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A Review on Exploratory based Learning Implementation by Integrating Technology Strategy in Teaching and Learning

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Abstract--- *As an educator, no matter how much experience we have, there are always challenges to face in the classroom. Today, how people learn and practice something that they learn in everyday life is rapidly shifting. The integration of technology strategy in teaching and learning enable student to explore environments, reality and virtual experiences. One of learning strategy that support this notion of learning is exploratory based learning (EBL). This study examines the implementation of EBL in education concerning to its definition and technology integration. Based on the literature reviewed, EBL learning model extends from the Kolb model of learning but it takes place in a cyclical mode following four steps; concrete, experience, observation and reflection, forming abstract concepts and testing in new situations. Technology integration in EBL that focusing on learning practices are identified to be applicable in order to improve learning experiences among students in Malaysia.*

Keywords--- *Technology Integration, Learning Strategy, Learning Practices.*

I. INTRODUCTION

In modern education systems, we understand that all students possess an independent learning profile characterized by individual strengths and challenges. Today, learners are expected to possess an increased their degree of autonomy and show initiative in learning processes, inspecting learning materials and understanding contents(Wegner, Minnaert, & Strehlke, 2013).Effective teaching is neither quick nor easy(Colasante, 2016). Laurillard (2013) argues that students acquire and use knowledge differently when engaged in formal and informal learning. Students' motivation to learn in academia differs from their intrinsic motivation to learn in everyday life. Twenty-first century educators have to survive with a rapid change cultural and technological environment(Laurillard, 2013; Singh, 1991).Today, the swift of digital technology in the last two decades has changed the world dramatically. This new and emerging technologies are already showing a transformative effect on education establishment. In order to do that effectively, educator need to both widen and deepen their understanding of how these new technologies and pedagogical tools can be an integral part in education (European Commision, 2014).The use of technology effectively as an effort to promote student learning means thinking about effective teaching and learning strategies(Eady & Lockyer, 2013).

There are various teaching and learning strategies that support twenty-first century learning. The use of technology in education is essential for enhancing both teaching and learning activities in classroom (Rana, 2017). Study by Schwartz(2013), claimed that by embedding digital technology in teaching and learning strategies, teacher will

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benefits their classroom in many ways, including the ability to reinforce and expand content, motivate students, and respond to a variety of learning styles. According to the research by APS Group Scotland (2016), the appropriate and effective use of digital technology within education will benefit the following stakeholder:

1. Learners: the opportunity to improve their educational outcomes and to develop digital skills that will be vital for life.
2. Teachers: allow them to become skilled in the appropriate and effective use of digital technology.
3. Parents: able to capitalize on the increased use of digital technology to communicate more readily and easily with their children and stay up to date with, and support their children's learning.
4. Digital industry and wider economy: will similarly benefit as our future workforce will possess a level of digital skills considered essential in occupations across a wide range of sectors.

Hence, this paper will provide a review on technology strategy integrating in teaching and learning focusing on Exploratory Based Learning (EBL).

II. EXPLORATORY BASED LEARNING (EBL)

A. Definition of EBL

Exploratory learning can be defined as an approach to teaching and learning that encourages learners to examine and investigate new material with the purpose of discovering relationships between existing background knowledge and unfamiliar content and concepts(Barufaldi, 2009). According to Lelouche(2005), the term EBL usually denotes some type of activity used by students, with or without a teacher's supervision, to facilitate the learning and mastery of a predefined and relatively circumscribed domain. That exploration may be more or less guided, according to the domain structure and the teacher's pedagogical goals and strategies. Therefore, EBL can be considered as an approach to teaching and training that encourages the learner to explore and experiment to uncover relationships, with much less of a focus on didactic training or teaching students by lecturing them(Foraker Labs, 2015). Exploratory learning does not necessarily mean an unguided or unconstrained learning environment, but does mean that learners may discover unexpected lessons and reach conclusions following various paths. In addition, the EBL also could lead to innovative processes(Dairo, 2011) as it is a learning method initiated from experience spirit(Lin, Wang, Kuo, & Luo, 2017).

According to the study by Foraker Labs (2015), EBL approaches are considered most appropriate for teaching generalized thinking and problem-solving skills, and may not be the best approach for such things as memorization (though proponents of exploratory learning would emphasize that memorization is probably much less useful than it is often thought to be). EBL allow students to explore certain learning content based on experience gained previously. Students actively participate to search and access information in order to achieve learning objectives in a guided environment (Ministry of Education Malaysia, 2015).

In order to support EBL, it is found that the use of computer and internet are effective tools to interpret exploratory learning concept (Foraker Labs, 2015; Ministry of Education Malaysia, 2015). Computer support for exploratory learning usually emphasizes using computers as tools rather than as teachers. Not only may traditional software such

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as spreadsheets be naturally appropriate to the task, but computers also make excellent communication devices for co-discovery and make great simulation devices for exploring safely in otherwise inaccessible domains(Foraker Labs, 2015). Thus, the usage of the technology can be considered as an effort to create conditions for the student to build his own knowledge (Silva, Marques, Oliveira, & Noda, 2014).

