ROLE OF ICT SELF-EFFICACY AND SELF-DIRECTED LEARNING IN E-LEARNING READINESS AND STUDENT ENGAGEMENT

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Dr. Naeema Arzeen

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DEDICATION

I dedicated this thesis to my beloved Parents who always believed in my capabilities to become successful in the academic field. And, to my supervisor Ms. Naeema Arzeen who has been very kind and supportive, and helped me throughout my research work. Due to her role in my educational career, her support and encouragement helped me to complete this thesis. Also, I dedicated this thesis to all my Professors, which helped me to complete my course work during my master's.

Role of ICT Self-Efficacy and Self-Directed learning in E-Learning Readiness and Student Engagement

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

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Abstract

The current research study was intended to explore the role self-directed learning (SDL) and e-learning readiness (ELR) in the relationship of ICT self-efficacy (ICTSE) and student engagement (SE) among middle and late adolescents. Data were collected from different schools, colleges, and university students of Rawalpindi and Islamabad, by using convenient sampling technique. Total research sample comprised of (N=300) students with both boys (n=144) and girls (n=156) in the age range of 15 to 21. In the present research study ICT self-efficacy scale (ICTSES; Alahakoon & Somaratne, 2020), Self-directed learning with technology scale (SDLTS; Teo et al., 2010), E-learning readiness scale (ELRS; Alem et al., 2016), and Student engagement scale (SES; Lee, Song, & Hong, 2019) were used. Findings indicated that ICT self-efficacy has significantly positive correlation with student engagement, self-directed learning, and e-learning readiness. Similarly, self-directed learning and e-learning readiness has significant and positive correlation student engagement. Findings also indicated that self-directed learning and e-learning readiness mediated the association between ICT self-efficacy and student engagement significantly. Furthermore, gender related differences existed on ICT self-efficacy and age related differences emerged among three variables of study i.e. self-directed learning (SDL), e-learning readiness (ELR), and student engagement (SE). The findings of current study may help policy makers, educators and administrators about the characteristics that foster adolescents' engagement in e-learning environment.

Chapter-I

Introduction

Today the information and communication technology (ICT) has magnanimous significance for different facets of our lives that cannot be negated, neither one can refute its developing prominence and use in academic arena. It has gained popularity in education sector besides the progressing COVID situation which has caused the closure of learning institutions all over the world and hence giving rise to numerous challenges particularly for learners at all phases and levels of education. Therefore, the progression of ICTs in this arena has provided a solution for educators and policy makers to implement its utility during quarantine by covering the course work. In other words, e-learning emerged as a blessing after the closure of institutions.

Although, e-learning has widely been adopted in many countries in the start of 21st century but the developing countries like Pakistan, e- learning was never viewed as part of formal education till the spread of COVID. Therefore, during COVID epidemic period young students were not well acquainted with this new learning methodology. They faced several issues related to connectivity, teacher – student interactions, social isolation, and engagement. All these issues directly affect their performances. Therefore, it is very significant to identify the detrimental elements in E- learning process. As, E-learning has been perceived as a self-directed process where learners control their learning process actively and take responsibility for their learning needs and decisions (Corbeil, 2003). Therefore, it is suggested that along with the features of system design for a constructive e-learning medium in the institutions, learners' abilities to utilize e-learning is also important (Nyagorme, 2018). Lai (2008) asserted that learners' readiness and internet self-efficacy performs primary role in adoption of electronic learning and achievement. Moreover, autonomy, independence, or/and self-direction are

considered as the main factors that are important for successful distance learning or e-learning (Guglielmino & Guglielmino, 2002). Unprepared and less self-directed learners are unable to get benefit from e-learning and become disengaged in online courses (Guglielmino & Guglielmino, 2002; Nyagorme, 2018; Rahardjo, 2018; Yen & Liu, 2009).

