

Effective Use of ICT for Learning and Teaching Geography

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Submitted: 6/6/2019

Accepted 17/10/2019

Published 1st, January 2020

Abstract

This study reviews and analyses the use of Information and Communication Technology (ICT) in learning and teaching geography, whether in colleges or schools. The research aims seek to answer the research question in terms of making effective use of ICT in learning and teaching geography. This study used a systematic review as the chosen research methodology and critically reviewed and analysed 5131 publications. The research found only 8 studies which were qualitative and met the inclusion criteria. These studies have been analysed and assessed according to the standards of systematic reviews in educational research. The literature revealed that learning and teaching geography are different in some countries such as in the UK, the USA and Australia. It also showed that geography teachers need to understand the relationship between the Technological Pedagogical Content Knowledge (TPCK) and geography subjects to teach them in an effective way such as with the GIS application within the classroom. Additionally, this research review found that there is a surprising gap in the use of ICT in geography education, in the UK, the USA and Australia for instance. The study shows that GIS and RS are a type of ICT tool which can be used in learning and teaching geography in higher education, but it seems to be a complex way of teaching in secondary schools. Moreover, teachers have limited knowledge and skills in using GIS in primary schools. GIS and RS have the ability to change the method of teaching geography in colleges and schools. The findings from this study also showed a lack of confidence with geographic knowledge, particularly in the geography curriculum in the USA. The use of computer games is very limited in geography education, especially in schools. This study indicates that integrating ICT in learning and teaching geography can develop the Geographical Pedagogical Content Knowledge (GPCK). Furthermore, the study indicates that the use of Remote Sensing (RS) technology is a kind of ICT tools which engage and develop students' knowledge and skills in geography. GIS application use is motivational in geography education. Finally, the study also found that synthesis research is a medium quality study in this review.

Keywords: ICT tools, geography education, pedagogy

1. Introduction

Geography is a subject that studies the interrelationships between the physical environment and humans in the place [1]. Geography can be divided into two branches, physical, and human geography. The natural side studies various topics such as climatology, weather, geomorphology, topography maps, rocks, soils, natural resources (e.g. water), seas and oceans geography. The human side pertains to the

social relationships (cultures, economics and politics) among peoples within the one region and the effects of the interrelationships between people and their surrounding environment. Geography deals with population all over the world, thus it is required to be studied from near and far. Historically, the word 'geography' was first used in 1540 "Middle French *geographie* (15c), from Latin *geographia* and from Greek *geographia*". It means describing the manifestations of the earth's surface [2]. In 1880, there has been a need to improve geography teaching in schools and colleges, thus, in 1886, the Royal Geographical Society (RGS) published the Keltie Report and conducted some improvements in geography education [3]. This means that geography has a long history as a learning subject in both schools and colleges. Geography can simply be defined as a topic studying the persons, earth's phenomena, and the natural environment for people and animals in the world [4].

Modern geography is seeking Geospatial, Spatial distribution of Spatial Phenomena and Spatial Interactions among humans and environment [5]. For instance, it studies climate change, economic, industry, urban planning, health service distribution, etc in a region. Today, geography is highly dynamic [1]. The Institute of Australian Geographers [6] defines that geographers investigate the dynamic relationships between peoples and their environment. The Institute of Australian Geographers [6] with UNESCO [7] state that geography has three key concepts;

- Place: geographers discover what place means and how persons are affected and influenced by places.
- Environment: geographers investigate "biophysical environments" [6].
- Space: to understand the space geographers examine how, why and with what impact dissimilar phenomena on earth's surface.

In other words, geography aims to build bridges of knowledge between human geography and physical geography in order to understand the dynamic of the relationship between societies and dynamic of physical phenomena on earth landscape and environment [4]. This means that geography enables humans to understand the differences between human groups and places in any region. For example, the differences in political systems, economics, cultures, landscapes, and spatial distribution of human activities across the world. Modern geography is understanding the causes of differences and inequalities in places and community groups within the region at borders.

The value of geography comes as a result of the changes that have happened in the world. Additionally, it is necessary to develop the knowledge and skills in geography due to the changes in the world and the great challenges faced day-to-day. Geography provides good information with well-interpreted analysis to help society understand the changes, problems, and challenges which are happening across the world. It also provides the information needed to make decisions and solve problems [8]. Research in geography has developed several issues related to humans, local and global environments throughout the knowledge and geographical skills

In terms of the use of technology in teaching geography, this study aims to answer the questions below:

- 1- How can ICT be used effectively in the learning and teaching of geography?
- 2- What are the characteristics of ICT used in the classroom to ensure that teachers and students use ICT effectively for learning and teaching in geography?
- 3- Is the use of technology in geography motivating for students?

In order to establish the background of the study, the existing related literature needs to be critically reviewed. Moreover, in this chapter, the focus is on the qualitative data of previous studies which are related to the use of ICT for learning and teaching especially in learning and teaching geography. Additionally, to answer the questions in this research is the major focus in this section to understanding systematic literature reviews that focus on qualitative evidence studies. The literature review will focus on research studies which are relevant to the research questions. The findings of these studies should be critically analysed, evaluating and discussing the findings of these studies which will use the secondary research method. A systematic literature review aims to establish a theoretical framework that enables the researcher to investigate how to make effective use of ICT for learning and teaching in geography. The tools which have been used to search different databases in this systematic review are Advanced Research, Science Direct, Google Scholar and Academic Search Complete.

2. Technology-enhanced learning

All aspects of life are influenced by technologies and computers, for example, communication, studies, presentation, making decisions, solving problems, creatively and challenges [9]. According to Terpule et al [10] technology enhanced learning has positive outcomes for learners who become central to their learning. Shah [11] claims that integrating technology within education has generated a “more stimulating learning environment” and this technology has the possibilities to make the learning process more entertaining and innovative. He furthers that technology can be used in several ways in the education process, such as:

- It is used as a part of the curriculum.
- It is used for delivering learning contents.
- It is used as a tool to enhance the learning knowledge.
- It is used as an aid to teaching.

Technology is a fundamental part of education and it plays a very important role in learning outcomes. However, this integration of technology is not an easy matter. To enhance learning in every part of the education system, it is necessary to change some methods by using and developing technology [12]. Technology in learning includes many forms such as computers, mobile phones, online learning, whiteboards and information technology (IT). All these kinds of technology devices support and enhance the learning and teaching in all subjects in primary and secondary schools in the world.

3. ICT for learning and teaching

One of the reasons for integrating ICT in school education is to help teachers to change the way they teach in the classroom [13]. Tezci [14] argued that technology has an important educational value when it is used in the learning process, but it does not have any value when it is used on its own. Technology, therefore, is neutral. Umar and Yousef [15] believe that ICT is used in all aspects of life. It can be used in leisure time and education. With respect to leisure time, children discover and search for general information, such as using Facebook and computer games. Whereas, using ICT in education can help students to obtain new information. Therefore, the use of technology in learning and teaching has a positive impact on education due to the fact that it is beneficial to enhance the learning process in schools and also it has changed the way of learning and teaching [12,15-17].

