Analysis of This Study in Brief:**

To answer the research questions involves the selection of a methodology through which data are gathered. These are several different research paradigms involving collection of quantitative or qualitative data or the combining of the two types of data. How data are collected and what type of data relates to the trustworthiness of those data and thereby the implications and findings drawn. Discussion and selection of the paradigm framing the study and the research methodologies can be described in these case study.

### **This Study in Brief:**

Two case studies were the basis of this exploration to build knowledge of best practices leads to implementation of professional development in a developing countries (refer, Table 1.2). Through immersion in an Australian tertiary mathematics education context, the researchers investigated mathematics education seeking to identify best practices in a department involved some of these practices in context through the trial of a professional development initiative (refer, case study 3).

The first case study, the Redesign of e-learning site, examined that involved redesigning an e-learning site for a first year service subject that is a mathematics subject designed by science students, namely MATH151. The choice of subject is redesign which involved altering the structure of the pages and developing learning support resources, which included orientation and showing the process of solving mathematics problems. It also involved evaluating three successive groups of student to discover the effectiveness of learning designs used to combine learning resources, in terms of improved student learning outcomes.

**Table 1.2. Case studies and the main methods of data collections.**

AUSTRALIAN CONTEXT	
	Case study 1 Redesign of e-learning site of MATH151 at secondary level
	Case study 2 Professional development for technology in mathematics education at secondary level
Objective	To explore students perceptions of the utility and efficacy of the subject e-learning site
	To explore the technologies used in Australian mathematics classrooms with the view to considering which might have relevance in the secondary level.
Participants	Students at UOW
	Mathematics Academic staff Mathematics secondary level students General Staff
Instruments	Survey for student in one subject( MATH151) in 2010,2011, 2012,
	Students development in math department at secondary level.
Developing Countries Context:	
	Case study 3 Professional Development in secondary level
Objective	To trial various technologies with staff students To identify the potential of professional development through determining the impact of the sessions on subsequent practice in one classroom
Participants	UK Mathematics Academic staff, Mathematics secondary level students and General staff
Instruments	Interview math staff at SQU Evaluation of training
Outcomes	Reflection on the adequacy of professional development

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theories

Identification of factors impeding the achievement of optimal benefits from the technology applications in the learning

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### **Analysis of Case Studies in Developing Countries:**

Remaining in the Australian context in Case study 2, Professional development for technology in mathematics education, interviews were used to identify what technologies staff used, how they were used and the difficulties staff found in learning technology in terms of self-development and staff development.

The focus of the third case study, Professional Development in Secondary Level, involved introducing technologies to academic staff in developing countries. Introducing technologies to academic staff in developing countries, an analysis of issues regarding educational technology. The insight into issues that led into the development of a professional development package for staff for the adoption, implementation and evaluation of the professional development package.

### **Educational Theories of Learning:**

As an organizing framework that brings an additional layer of understanding to concrete experience by implying relationship, consistency and a degree of predictability and testability'. Learning theories are commonly consulted in the instructional design process in many traditional educational settings.

The case studies explored in this article conducted at the tertiary level, involve adult participants, students, the learners, staff, and those engaging in professional development. Knowles(1990) argues that adult learners bring a great deal of experience to the learning environment and therefore the active participation of learners should be encouraged and acted upon when designing and implementing educational programs. Social constructivism emphasis the importance of social interactions in affecting the individual's generation of knowledge or facts about the world and this is important for adult learning. A deep discussions of the learning theories are as follows:-

#### **1. Behaviourism:**

Behaviourism is associated with stimulus and responses. The learner is trained to respond based on a stimulus. Behaviourists concentrate their efforts on observable learner behavior and reinforcement. Behaviourists believe that a student has learned something by observing their changes in behavioural responses. This is an objective approach where knowledge is perceived as facts that can be transmitted from teacher to student. These implications include:-

- Students should be informed of the explicit online lessons learning outcomes;

- Students must be tested to examine an individual student's achievement level and to provide feedback;
- The learning materials should be sequenced appropriately to promote learning; and
- Students must be provided with feedback so that they can examine how they are doing and take corrective actions if required.