B. Model and Approaches of EBL

Generally, the exploratory learning model (ELM) extends from the Kolb (1984) model of learning (Life, 2007). Kolb's model of experiential learning might be considered as a descriptive rather than analytical model of how we learn. Within Kolb's experiential learning theory (Kolb, 2014), learning is described as a four-stage cycle consisting of concrete experience (CE, doing or having experience), reflective observation (RO, reviewing or reflecting on the observation), abstract conceptualization (AC, concluding or learning from the experience), and active experimentation (AE, planning or trying out what you have learned). Figure 1 shows the Kolb's Experiential Learning Model.

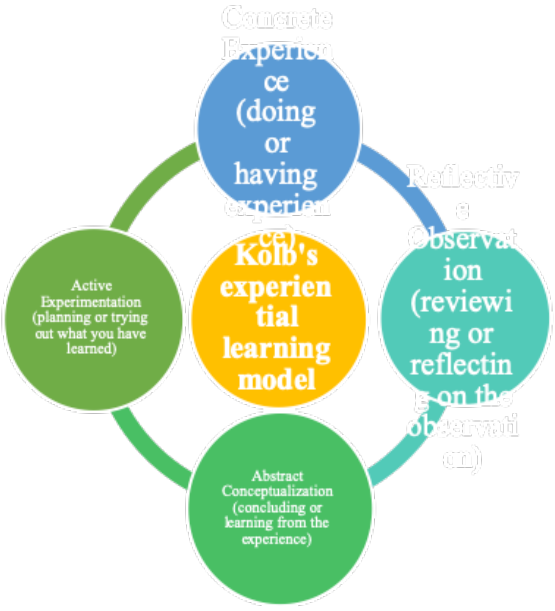

Fig. 1: Kolb's Experiential Learning Model(Kolb, 2014)

The development of teaching and learning strategies urge the Kolb's model to be enhanced. The use of more media-rich and engaging tools propagates the ability to use more learning approaches and places greater control in the hands of the learner. Thus, one of the reasons that Kolb's model needs to be updated to include e-learning and virtual learning is because the need to redefine what we mean by the learner's experience (Dyke, Conole, Ravenscroft, & Freitas, 2006). The ELM then outlines an additional step to the experiential learning cycle. Adapted from Kolb's model, there are five steps incurred during the descriptive model of learning(Freitas & Neumann, 2009)as shown in Figure 2.

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Fig. 2: Exploratory Learning Model(Freitas & Neumann, 2009)

III. TECHNOLOGY INTEGRATION IN TEACHING AND LEARNING

Sample And Selection Criteria

A. Conventional Subject Searching Procedure

The research began with collecting research papers that are relevant to EBL, including peer-reviewed publications, journal articles, proceedings, educational reports and also government reports. Various databases had been searched using the keywords “exploratory learning” (quotation marks included for the purpose of very specific search query) and specified that the term occurred either in the title or in the abstract. In the searching collection effort, online databases and web sites were employed as shown in Table 1

Table 1: Online Databases and Web Sites Selected for the Research

Online databases / web sites	Descriptions
ERIC (Educational Resources Information Center) https://eric.ed.gov/	ERIC is an online digital library of education research and information that provide a comprehensive, easy-to-use, searchable, Internet-based bibliographic and full-text database of education research and information for educators, researchers, and the general public.
ACM Digital Library https://dl.acm.org/	The ACM Digital Library (ACM DL) is the most comprehensive collection of full-text articles and bibliographic records covering the fields of computing and information technology.

B. Citation Searching and Unstructured Searching

Citation searching had been used to track down which researchers have cited a particular journal article for inclusion in the systematic review. Citation searching allows us to follow research leads both forwards and backwards in time. In this research, databases used for the citation searching were Google Scholar and Social Sciences Citation Index.

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C. Inclusion and Exclusion Criteria

Overall, approximately 113 documents including empirical and theoretical papers were primarily collected including 83 documents from conventional subject searching procedure (48 documents from ACM Digital Library and 35 documents from ERIC) while the rest 30 documents from citation searching (Google Scholar and Social Sciences Citation Index) and unstructured searching. From this collection, a totalof 26 documents met the inclusion criteria for the literature review. The inclusion criteria considered the documents that are related with the research purposes.

IV. THEMES AND FOCUS QUESTIONS

Once the nature of the sample was established, the papers were then further categorized by theme. Examples of focus questions associated with each of these themes are given below, along with an example of the notes taken on a particular paper. For this purpose, this review paper is guided by the following research questions:

1. How can EBL with technology integration benefit to the teaching and learning session?
2. What are the major characteristics or principles of EBL?
3. What are the interventions used by other researchers in performing technology integration in EBL?

V. RESULTS

This review research consists of three main parts beginning with the benefit of technology integration in EBL towards teaching and learning session, major characteristics of EBL and interventions used by other researchers in performing EBL.