Even though, technology has also a negative effect on students. For instance, some students use technology just for enjoying and playing rather than focusing on important issues in their education. This problem may be attributed to the teacher's lack of control on his/her students and inability to advise them to use technology for educational purposes whether in school or outdoor. Nevertheless, Hionstroze et al., [18] argue that using ICT has had an impact on students' achievement and motivation in education. One kind of ICT toolkit is a computer, it is used for learning skills, gaining information and knowledge that are relevant to computer programmes. For example, some computer programmes such as Excel can be used the geographical statistics. The computer can also be used for communicating between pupils and schools. Internet service is also an ICT tool. It has the abilities and flexibilities to seek information and research reports that are related to students' education. According to Haywood and Hutchings [19] in 2002, the UK schools have widely used the internet service in the education process. Smith [8] points out that the purpose of using ICT in English primary and secondary teaching geography is to enhance pupils' skills, gain information and geographical knowledge, deep understanding of spatial relationship and environments, differences between people and places, and the effect of IT on the humans' environment.

Haywood and Hutchings [19] added that ICT has the ability to gain pupils' interest and it offers a much more effective connection. In terms of the capacity of ICT, it has a positive influence on cognitive development, if it is used appropriately. McFarlane [20] sees that IT has the ability to help and develop students in geography learning skills by discussing, making decisions and then solving problems. According to Rambousek et al. [21], the modern concept of ICT is to help and enhance students' skills and abilities to think critically and then to solve problems in their education. In addition, Condie and Munro [22] affirm that ICT has improved students' learning by developing their skills to solve problems and it has the ability to explore some patterns and relationships in learning mathematics and other subjects. Tuzun et al., [23] also confirm that ICT has a positive effect on the learner's motivation and achievements.

Technology has not only enhanced learning and teaching in schools, but also has enhanced assessment for learning because assessment for learning is an essential part of the learning process in education [24]. This means that ICT has a great impact on education and it has enriched learning and teaching in schools and colleges. ICT has the potential to improve and support the education process. Teachers and students have to utilise these key features of this technology to improve the quality of learning and teaching in all education authorities as well as for enhancing assessment for learning. Thus, technology can be considerably helpful for teachers and students if it is used appropriately in the learning environment.

Numerous writers have studied the impact of ICT on learners' motivation and achievement in the classroom [11,12,15,25,26]. The results of these studies have shown that students were positively influenced by using ICT in learning. The literature of using ICT in education has widely discussed the influence of technology on education in several countries. Nevertheless, the use of communication in classroom learning is more difficult than other places [27]. The School of Education at Trnava University in Slovakia has carried out a research which used different forms of ICT in online learning to support learning in mathematics and computer science [26]. Taffs and Holt [28] also studied online learning in environmental science to improve students' skills in academic writing in the environment subject. The use of games in the learning of geography in primary education is helpful and motivational to learners

to enhance their knowledge and skills in geography [29]. It is clear that the use of ICT is an important tool in learning, teaching and assessment in the education process throughout the world [30].

4. Teachers' skills and confidence

The effect of technology on education is one of utilising ICT in learning and teaching environment. Over twenty years ago, ICT created an evaluation and development of the whole education system and it has had significant influences on the learning and teaching environment [31]. As a result of this development, it changes pedagogy and learning environment in the schools. Umar and Yusoff [15] conducted a study that aimed to examine the level of ICT skills of teachers in Malaysia. This study found that teachers need to have high skills on the internet to seek information and communicate. Furthermore, it indicated that female teachers use ICT significantly less than males in the classroom. This could be related to the lack of training or limited knowledge in using ICT in their teaching. Umar and Yusoff mentioned that The Ministry of Education in Malaysia has invested a lot of money implementing ICT in schools. In addition, several countries have also spent a lot of money integrating ICT in education, The Netherlands, for example, has spent a large amount of money on integrating ICT in teaching primary and secondary pupils [25]. In European Countries, the universities of Spain were obliged to implement different kinds of ICT tools in order to make the method of teaching more interesting and motivational and successful pedagogical in higher learning [32]. In his introduction [11] states that technology has impacted the relationship of teachers with learning and not only improved the learning process but has changed the way students learn in school.

Tezci [14] points out that some challenges in Turkish education were resolved as a result of some efforts that were done by The Ministry of Turkish for National Education. According to Goktas et al, [16] since 1984 the Ministry of National Education in Turkey attempted to increase the integration of ICT in schools and these efforts have resulted in increasing the number of academic research on ICT studies to use it in learning. Goktas, Gedik and Baydas added that the aim of their study was to address the barriers that face the implementation of ICT for Turkish primary school teachers. To overcome these barriers, the study suggested many enabling factors, for instance, offering high-quality training and giving more money to support research units. Another study has focused on barriers in schools, where teachers in their education cannot effectively or fully use ICT in the UKs' schools due to they have a lack of knowledge and high skills in the use of ICT [33]. It is clear that Turkey did a great deal to integrate ICT in education and tackle the challenges that faced teachers and students in schools.

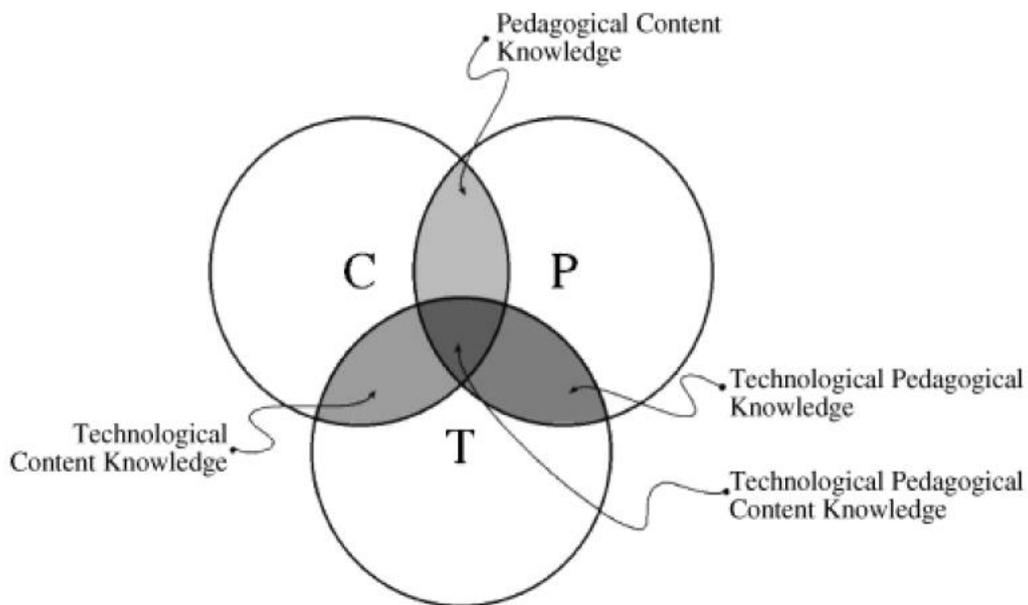
5. Technological Pedagogical Content Knowledge (TPCK)

TPCK refers to the kinds of knowledge which teachers need in order to teach effectively by using technology to enhance the learning environments. Shulman [34] was the first person who describes the notion of Pedagogical Content Knowledge (PCK) and throughout the inclusion of technology, the TPCK framework was built on that main idea. The relationship between Technology, Pedagogy and Content requires a high level of understanding and knowledge in order to use technology in an effective way to teach a subject or a specific content. For example, the geography teacher needs to understand this relationship to teach geography subjects such as GIS application by using technology in the classrooms effectively.

The relationship between these three components is complex. However, this relationship can be highlighted by a particular framework like TPAC to address requirements that teachers need and know how to incorporate technology effectively in learning and teaching geography for instance. Likewise, Mishra and Koehler [35] see that the three core components of Technology, Pedagogy and Content are the heart of good learning and teaching with the use of ICT in the schools. The figure below illustrates the relationship between the key concepts of TPCK in the teaching process as described by Mishra and Koehler [35].