Behaviourists' strategies are relevant to this study in two ways. Firstly, when designing materials for an e-learning site, issues of specifying objectives, feedback and reinforcement are apparent. Secondly, with regard to professional development, behaviourist theory is relevant when setting the goals of the training, practice and observation. However, some educators argue that not all learning is observable and there is more to learn than a change in behaviour.

## **2. Cognitivism:**

Cognitivism opens up the black box of the mind, regarding the learner as an information processor. Good and Brophy defines learning from a cognitivist perspective as the acquisition or reorganization of cognitive structure through human processes and the storage of information. Cognitive theories focus on how learners process information with memory, motivation, abstraction, thinking, and reflection, all playing a significant part in learning. As such, cognitivist approaches have provided a foundation for learner-centred education. Graphic organizers and note taking skills are the examples of cognitive theories that are of particular importance for teaching.

Several aspects of cognitivism are of importance when exploring online learning and hence of importance for the case study. The redesign of e-learning. For example, in cognitivism, the learner is seen to use different types of memory during learning. This means that the strategies implemented for online learning should allow students to perceive information in ways that facilitate transfer to working memory. Such strategies include proper location of information on the screen; appropriate use of colour graphics and size of text; the packing of the information; and the mode of the delivery such as, audio, visuals, animation and video.

## **3. Constructivism:**

Vygotsky defined constructivist learning theory as the active construction of new knowledge based on a learner's previous experience. Constructivist theory suggests that students learn by actively constructing knowledge, comparing new information to previously learned information, thinking about and working through discrepancies and ultimately reaching new understandings. Constructivists see learners as being active rather than passive. Constructivism students work.

Constructivist learning theory with its focus on knowledge construction based on learners' previous experience is a good fit for e-learning. Koochang(2009) suggests a model based on

constructivist learning theory for promoting learning in e-learning activities, learning assessment and the instructor's roles.

While both constructivist and cognitivist learning theories provide ample pedagogical practices for designing instructional opportunities, their underlying principles do not often intersect and may leave something to be desired. In this study, a combination of aspects from existing learning theories, behaviourism, cognitivism, and constructivism, along with the principles of connectivism has been adopted.

### **Connectivism:**

Connectivism is a learning theory for the digital age, that contrasts with behaviourism, cognitivism, and constructivism. The limitations of these earlier theories include their intrapersonal view of learning and their failure to address learning that is located within technology and organizations.

In connectivism the starting point for learning occurs when knowledge is activated through the process of a learner connecting to and feeding information into a learning community. Learning is seen as a network phenomenon, influenced, aided, and enhanced by socialization, technology, diversity, strength of ties, and context of occurrence. Connectivism involves opportunities for peer-to-peer learning networks where learning occurs in short bursts driven by the needs and interests of the learners and where flexible learning activities encourage interaction between instructors and students and among learners.

**Table 1.3: Theories of Learning:**

Theories	behaviourism	Cognitivism	Constructivism	Connectivism
How learning occurs	Black box- observable behavior main focus	Structured, computational	Social, meaning created by each learner(personal)	Distributed within a network, social, technologically enhanced, recognizing and interpreting patterns.
Influencing factors	Nature of reward, punishment	Existing schema, previous experiences	Engagement, participation, social, cultural	Diversity of network, strength of ties
Role of memory	Memory is the handwriting of repeated experiences	Encoding, storage, retrieval	Prior knowledge remixed to current context	Adaptive patterns, representative of current state.
How	Stimulus,	Duplicating	Socialization	Connecting to nodes



transfer occurs	response	knowledge constructs of knower
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In this theory there is much more intense focus, compared to other learning theories, on the networked and shared (or sharing) experiences (Tschafen & Mackness, 2012).

Social media and emerging technologies are used to facilitate learning through providing opportunities for external learning situation that are not always available, or feasible, in face-to-face classrooms. Connectivism appears relevant to the delivery of the subjects in the Redesign of e-learning site study, as students were to connect to and use learning resources and to communicate via the e-learning site. It is also relevant in the study Technologies in Higher Education where academic staff use different technology for communication with each other and for self-professional development.

### **Improving Mathematics Education through Technology:**

To ensure targeting of staff development, the survey improving mathematics education through the use of technology and interviews were used to identify which software and resources were already used, their needs, and the difficulties faced in integrating technology. This information provided the background context to ensure that professional development was orientated in a manner that suited staff. Secondly, the survey was used to identify difficulties facing lectures wishing to integrate technology into their teaching.