As, adolescence is the very critical period of development. Individuals` during this period not only experienced the number of physiological, emotional and social changes. Moreover, they also exhibited gender differences on maturity levels in various aspects such as interest, motivation and engagement (Lenroot & Giedd, 2010; Jetha & Segalowitz, 2012; Crone & Dahl, 2012; MarcenaroGutierrez, Lopez-Agudo, & Ropero-García, 2018). As a result, both male and female adolescents` performed differently on academic tasks or assignments ((Fredricks et al., 2004; Wigfield et al., 2006; Eccles & Roeser, 2011). So, in order to perform better in e-learning process students must show high level of e-learning readiness, ICT self-efficacy, self-directed learning, and academic engagement (Coates, 2006; Hodge, Wright, & Bennett, 2018 ; Islam, 2013; Schweder & Raufelder, 2019;Skinner, Kindermann, & Furrer, 2009; Tan, Divaharan, Tan, & Cheah, 2011). In this regard it is significant to explore e-learning readiness and student engagement among adolescents in e-learning environment. Hence, current research study purposes to explore the role of self-directed learning (SDL) and E-learning readiness (ELR) in the relationship of ICT self-efficacy (ICTSE) and student engagement (SE) among adolescents. The details of all variables of current study are as follows:

ICT Self-Efficacy

Self-efficacy construct was first explained by the American Psychologist Bandura (1977) as an efficacy assumption is based on the belief of the person about himself that he/she can execute the task to achieve certain goal. Moreover, Bandura (1977) explained that individual processes, assess and incorporate distinct sources of information that are related to their ability and regulate their desired behavior and put effort accordingly to accomplish desired outcome.

Furthermore, Bandura (2004) explained that people's faith about their capabilities to complete a particular assignment or attain specific accomplishment is referred to as self-efficacy. The self-efficacy believes of learners are influential how he/she deals with academic challenges, goals, or tasks (Schwarzer & Luszczynska, 2005). Similarly, Ormrod (2006) defined self-efficacy as the strength of a learner about his believes to become successful in completing his assignments and task and accomplish goals. The concept of self-efficacy has been researched from years and years and researchers had brought about many domain specific constructs of self-efficacy in many academic subject areas, including reading self-efficacy, mathematical self-efficacy as well as ICT self-efficacy (Pajares & Miller, 1994; Moos & Azevedo, 2009; Baker & Wigfield, 1999; Tsai et al., 2011). In other words, Self-efficacy construct leads to the origin of more specific domain that is ICT self-efficacy.

According to Meelissen (2008) ICT self-efficacy is referred to as the learners' believes or judgments about their capabilities and skills to execute computer and internet related activities or tasks. ICT self-efficacy has an important and positive influence in ICT related decisions as it is a judgment of a person concerning his capability to take advantage of ICT (Papastergiou et al., 2011). ICT self-efficacy which is also mentioned as computer or internet self-efficacy, explained as person's beliefs of self-confidence about the effectual utilization of internet or computers with

regard to his ability to execute a particular task or assignment (Hong et al., 2014). In accordance with Goldhammer, Gniewosz, and Zylka (2016), perceived ICT competence or ICT self-efficacy can be referred to as the perception of learners about their expertise in ICT and their utilization of ICT to complete assignments or tasks.

Components of ICT Self-Efficacy

Papastergiou (2010) claimed that ICT self-efficacy (ICTSE) composes computer self-efficacy (CSE) and internet self-efficacy (ISE). In accordance with Compeau and Higgins' (1995) CSE is defined as person's believes about their abilities to perform computer skills to wide range of tasks in future. Several definitions of CSE have been presented frequently by altering the initial definition of CSE. Similarly, Marakas et al. (1998) explained computer self-efficacy as judgment of students about their capabilities to accomplish particular computer tasks or assignments. Computer self-efficacy has been further divided into two components; (1) General computer self-efficacy and (2) Task-related computer self-efficacy. General computer self-efficacy is referred as persons' judgment about his abilities in performing various computer related tasks while, task-related computer self-efficacy is referred to as self-perceived competence in particular computer related task in the domain of general computation (Marakas et al., 1998; Agarwal, Sambamurthy, & Stair, 2000). General self-efficacy plays vital role as compared to task-related computer self-efficacy for learners to acclimatize the rapidly changing digital applications and online learning environments (Sam et al., 2005; Papastergiou, 2010). The other component of ICT self-efficacy is Internet self-efficacy. It is described as the individuals' assessment about his or her capability to utilize internet in order to accomplish particular tasks and reach to their goals (Sun, 2008). Similarly Liang and Tsai (2008) stated that, internet self-efficacy has been further divided in two parts like computer self-efficacy: (1) Generalized