The use of technology in the United States of America in education is rather low. The Office of Technology Assessment (OTA) in the US pointed out that in 1994, there was a lack of good practice of technology between all states in the USA. However, over the last three decades, the USA has invested a considerable amount of money in the use of technology in education across all states [36]. The use and integration of technology were given little support in the classroom by the teachers [36]. Most teachers also did not utilise the technology in their teaching and they did not implement or use the technology in pre-services in their field experiences. Hindle [17] reported that the lack of geographical knowledge of American geography teachers is related to lack of consideration in geography syllabus and the limited use of technology in teaching geography. Therefore, American geography teachers can enhance their geography teaching skills by means of utilising technology in geography education.

Figure 1. Key Concepts of Technological Pedagogical Content Knowledge [TPCK]



Source: adapted from Mishra and Koehler [35]

6. Barriers to learning: Digital devices and access

Most developing countries including Africa are facing challenges to using ICT for training teachers in the process of teaching [37]. This barrier could be attributed to lack of funding to provide technological devices or lack of experience and skills in using ICT. However, the biggest challenge can be due to insufficiency of these devices at educational institutions like schools and universities. For instance, lack of hardware and software in addition to maintaining these devices [38]. According to Balanskat et al., [38] some education systems in the world depend on the conventional way of learning the process and the inflexibility of using ICT resources, rather than integrating ICT in their daily learning tasks.

Taylor and Packham [39] carried out a study on Social Inclusion through ICT to identify barriers in using ICT which is related to lack of skills, fear of technology and interest/relevance. According to Welsh Assembly Government [40], some barriers and issues like lack of skills and confidence as well as anxiety in using of ICT are required to be addressed. Another reasons that build these barriers can be culture and physical factors [41]. On the one hand, teachers who do not have enough training or skills in using technology, can not access to educational information via ICT. On the other hand, time can also be a barrier for most teachers in developing countries in using ICT in the processes of learning and teaching. Consequently, the skill level of teachers, schools and the educational system are the main barriers to use digital technology [38]. The skill level of the teacher is a significant matter in using technology in learning and teaching process. Thus, intensive training in using ICT is necessary for teachers to obtain high levels of proficiency in using such technological tools. All these kinds of barriers can have a negative influence on both teachers and students in using ICT. It also could have a negative influence on learners' and teachers' motivation to use ICT effectively in learning and teaching geography. As a result, all the above mentioned reasons can be barriers for some countries that have not successfully implemented ICT in the education process yet.

7. Technology-enhanced learning and teaching in geography

Digital technology can be used as a tool in learning and teaching geography, whether in schools or colleges. Computer games have been used as an ICT tool in learning geography in primary schools in Turkey [23]. The results of this study suggest that it has a positive effect on teachers' and students' motivation in learning environments and especially in an effective primary geography learning environment. 'Geographical Information Systems' (GIS) has been used for teaching geography [42]. Incekara in his introduction states that GIS is a computer system for drawing maps, inquiring, analysing and displaying the spatial data that is related to places in the world. GIS has the ability to display all information which is relevant to the places in several methods like charts, maps, and tables on the computer screen.

Another tool is a cell phone that can be used in learning geography. Prensky [43] notes that a cell phone is a tool of technology which can be used by the learner to seek places and things by using Global Positioning System (GPS). Hence, students have the ability to identify their positions by using this geographic application. In 2003, the government of Malaysia was committed to developing Information Technology (IT) in school education. Moreover, since 1970, Malaysia as a developing country, has used GIS as one of the ICT tools in learning and teaching geography at schools [44]. GIS is an effective tool to enhance learners in their geography skills and to think geographically so that they can analyse spatial data [42].

Since 1990 onwards, Turkey started to integrate GIS courses in higher education. This procedure aimed to explore the capacity of GIS in the country [42]. These courses have undergone an ongoing development until 2004. Incekara in his study of the National Curriculum in Turkey, recommended that a new curriculum of geography needs to integrate the technology into geography classrooms. It also showed that most geography teachers have limited skills for implementing GIS in their geography teaching.

8. GIS in Higher education

GIS research is widely used in Malaysian universities as it is one of the basic subjects offered to students [44]. GIS also is offered as a degree subject in most Malaysian universities, such as a Degree of Geoinformation in the University of Technology [44]. However, GIS can not be taught at all Malaysian Universities due to the difficulty of teaching this subject as it is thought to be a very complex subject [45]. In 2002, the Higher Education Program in Turkey started teaching GIS and it has been recently added to the curriculum at Northern Cyprus University in 2011 [46]. In his suggestions, Kovucu [46] points out that the Department of Mapping “must take the leadership of this work” and make the following points:

- GIS is necessary for students in the Education of North Cyprus.
- The Ministry of Education should teach GIS to support teachers to use GIS classes because it is not taught in secondary education.
- Universities should teach GIS in undergraduate lessons as a compulsory class.
- Universities should provide a guidance on GIS to give it to both students in undergraduate and postgraduate studies.
- Universities should build **GIS laboratories** to teach GIS.
- A student who gets GIS education with good quality and quantity should be given a GIS Certificate.

In the light of the above, it is important to note that integrating GIS in learning and teaching, whether at universities or schools is still a difficult subject. Despite of its complexity, GIS can still be used to enhance learning and teaching in geography. Teachers and students are required to have high level of skills to use this technology to improve learning and teaching geography.

3. Methodology

According to Andrews’s [47] point of view, the systematic research review is an increasing subject of educational research in the UK. Such a type of research review, as Jokelainen et al., [48] state, is extensively accepted as a method to summarise studies evidence in order to identify, select and synthesise all studies that have high-quality research, which is related to highlight on a specific theme. In this research, therefore, the systematic research method is employed to implement the quality synthesis as a process which focuses on the key concepts of the use of ICT in learning and teaching geography. The research approach, therefore, is a systematic literature review to set up trustworthy evidence to make recommendations for primary, secondary schools and higher education as well [49].

3.1 Challenges associated with the use of secondary research.

The purpose of analysing the secondary research studies is to properly evaluate the primary data and secondary questions. Thus, the judgement in the use of secondary study must be based on the matching between the primary research and secondary studies. Dixon-Woods [50] argued that the secondary analysis is understood as a way to analyse data that is originally collected by other researchers. This means that

secondary research analysis is vital to formulate the secondary analysis. It is highly recommended that the questions of the secondary study analysis are to be adequately closed to the primary datasets. Secondary analysis “involves the use of existing data, collected for the purpose of a prior study, in order to pursue a research interest which is distinct from that of the original work” [50].

3.2. Objectives in systematic review

The purpose of the systematic research review is to summarise, analyse and synthesise the existing qualitative studies to identify evidence relevant to the use and value of ICT in learning and teaching in general and in using ICT tools in learning and teaching geography whether in schools or universities [51].

3.3. Justification

The good reason for adopting the secondary research design is to provide an effective approach. This approach supports the author to handle the information and data collection. Researching data provides a good opportunity to explore the differences and similarities among research reports. Many researchers claim that the best approach in research studies is to support the adoption of methodological triangulation in the study [52]. The approach of this study helps the documentation and develops the research patterns in the exploration that supports the procedure of creating and developing the use of ICT in an effective way, especially in the learning and teaching of geography. Furthermore, it contributes to reporting the qualitative synthesis, which helps to identify particular main concepts for the effective use of ICT in geography. Also, it leads to reaching and stimulating epistemological and the methodological context.