**Table 1.4. Evaluation of Professional Development in UK**

Phases	Source of data for each stage for evaluation
Design	Literature review to identify issues in developing countries Case study 1 Redesign of e-learning site: identification of e-learning site practices in Australia focusing on design, resources, activities and supports students learning to inform design of subjects. Case Study 2 Professional development for technology in mathematics education. Identification of best practices, technologies used and techniques for professional development in Australia to inform professional development. Professional Development in UK: Identification through surveys of staff needs in relation to technology use in developing countries.
Development	Choice of topics determined from Case study 1 and 2 The preparation of professional development packages.
Implementation	Delivery of the professional development countries
Institutionalization	Professional Development in UK: Interviews and surveys of participants regarding the usefulness of the technology;

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One class developed to the point of implementation of the professional development program.

Issues in transfer explored

Request for and use of workshops.

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### **Analysis of Evaluation Case Study: Redesign of e-learning:**

The first case study provided an opportunity for immersion into the Australian educational context. It explored the Redesign of e-learning site with a view to improving student learning experiences, e-learning is already known to have influenced the field of teaching, training, and development( Manochehr,2006), with many schools using systems such as Moodle to provide communication and additional resources for students. There are claims that e-learning, or online learning as it is also known, can improve student learning if it is purposely planned. However, there are also concerns that there is insufficient evidence to show that e-learning is an effective delivery mechanism. Furthermore, there are many new technologies in e-learning environments, such as blogs, wikis, podcasting, interactive pads and smart boards, videos resources and video conferences, Tablets PC, Moddle/ e-learning site and social websites, which have been used to support students learning. Even though, academic staff have been willing to open up to the use of these technologies in their classrooms, the question to address is whether these technologies are effective in improving learning.

Evaluation is important in this article where a redesign of e-learning site is undertaken as part of the exploration of best practices. One challenge facing evaluators of technology-based programs is to design studies that can provide the feedback needed to enhance their design or to provide evidence as to their effectiveness in answering some of the pressing issues facing teaching and learning with technology (Owston, 2008).

### **Conclusion:**

There was a premature end to professional development. This intended site for development to implement the professional development program. The disruption to the planned implementation of a professional development program in a stark reality for many developing nations. This study confirmed what is reported in the mathematics education. Development in many countries is interrupted political events, such as political instability, resulting in a loss of continuity and development being set back. Plans to return to implement a professional development program were put on hold.

The strongest recommendation from this case study regarding the embedding of technology into mathematics education develops a policy for technology use along with a plan for implementing it within the curriculum. A requirement to use technology should motivate the use of technology, in many cases existing technology and software, while facilitating the use of freely available software. Lectures believe that they would integrate more technology if the shortage of equipment, such as document projectors in lecture room, were addressed. To use

technology lectures also need professional development and more technical support so that they can become comfortable with the integration of technology into the classroom.

An examination of how professional development was conducted showed that these practices were similar to the workshops followed by one-on-one facilitation to achieve specific learning outcomes are used in developing countries. Opportunities to access funding through small grants and large grants were similar. For example, staff may apply for small internal grants (Educational Development Strategic Funds) and extremely through the Office of Learning and Teaching, which acts to promote excellence in higher education learning and teaching. To support and sponsor research activities and projects at all levels. Staff members have several sources of funds and grants available such as Research Council. However, the scope of funding to motivate developments was, and almost certainly will remain, and more limited.

In this case study staff desire for more recent forms of technology such as a document camera and the interactive whiteboards. This might imply that despite their poor accessibility, these staff considered these tools would be valuable addition for the teaching of Mathematics. There are many potential variations on the professional development of teaching staff. These range from teaching practice guides or funding to attend conferences, to formal teaching programs. Workshops that would be of benefit to staff include:

- i. Combining open learning to provide across curriculum learning support
- ii. Rudimentary html for web page design
- iii. LaTeX documents for design resources

The purpose of Mathematics education is to draw how tertiary mathematics education enhanced through the integration of technology and to triangulate upon answers to questions addressed with respect to the need for professional development for teachers.

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