A. Research Question 1

How can EBL with technology integration benefit to the teaching and learning session?

Learning can be improved by exploring a new concept before instruction but can also be challenging. Individual differences in achievement motivation influence how learners respond to challenge and may therefore moderate the benefits of exploratory learning (D. A. DeCaro, DeCaro, &Rittle-Johnson, 2014).

Through convenient information gathering and sharing, this learning strategy can also facilitate innovative teaching and learning methods methods.

A research done by Lin et al. (2017), integrating virtual reality to exploratory learning also proves that experience, better than text, allows a person more easily generating learning attitudes and motivation to further change the behavior. For instance, studies by DeCaro&Rittle-Johnson (2012) towards elementary-school children in mathematical equivalence concepts. Some explored problems before instruction while others solved after instruction. The results of the experiment shows that the exploratory activity helped children learn better from instruction.

In other case, Danker (2015) had performed an exploratory learning towards Diploma in Performing Arts students through the implementation of Flipped Classroom. The study had suggested the followings benefits by performing the strategy:

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1. The flipped classroom model creatively helped these students to manage their own learning.
2. Students participate actively in the classroom.
3. Most students were able to relate new ideas to previous knowledge to build an understanding of the material taught.

The benefit of technology integration in EBL do impact the emotional intelligence. According to Deane & Harré(2014),exploratory education activity could promote gifted students' leadership ability and emotional intelligence.

It could also promote the inclusiveness, self-confidence, thinking ability, and response that the course experience could help the future group life. This idea had also been supported by Rhodes & Martin (2014) in which they revealed that students participating in the exploratory education activity program could affirm themselves and appreciate others, enhance teamwork and induce creativity, objectively solve problems, and apply what they learned to daily life.

B. Research Question 2

What are the major characteristics or principles of EBL?

EBL is grounded in and derived from constructivist epistemology (Murphy, 1997). According to Jonassen (1991), many educators and cognitive psychologists have applied constructivism to the development of learning environments. Based on these applications, he has secluded the following design principles:

1. Create real-world environments that employ the context in which learning is relevant;
2. Focus on realistic approaches to solving real-world problems;
3. The instructor is a coach and analyzer of the strategies used to solve these problems;
4. Stress conceptual interrelatedness, providing multiple representations or perspectives on the content;
5. Instructional goals and objectives should be negotiated and not imposed;
6. Evaluation should serve as a self-analysis tool;
7. Provide tools and environments that help learners interpret the multiple perspectives of the world;
8. Learning should be internally controlled and mediated by the learner.

C. Research Question 3

What are the interventions used by other researchers in performing EBL?

The explosion of technologies for human computer interaction is creating new possibilities for exploratory learning (Bidarra& Martins, 2010; Mavrikis, Gutierrez-Santos, &Poulovassilis, 2016). Tablet PCs, mobile devices, and table tops are emerging as alternative media where learning applications from educational games to simulators can encourage interaction and experimentation (Mavrikis et al., 2016). Table 2 summarize some of the studies that had been done according to authors, participants, interventions and subject area.

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Table 2: Summary of studies according to authors, participants, interventions and subject area

Authors	Participants	Intervention	Subject Area
M. S. DeCaro & Rittle-Johnson (2012)	Elementary-school children	Students introduced with solved the Problems first using accuracy feedback, as an exploratory learning activity, and then received instruction (solve-first condition).	Mathematics
Esper, Foster, & Griswold (2013)	Students with ages 10 to 12	A modified version of CodeSpells – a videogame designed to teach Java programming	Computer Science
Silva et al. (2014)	Undergraduate students in computer science and computer engineering	Using Tablet Personal Computer (Tablet PC)	Human Computer Interaction
Sargent, Schweighofer, Kubo, & Fetters (2014)	3 month old infant	Mobile paradigm supported tool	Medical- Leg Joint Coordination
Redel-Macías, Castillo, Porro, Polo, & Taguas (2014)	Undergraduate students	Virtual tool	Basic Organisation and Planning in Rural Engineering Projects
Colasante (2016)	Undergraduate students in business, speech pathology and psychology	Digital video content	Business, Speech Pathology and Psychology
(Assiter & Wiseman, 2016)	Girl scouts	Computer science workshop (Alice workshop)	Programming
(Lin et al., 2017)	Undergraduate students in leadership course	Virtual-reality	Leadership skill
Conte & Munteanu (2018)	Adult learner	Interactive tactile aid for tablets (TAGhelper)	Mobile technology

VI. CONCLUSION

EBL can be concluded as a relatively new approach to education that highlight more on student involvement in the classroom. It is a student-centered pedagogy where it encourages students to think creatively, experience key concepts, and learn how to question or reflect on what they learn. Exploratory learning is based on constructivist theories of learning and teaching. Based on the review on selected research, EBL benefit teaching and learning session in terms of students will be more creatively driven to succeed, students develop a sense of self responsibility for learning while classroom becomes a place of active learning, as opposed to the stereotypical passive one.

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