3.4. Procedure of secondary analysis

The review of research approach used systematic review studies [53]. This process involves “formulating research questions, identifying search terms, selecting databases, conducting the literature search, formulating inclusion criteria and applying these to selected relevant literature and the extraction of data” [54]. In terms of collecting data from primary studies, the researcher should include these data in the secondary research review. This procedure is implemented by identifying and explaining the related research, then critically evaluating and analysing these studies and lastly, putting out the results in the synthesis report. The steps followed the process of systematic review are set out in figure 2 below:

3.5. Research Design

In this research project, systematic research review is used as a methodology to find qualitative evidence about the use of ICT in learning and teaching geography. This methodology has been used to identify the key concepts in order to answer research questions and how ICT can be used as an effective method of learning and teaching geography. This method is the most effective way to address the key concepts and answer research questions.

Jokelainen et al., [48] state that a ‘systematic review’ is a procedure that utilises practical, inclusive approaches which, as a result, admits access to research drawing on relevant data from various methodologies. Central to the admittance of qualitative research data, this technique draws attention to particular revelations of current theoretical knowledge. This technique will maintain a previously defined and largely successful system that is designed significantly for education [51], with particular potential for the geographic pedagogy. This field of research is directed towards producing qualitative data, which, according to Dixon-Woods et al., [51] and Johnson

and Onwuebuze [55], has the potential to provide an abundant source of evidential data, essential for establishing the legitimacy of a research project.

The advantage of systematic reviews lies in the capacity to examine the unknown, making this technique one of the most frequently used in this category of research. A number of researchers [56] perceive the systematic review approach as becoming utilised largely with academics. Inclusion and experimentation will surely produce increasingly valid evidence and data, not only in the collection of conclusions but also in introducing a valuable opportunity to present the semantics supporting the research design [57].

The qualitative evidence method plays an essential role in educational research [58]. Educational research uses systematic reviews as a qualitative method due to the strength of the archive of studies and research findings. This method of qualitative synthesis could develop and evaluate the clear design in the study findings [59,60]. The importance of the use of combined reviews is to carry out an evaluation of the methods utilised and then utilise this way to discover the typical hypothetical approaches to defining them [50,51]. These reasons are important and suggest that the application of integrative qualitative approaches in this systematic review is a suitable method.

Johns [56] confirms that in learning and teaching geography it is very important to find applicable research through inclusion data which is characterised by qualitative data in order to provide specific understanding into space of knowledge and theory. In addition, it is very important to classify research which can specify appropriate ways to find the best educational knowledge for learning and teaching geography with the use of ICT in learning and teaching environments, which will enhance and develop the key skills necessary for learning and teaching geography. Therefore, this can help students to develop their skills and knowledge in using ICT tools in the future.

The integrated framework has been used to allow the researcher to incorporate and synthesise the theoretical concepts, findings which relate to research and comparison of the goals [51]. In this systematic research, likewise, this review method will support teachers and students in using ICT for learning and teaching in schools, and to consider mainly the quality of ICT and to focus principally on the importance of using ICT in the education environment [59]. The professional standards and the quality of education required needs to build up strong evidence due to the importance of learning and teaching geography with technology for both teachers and students in schools.

3.6. Ethical issues in reviews

Vergnes et al., [61] assert that ethical considerations are significant issues in the systematic research reviews. Thus, the ethical consideration approval has to be sought and confirmed from The University of South Wales' Faculty of Life Sciences and Education in this present research review. The researcher has checked that all original studies have taken ethical approval. Also, the researcher has to consider that the study should be well-designed and then it will not have negative influences [62]. To confirm an appropriate discussion of the results of the systematic research review, therefore, the ethical consideration approval of the studies has to be collected and analysed in appropriate methods. In the primary research, the codes of ethics are essential and all research participants should be aware of these codes of ethics [63,64]. On the one hand, it is important and necessary to get ethical approval for this systematic research review, for instance, taking previous approval from the committee of ethics because there is a very interesting debate about this matter in the educational research. On the other hand, this recent research is not yet certain if it is required to renew the ethical

approval [65,66]. The method of data collection, analysis and interpretation of secondary analysis should take into account the ethics of educational research [67]. McNamee and Bridges [67] added that the research design should ensure these ethics concerning data gathering and analysing.

The validity of information and data which are obtained in this research from the original studies have to be confirmed as valid. Therefore, there is a significant concern in the systematic reviews regarding the obtaining of original and valid data in the secondary analysis.

3.7. Limitations of the study

In terms of limitations of this research, there are some confirmed limitations. Firstly, the aim of this study is to involve a large number of research reports in the systematic review, however, because of the limited number of ICT in geography education, the study could not capture all research related to this study [51]. Secondly, the researcher is an international student and in order to complete the research project should take into account the limited time nature of the study. Additionally, it is important that this review is undertaken systematically and effectively research review as a methodology in doing this research. His supervisor might help and guide him in order to set up this methodology and to complete the study [68]. Finally, of course, the reasoning behind the systematic review approach could be a limiting factor in itself due to unpredictable parameters placed on the study.

3.8. Keywords in the selection of studies

In this study information and secondary data are required in order to investigate and collect data from journal articles and research. The selection of previous research and articles depends on the time setting available and represents a major factor in the process of data selection which is the key basis for this study. Boolean search terms and Different keywords used in this research to find sources:

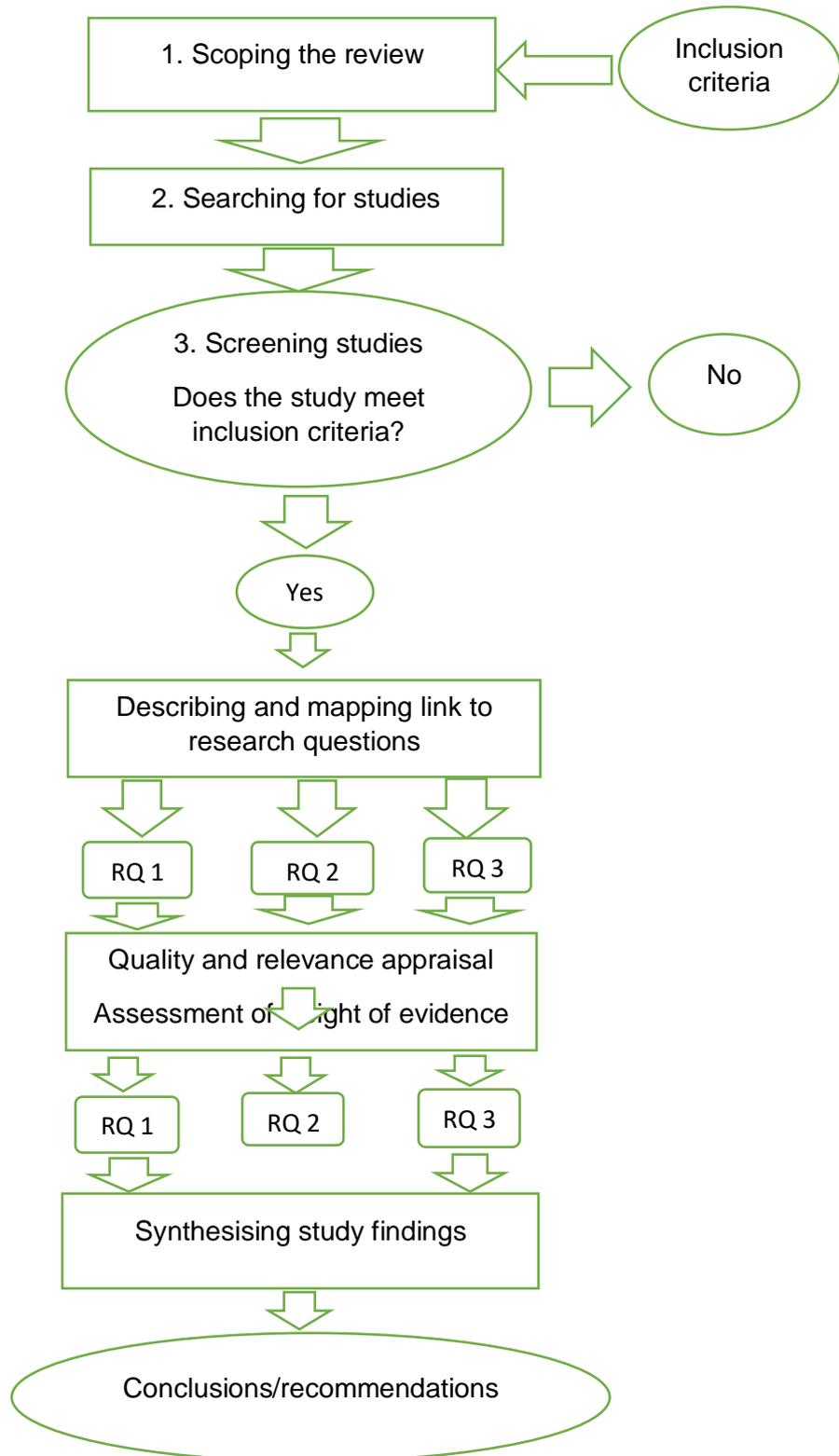
- ICT and secondary education.
- ICT, learning and teaching geography.
- Effective use of ICT and learning and teaching.
- GIS, teaching and learning.