internet self-efficacy (GISE) and (2) Communicative internet self-efficacy (CISE). Here GISE is defined as persons' judgment of his/her abilities to perform general internet related task while, CISE is referred to as efficacy of individuals about communication and interaction with internet (Aesaert et al., 2017).

Theoretical Background

Following are the theories which highlighted the deeper understanding of self-efficacy and these theories have been frequently used to develop models and conceptualization of self-efficacy in several domains.

Self-Efficacy Theory. According to self-efficacy theory of Bandura (1977), individuals while developing self-efficacy judgments depend on four major sources of information. The first source of knowledge stated as performance accomplishment is based on personal mastery experiences and is most prominent source. Success in a particular task boost mastery expectations while repeated failures cause them to be lowered (Bandura, 1977). Second source is known as vicarious experience, it is based on observing others' successful performance also referred to as modeling. Through modeling, learners or observers develop their own expectations to perform a particular task successfully (Gist & Mitchell, 1992; Bandura, 1978). The third source of information is referred to as social persuasion, in which individuals are persuaded by verbal and non-verbal judgments of others that they can perform a particular task successfully. For example, usual types of social persuasion is giving someone feedback or evaluation of a particular task and mentoring (Bandura & Cervone, 1986; Bandura, 1977). The physiological and emotional states are the final state of information. Emotional or physiological states also impact self-efficacy skills to perform a particular task. Positive emotions strengthen self-efficacy judgments while negative emotions (like anxiety or stress) lower them (Bandura, 1988).

Therefore, according to Bandura self-efficacy judgments are important and significant predictor of person's action and behavior, which means that individuals perform such activities which they think have the competence and skills to perform those particular tasks (Hatlevik et al., 2018). Hence, it is claimed that self-efficacy acts a good determinant of future behavior and performance of an individual and it has been applied to various settings (Bandura, 1978, Gist & Mitchell, 1992).

Social Cognitive Theory (SCT). In accordance with SCT perceived self-efficacy is referred to as the personal regulation of one's action or activity. Individuals who judge themselves as having control over their actions are more self-determined and active. It reflects that these individuals have control over their cognitions and they can master their tasks by self-adaptive behavior or action (Luszczynska, & Schwarzer, 2005). In other words, self-efficacy changes individuals' actions, feelings or thinking (Bandura, 1977, 1997). Decreased level of self-efficacy is related with helplessness, depression, and anxiety, while individuals with increased self-efficacy are associated with better societal integration. A high level of person's ability further aid performance and cognitive processes by improving academic achievement, goal setting, and decision making (Bandura, 1997, 2001; Maddux, 1995; Bandura et al., 2002). Learners with increased levels of self-efficacy revealed greater interest in learning tasks, work harder, have persistence in academic challenges, and are high achievers. Whereas, students with low believe on their abilities cannot resist the challenges (Bandura, 1997). Self-efficacious students when encountered with challenges in their learning environments, they tackle such situation with cognitive and metacognitive strategies and remain motivated (Zimmerman, 2000).

Conservation of Resources Perspective (COR). In accordance with COR perspective, coping has been conceptualized predominantly in the context of resource loss, gain, and

maintenance. These resources are referred to as entities which have central value in their own right or they may act as a medium of obtaining centrally valued ends (Hobfoll, 2002). Self-evaluations or personal characteristics can be an individual's internal resources (Hobfoll, 1989). Hobfoll et al. (2003) claimed that resources are related with resiliency as they affect person's competencies or abilities to successfully influence and control his/her environment. Xanthopoulou et al. (2009) stated that personal resources are useful for encouraging personal growth and accomplishing goals. Present study adopts the supposition of COR perspective which stated that people not only desire to sustain resources which are already available to them but also try to acquire additional resources. These resources tend to produce other resources, hence, making a caravan of resources, which leads to positive results i.e. better coping and wellbeing (Hobfoll, 2002). This perspective explains how self-efficacy can enhance level of learners' engagement.