The challenge faced by the author after the protocol has been developed is to expand in searching for other related papers and data appropriate for inclusion in the research review.

3.9. Search strategy

In order to identify papers more relevant to the research questions, the author used a number of electronic databases. It involved Science Direct, Wiley Online Library, Advanced Search, Google Scholar and Academic Search Complete. These search tools were explored for papers and articles which are printed in English in order to confirm these studies are related closely enough or sufficient in number to the study. Terms used in searching: ICT in education, GIS in the geography, ICT in primary and secondary education and effective use of ICT in education. This process helped locate related papers from different sources. The study involved many countries such as the papers in the UK, the USA and many international articles which discuss ICT in learning, teaching and assessment the quality of education process. Thus, the study involved several countries.

Figure.2. Flowchart illustrating systematic review process.



Source: adapted from Davies et al., [49](2013).

3.10. Databases research

Multiple databases were used for detailed electronic databases. Five databases were used to search the related literature as mentioned above [54]. These databases were selected to continue searching for most documents relevant to the educational research. All databases used the same strategy for searching for publications. Keywords used in the search process were terms such as; ‘ICT in education’ and ‘ICT in learning and teaching geography’. These databases are illustrated in Table 1.

Table.1. Summary of papers included in the evaluation process

Databases	Researcher/Year	Main topics
Science Direct	Yin, Shaw and Yu (2011)[69]	“Potential effects of ICT on face-to-face meeting opportunities: a GIS-based time-geographic approach”
Science Direct	Favier and Sche Van der (2012)[45]	“Exploring the characteristics of an optimal design inquiry-based geography education with GIS”
Science Direct	Korucu (2012)[46]	“GIS and types of GIS education programs”
Academic Search Complete	Van der Westhuizen, Nel and Richter (2012) [70]	“An analysis of students’ Academic performance when integrating DVD Technology in geography teaching and learning”
Science Direct	Wangia and Shireman (2013)[71]	“A review of geography variation and GIS application in prescription drug use research”
British Education Index	Roulston (2013)[72]	“GIS in Northern Ireland secondary schools”
Google Scholar	Joyce et al., (2014)[73]	“Interactive online tools for enhancing students learning experience in Remote Sensing”
Science Direct	Hinde (2015) [17]	“Geography matters: Teacher beliefs about geography in today’s schools”

3.11. Inclusion criteria in the review

Inclusion and exclusion criteria were defined in this research to ensure high-quality of information/data used in the study [74]. These criteria are presented clearly in table 2 above. The researcher checked all papers found during the research process, first, by title, abstracts and full texts in order to confirm that the selection of the papers meets the inclusion criteria. These studies involved mixed methods and qualitative articles. Additionally, it was confirmed that all studies included are appropriate in regards to educational intervention and the papers must meet the goal of this research review. Furthermore, the inclusion criteria were limited to the use of ICT in learning and teaching geography in schools and universities. In contrast, exclusion criteria included those studies which are conference papers and out of the time period (before 2011). Thus, a lot of papers have been excluded from the review.

Table. 2. Searching terms and criteria used in the research review

Criteria 1	Language	English only
Criteria 2	Period of time	Literature reviews from 2011 to 2016
Criteria 3	Key concepts for searching	ICT in primary and secondary geography, ICT in education, effective use of ICT in learning and teaching geography
Criteria 4	Study content	Making effective use of ICT in learning and teaching geography
Criteria 5	Validity/ reliability	Literature recently published and related to review---literature is based on reliable and valid
Criteria 6	Availability	Literature ability to illustrate studies within limited time
Criteria 7	Fields of science	ICT in education- technology, education and research education

Source: adopted from Jokelainen et al., (2011).[48]

3.12. Extraction of data

All selected publications were read wholly, related findings were detailed in the use of data extraction formula [54]. By research design, analysis, and syntheses, the papers were characterised. The extraction of data is following these steps:

- Researcher, title, publication year context and location (general information).
- Method and research question.
- Samples, participants, study population.
- Result and conclusion and data analysis.
- The aim of the study and evaluating method.
- Summary findings

These data extraction steps are shown in the Table 3.

3.13. Results of searching strategy

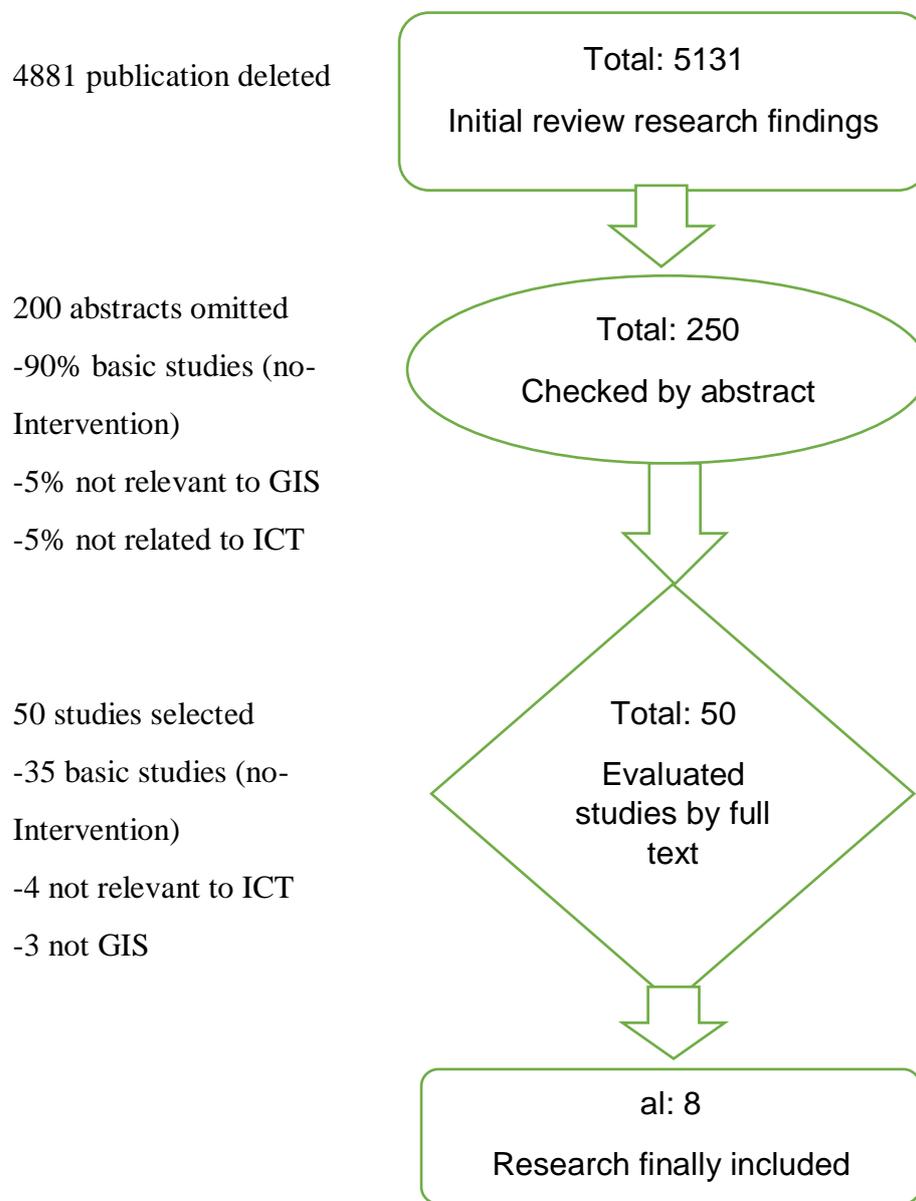
The searching strategy for this research is achieved by means of title, abstract and full text as shown in figure 3, and table 4 illustrates how databases are collected according to four stages. Each of the 8 publications have been checked in this research to support the use of GIS as an ICT tool in learning and teaching geography. A number of studies have been included, which have topics that are related to the use of GIS in geography learning and teaching whether, in schools and universities. The importance of using GIS in geography teaching and developing students' knowledge and skills in the use of GIS programmes to enhance geography education, especially at universities.

Table. 3. Data extraction

Author and location	Study aim	Methods	Data analysis	Samples	Findings and conclusions
Yin, Shaw and Yu (2011). USA [69]	Examining functions in supporting of quantitative assessments of ICTs impacts on human activities	Face-to-face meeting – time-geographic analytical framework	Not identified	Communicating between two people	The effects of ICT on human activities changed social networks, urban systems and travel patterns. The study also provides empirical data for scholars
Favier and Sche Van der (2012). Netherland [45]	Exploring the characteristics of an optimal design for GIS-supported geographic inquiry projects	Educational Design Research Study (EDRS). Survey questionnaire	Not identified	6 schools/ 375 students in Netherlands	GIS provides several opportunities for enhancing inquiry-based geography projects. GIS has the ability to completely change the way of teaching geography in schools. It can be a complex kind of geography teaching
Korucu (2012). North Cyprus [46]	Introducing and starting teaching GIS in secondary schools and universities, its importance to start to use GIS in different education department	Framework-students project Laptop	Not identified	Not clear	Generalisation of the use of GIS support directors and their management in decision-making and to support mechanism in developed countries and positive step to involve GIS education at universities
Van der, Nel and Richter (2012). South Africa [70]	Discussing the impact of implementing the Digital Versatile Disc (DVD) as ICT tool in learning and teaching geography at a rural university in developing country	Action research (quantitative and qualitative data collected) two questionnaires. 3 years study	ANCOVA	2006 students	The experiment seems to be successful and the DVD helped students to achieve better mark in their assessment. Students marks were better or equal for years; 2004, 2005 and 2006 in sequence
Wangia and Shireman (2013). United States [71]	Application geography-based analysis in the use of medication data	Empirical, systematic review	Statistics analysis	145 publications	Limited number of papers which have studied geographic variation in the use of medication, an opportunity to cooperate with geographic

					researchers to use GIS technologies in the medication studies
Roulston (2013). Northern Ireland [72]	Examining the development made in integrating GIS in secondary schools in Northern Ireland	Online Survey Monkey	Not identified	37 schools (post-primary and secondary) teachers and students,	Geographers state that they have high level of access to data projectors and computers in the classrooms, internet accessible in geography classrooms, whiteboards, high level of ICT competence in general. Most geography teachers in Northern Ireland see that GIS is a positive tool in their geographic classrooms
Joyce et al., (2014). Australia [73]	To facilitate student active engagement with foundational knowledge and skills , to engage students to use multi-media tools and to answer pedagogical perspectives and emerging student needs	Case study- Remote Sensing Computer aided Learning (RSCAL) programme	Not identified	150 students- postgraduate and undergraduate, government employees and industry from different country (USA, New Zealand, Spain, Turkey, Bhutan, Belgium, Indonesia, Algeria and Bahrain	Engaging students throughout the use of multi-media devices such as animation, audio and visualisation. provides opportunities for summative and formative assessment
Hinde (2015). USA [17]	Identifying teacher's thoughts about geography education	Online questionnaire survey	Qualitative analysing	173 pre-school (primary and secondary), 12-grade teacher	Geography is a lake of consideration in the curriculum and American tutors were unhappy with the state of geography in schools as they have limited knowledge about geography

Figure 3. Searching stages



Source: adapted from Nocentini, Zambuto and Menesini (2015).[74]

Table 4. Results of research terms used

Databases	Hits	First stage: studies remain after repetitions removed	Second stage: studies remain after abstract reviewed	Third stage: studies meeting the inclusion criteria	Fourth stage: studies included
ScienceDirect	981	450	100	20	5
Academic Search Complete	700	50	15	2	1
Wiley Online Library	600	100	50	0	0
British Education Index	850	50	30	5	1
Google Scholar	2000	1000	200	10	1
Total	5131	1650	395	37	8

Source: Researcher's own data

3.14. Quality evaluation

Assessment of the systematic research reviews is not an easy matter, researchers, therefore, have written a great deal on how to evaluate and how best to assess systematic reviews. Of course, evaluating systematic reviews has to take into account the reliability and validity of qualitative papers, in regards to this there is an extensive discussion in the literature on these application criteria. Thus, Judging the quality or validity of papers needs to be clear in order to ensure that these research papers are valid and reliable [75]. These based-key concepts are fundamental in the evaluation process. In a broader sense, research papers are reviewed depending on these key concepts that are essential to the purpose, conduct, method and nature of the evaluation.

There are several guidelines and tools which evaluate the qualitative studies, however, there is a lack of agreement concerning the quality of evaluation tools. According to Dixon-Woods et al., [51] assessment, qualitative research can be done by a range of tools in the systematic research reviews. One of these guidelines and tools which can be used to evaluate a systematic review is the research essentially that achieves the aim of the study. It is also fit for the review, addresses the research questions and meets the standards of quality criteria for attention as qualitative research. Therefore, such a guideline can facilitate to evaluate the validity of these papers.

Numerous scholars have created different tools for assessing the quality of studies, for example, Thomas and Harden [76] have several ways and criteria for assessing qualitative frameworks. In the latest review by Cohen and Crabtree [77], they used seven quality evaluation tools to identify existing assessment studies:

- Reliability and validity of the studies.
- Researcher's bias.

- Assessment of students that could have an impact on the research, such as ethics, clarity, study project consistency and use appropriate methodologies.

To ensure the validity and quality of studies, these key concepts are essential in assessing the validity of qualitative research in the reviews [76]. For this study, the framework proposed by Jokelainen et al.,[48] was adopted in this systematic review uses and focuses on the assessment of nine qualitative research studies. It examines the research topic of this review to make an effective use of ICT for learning and teaching in geography. This is demonstrated in Table 6.

Table 5. List of papers included in the review

1	Yin, L., Shaw, S.L. and Yu, H. (2011). ‘Potential effects of ICT on face-to-face meeting opportunities: a GIS-based time-geographic approach’. <i>Journal of Transport Geography</i>, 19(3), pp.422-433. <i>Science Direct</i>. [Online]. Available at: http://www.sciencedirect.com (Accessed: 10 April 2016).[69]
2	Favier, T.T. and van der Schee, J.A. (2012). ‘Exploring the characteristics of an optimal design for inquiry-based geography education with Geographic Information Systems’. <i>Computers & Education</i>, 58(1), pp.666-677. <i>Science Direct</i>. [Online]. Available at: http://www.sciencedirect.com (Accessed: 10 April 2016).[45]
3	Korucu, M.G. (2012). ‘GIS and types of GIS education programs’. <i>Procedia-Social and Behavioral Sciences</i>, 46, pp.209-215. <i>Science Direct</i>. [Online]. Available at: http://www.sciencedirect.com (Accessed: 10 April 2016).[46]
4	Van der Westhuizen, C.P., Nel, C. and Richter, B.W. (2012). ‘An Analysis of Students' Academic Performance When Integrating DVD Technology in Geography Teaching and Learning’. <i>Educational Technology & Society</i>, 15(3), pp.190-201. [Online]. Available at: http://www.jstor.org (Accessed: 20 April 2016).[70]
5	Wangia, V. and Shireman, T.I. (2013). ‘A review of geographic variation and Geographic Information Systems (GIS) applications in prescription drug use research’. <i>Research in Social and Administrative Pharmacy</i>, 9(6), pp.666-687. <i>Science Direct</i>. [Online]. Available at: http://www.sciencedirect.com (Accessed: 21 April 2016).[71]
6	Roulston, S. (2013). ‘GIS in Northern Ireland secondary schools: Mapping where we are now’. <i>International Research in Geographical and Environmental Education</i>, 22(1), pp.41-56. [Online]. Available at: http://www.tandfonline.com (Accessed: 13 April 2016).[72]
7	Joyce, K.E., Boitshwarelo, B., Phinn, S.R., Hill, G.J. and Kelly, G.D. (2014). ‘Interactive online tools for enhancing student learning experiences in remote sensing’. <i>Journal of Geography in Higher Education</i>, 38(3), pp.431-439. [Online]. Available at: http://www.tandfonline.com (Accessed: 17 April 2016).[73]
8	Hinde, E.R. (2015). ‘Geography matters: Teacher beliefs about geography in today' s schools’. <i>The Journal of Social Studies Research</i>, 39(2), pp.55-62. <i>Science Direct</i>. [Online]. Available at: http://www.sciencedirect.com (Accessed: 2 February 2016). [17]

Table.6. The evaluation of quality checklist

Criteria	Reference number							
	69	45	46	70	71	72	73	17
Is the aim of study and research question clearly identified?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Was the question formulated with research?	No	Yes	No	No	No	No	Yes	Yes
Is the sample of the study suitable?	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Is there any data analysis?	Not clear	Not clear	Not clear	Yes	Yes	Not clear	Not clear	Yes
Is the data collecting method clearly described?	No	Yes	No	Yes	Yes	No	No	Yes
Is the method reliable?	Not clear	Not clear	Not clear	Yes	Yes	Not clear	Not clear	Yes
Is there any ethical issues addressed?	No	No	No	No	No	No	No	No
Is there limitation of study addressed?	No	No	No	No	No	No	No	Yes
Are the findings and discussion clearly presented?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total assessment	4	6	4	6	6	5	6	8

3.15. Analysis of data

In this research review, the stage of synthesis has carefully assessed and analysed. This stage includes systematic searching and grouping of results in an initial examination to empower the research to produce a general synthesis, which can provide answers to the questions within this review. Perhaps, this technique would vary according to applying different methods. The data from primary studies can be narrative or numerical concerning this synthesis. In the review questions, the outcome would result in numerical outcomes. However, in this research review the researcher, therefore, implemented the strategy of narrative in order to allow the researcher to provide thematic responses to answer the questions of this research [78]. Assessment of the studies are based on research scoring. For instance, high study scoring would be eight to ten, medium quality scoring would be six to seven and low-quality study would be scored five or below.

3.17 Synthesis of data

All data and information were collected carefully and then assessed and appraised. Characteristics of studies and the results in the relevant method were summarised. Almost 13% of research papers were considered as a high-quality research. About 50% of the papers were characterised as medium quality studies, whereas, more than 37% of the research were evaluated as being low-quality studies. As a result of this assessment tool, the data in this review comes from medium quality studies as illustrated in the figure 2.

4. Findings and Discussion

4.1 Introduction

The findings of the original studies will be investigated in this chapter. As a result, of a systematic review of 5131 research papers, this study found only eight studies, which are qualitative studies, and one study, which used Action Research. One study used empirical (systematic review), and three studies used online questionnaires, whilst another study used an Analytical Framework. Only one study used Student Project Lab and one study also used a Case Study methodology. All these studies are related to the use of GIS in teaching geography. The researcher will discuss these studies regarding making effective use of ICT for learning and teaching in geography.

The aim of this research review is to answer the research questions in terms of making ICT more attractive and motivational in geography education in schools and colleges. In this qualitative study, therefore, the main aim is to identify the most effective use of ICT in the learning and teaching of geography. It is estimated that an effective use of technology would overcome some barriers to using ICT in an efficient way for both teachers and students. This study review has discussed the educational use of ICT tools in detail. In order to provide more clarity, the next three key questions were addressed:

- How can ICT be used effectively in the learning and teaching of geography?
- What are the characteristics of ICT used in the classroom to ensure that teachers and students use ICT effectively for learning and teaching in geography?
- Is the use of technology in geography motivating for students?

First theme: Teachers' confidence and skills in the use of ICT in geography

The findings from this study showed a lack of confidence with geography knowledge particularly in geography curriculum in the USA [17]. In her discussion Hinde acknowledges that this problem is not easy to solve but participants were hoping to find a solution. The discussion is focusing on raising teachers' knowledge in geography with the help of organisations which are related to geography such as "the National Council for Geographic Education" and "The National Geographic Education Foundation" in order to enhance and promote teachers' knowledge and skills in their geography teaching in the USA [17]. Additionally, as Bednarz [79] confirms that teachers in the USA used less fieldwork as a method of teaching geography than the Netherlands or the UK. Geography subjects are flexible. Geography teachers can teach these subjects outdoors, but they should have sufficient knowledge and skills in using technology such as Digital Maps, Google Earth Computers, GIS, GPS and RS in their learning and teaching geography whether inside classrooms or outdoors.

These multi-media options have the ability to develop teachers' skills and their knowledge in geography education and then they can be used in an effective way for teaching geography in schools and colleges. Thus, using ICT effectively in teaching geography depends on a high level of teachers' skills and knowledge to make teachers more confident with the use of technology in schools and universities.

Second theme: The use of games in geography learning and teaching

The use of computer games is very limited in this study's findings. However, Tuzan et al, [23] conducted a study on the influences of using computer games on learners' motivation and achievement in geography classrooms. This research

indicates that students' motivation is increased when these games are utilised as an ICT tool in learning geography in primary schools in Turkey. Another study conducted by Van der Westhuizen et al, [70] used DVDs as an ICT tool in teaching geography at the University of North-West in South Africa. This study found that most students responded positively concerning the incorporation of a DVD player in the learning and teaching of geography. It also suggests that it's possible to implement ICT tools in an effective method in learning and teaching geography at universities. The advantage of the DVD as a technological tool is its ability to work without an electric supply, and can therefore be successfully used and applied in geography instruction. It has the capability to illustrate geography lessons by video, audio, lecture and text, etc. Using the DVD player as an ICT tool in learning geography, for example in economic geography subjects, enhances meaningful learning in the geography classroom.

It is possible to use a DVD player as a method of learning and teaching geography in schools and universities. Similarly, this kind of technology can be used effectively in learning and teaching any subject in all developing and developed countries due to this technology not requiring an electric supply, computer and internet connection. The results of developing creative skills and knowledge depends on bringing more games or 'playful' teaching methods into geography classrooms in higher education and schools [80].

Third theme: The use of ICT in geography is motivating for students

In their evaluation of the study of Joyce [73] found that the participants extremely recommended this online tool to a colleague or peer. It also shows that students preferred this kind of ICT tool considering it as a facilitated process of learning and teaching geography. Furthermore, participants were happy with the level of engagement within these learning materials. A further result indicates that students have a great level of satisfaction in the use of RS technology. This study also indicates that students were actively engaged in developing their knowledge and skills in learning.

Teachers who were participants in the survey of a study conducted by Roulston [72] stated that the use of GIS is favourable and valuable in geography classrooms. Teachers also positively recommended the widespread use of GIS in geography curriculums. If GIS technology is used in learning and teaching, geography will be more effective. Similarly, the study by Joyce [73] indicated that the use of DVD player in learning geography is motivating for students. This is due to the fact that students were achieving better grades in academic performance. In addition, using computer games as an ICT tool in learning geography is also motivating for pupils. For example, the study by Tuzun et al., [23] indicates that pupils' motivation increased when they are making learning geography enjoyable. It is clear that using ICT in geography is motivating for students in higher learning as well as teachers which implies that the use of ICT, such as GIS application in learning and teaching geography is considered to be positive. Computer games also have positively impacted and motivated pupils in learning geography in primary schools

5. Conclusion and recommendations

5.1 Conclusion

Using ICT effectively in learning and teaching geography is highly important in learning environments. This study also considers the use of ICT and its effects on learners' motivation. ICT is an essential part of geography education. It also plays a significant role in learning outcomes. TPCK is a very important part of learning and

teaching geography. Thus, effective geography pedagogical knowledge underpins how students learn geography by using ICT in the classrooms whether in schools or universities. The good relationship between student and teacher is also an important issue in learning environments.

Using ICT in geography education may encourage teachers to change their method of teaching geography from conventional ways to contemporary ways. Integrating ICT in geography education can help students to develop their geography skills, knowledge and think geographically. This means students have the ability to make decisions and solve geography problems. Implementing ICT in learning and teaching geography not only enhances geography education but enhances assessment for learning and teaching geography in schools and higher education.

This research review has considered the influence of using ICT in geography education in many countries. It suggests that geography education is positively enhanced by using GIS, RS and computer games in the learning and teaching process. Students showed that they are able to achieve better marks and are more motivated with the use of ICT in geography classrooms.

A systematic research review has been identified in this study to answer the three key research questions. This methodology means investigating the literature related to the use of ICT in geography education and then the researcher has focused on identifying research reports on the use of technology in learning and teaching geography. The findings of this research review identified a surprising outcome of the use of ICT in geography education. It found a very limited number of journal articles which focus on using ICT in learning and teaching geography in schools and higher education in many countries such as the UK, the USA, Australia and other countries.

Used well GIS and RS have the ability to change the method of teaching geography from less to more attractive and motivational, especially in higher learning. Technology tools have the ability to develop teachers' knowledge and skills in order to use ICT as an effective method of teaching geography at schools and higher education. The use of ICT in geography learning and teaching is motivating for students in higher learning. Examples are GIS and RS applications. Computer games also have a positive influence on students' motivation at primary schools.

5.2 Recommendations

5.2.1 Recommendation for schools

- Schools should use ICT in teaching geography in all phases from primary to secondary education. Policy makers should support and encourage schools to use technology in learning environments, including geography. The National Curriculum should develop the geography curriculum to meet sophisticated education and learners' needs in this era. Governments should support schools by providing technology equipment such as computers, DVD players, allowing mobile phone use, GIS, RS, GPS applications and other software which can be used in learning and teaching geography in rural and urban areas. The most useful tool is the use of GIS applications in school more than other technology tools because it has geography content knowledge with the use of technology at the same time. Using GIS could completely change the way of teaching and learning geography in schools whether in developing or developed countries.
- Developing countries such as the Middle East, Africa and some other countries should further develop the use of ICT in their education systems to enhance the

quality of education, students' outcomes and understanding the differences between geography phenomena in the world.

- The geography curriculum should be enhanced especially in developing countries to meet students' needs in learning modern geography concepts. Computer games could be widely used at primary schools because they have the ability to motivate pupils to learn geography in an enjoyable way as well as developing the skills to use ICT tools in higher education in future.
- Teachers could spend more time on learning about the uses of GIS and other technology tools in order to use them in geography classrooms. Teachers could use programmes such as Excel, PowerPoint, audio, video, animation and visualisation in learning and teaching geography. Teachers should be offered training on the use of technology software particularly on GIS, GPS and RS to avoid theoretical lessons with little application. Overcoming barriers to the use of technology in geography education is required. Leaders and parents should advise their learners to use technology in the right way during their education inside and outside schools. Students should use ICT in learning to enhance and develop their knowledge and skills in geography education.

5.2.2 Recommendation for higher education

- Colleges could make greater use of digital technology in geography lessons. For instance, GIS, RS and GPS application could be taught as the main subject at universities for undergraduate, postgraduate studies, A-level and Further Education. Higher Education could use fieldwork with the use of ICT in outdoors teaching for applied geomorphology, applied geology, topography, drawing and delineation topographic maps and other geography subjects.
- Policy makers should support universities with computer laboratories, GIS, GPS and RS software. Teachers should be offered more training on these applications to use them effectively in teaching geography. Students in Higher Education could use the ICT toolkit as compulsory lessons in learning geography. Encouraging students to take geography lessons outside the schools to teaching them in a different way of teaching geography as well as developing their knowledge and skills to thinking geographically.
- There is a need to develop teachers' skills and confidence to overcome barriers in the use of ICT in learning and teaching geography.
- There is a need to encourage students to read and use online courses about digital technology such as GIS, RS, Google Earth, Google Map to develop their geography content knowledge and skills.

5.2.3 Recommendation for future research

Researchers should further investigate the impact of ICT in learning and teaching geography. Researchers also could examine the influences of using digital technology on student's motivation and achievement at primary and secondary schools, especially in the UK. Universities must do more research on the use of ICT in geography education in both schools and Higher Education as there is very limited number of articles that have evaluated the use of ICT for learning and teaching in geography. Studies which will be conducted for studying the use of digital technology in geography education should cover rural and urban areas. Future research could include qualitative and quantitative methods in order to examine the effects of technology software on pupils' and students' achievement and motivation levels in learning geography. Future scholars could use experimental studies and action research in their research to investigate teachers' and students' confidence and

skills in the use of ICT in teaching geography. Research centres could then develop software programmes such as computer games to be used in learning geography at primary schools as well as developing GIS, RS, GPS and mobile phone learning software in colleges and Further Education.

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