According to the context of COR perspective, it is claimed that a person with the given type of resources i.e. self-efficacy, tend to acquire more resources like self-directed learning skills or readiness, which further leads to achieve more resources like engagement of a person in a particular environment. Research upholds the idea that, as an individual acquires resources this tendency leads to more positive results including greater achievements (Hobfoll, 2002; Xanthopoulou et al., 2012). There are few studies in which COR theory has been explored in educational setting. For example, a research study accomplished by Ouweneel et al. in 2011 explored the personal resources on a sample comprised of 403 Dutch students of university. Findings revealed that learners' personal resources predicted effort and student engagement. Moreover, findings also revealed that student engagement further effected resource levels, hence establishing a gain cycle.

There are few studies which briefly revealed the significance of raising ICT self efficacies among students to promote their ICT competences by enhancing their ICT utilization and feelings regarding technology. Such as, in the research study of Tsai and Tsai (2003) findings showed that persons whose ICT self-efficacies were high they have better strategies for processing online information. Another study conducted by Wilfong (2006) revealed that ICT self-efficacy was negatively and strongly correlated with an individuals' feeling of anxiety and anger towards computer use. Furthermore, learners with increased ICT self-efficacies are related with more utilization of internet, and appear to have an increased level of particular types of ICT utilization i.e. educational use and leisure (Durndell & Haag, 2002; Tømte & Hatlevik, 2011; Rohatgi, Scherer, & Hatlevik, 2016). ICT self-efficacy is associated positively with behavioral intention of learners to use technology, its perceived usefulness, and perceived ease of use of technology (Ong & Lai, 2006; Courtois et al., 2014; Aesaert et al., 2015).

Findings from the international ICILS (2013) research showed that if students have increased levels of basic ICT self-efficacy (ICTSE), then their computer and information literacy (CIL) will also be increased (Fraillon et al., 2014). Another study conducted by Aesaert et al. (2015) among students of elementary school revealed that ICT self-efficacy has positive association with student's actual competence in communicating, processing, and locating digital information by utilizing a computer. Furthermore, researchers revealed that individuals with increased perceived computer self-efficacy (CSE) were more inclined to take their responsibilities and they are more progressive in utilization of technology as compared to participants with decreased levels of perceived CSE (Celik & Yesilyurt, 2013; Teo et al., 2018). Therefore, it is suggested that learners with increased self-efficacies are more comfortable to

adapt new technologies and eager to test different pedagogical strategies that merge digital technologies.

Self-Directed Learning (SDL)

Knowles (1975) definition of self-directed learning is the most cited definition and it is stated that self-directed learning (SDL) is a process of learning in which people take action to determine their learning requirements, recognize human and material reserves for learning, formulate learning goals, select and execute suitable learning methodologies, and assess outcome of learning with or without the help of others (Beavers, 2009; Guglielmino, 2013).

Long (1994) refers self-directed learning as the psychological processes in which people direct themselves consciously in an activity to attain knowledge and solve problems according to their understanding. Self-directed individuals are considered as responsible masters and administrators of their own learning process (Abdullah, 2001). Gibbons (2002) defined SDL as the effort individual put in to increase his/her skills or competence, information, attainments or personal development by the use of any method in any conditions at any time.

SDL is also referred to as instructional method in which learner takes the liability of his/her own learning (Fisher, King, & Tague, 2001). Similarly, Merriam and Bierema (2014) defined SDL in which people assume responsibility for their learning by choosing what and how to learn, with or without the help of other. Furthermore, Herlo (2017) explained self-directed learning (SDL) as a process in which people for their particular reasons seek gain in their skill, information and performance by applying any means, at any age, and in any time.

Therefore, it is stated that for an individual to adapt to new environments or circumstances they face or dealing with issues, self-direction or independence in learning is fundamental in such conditions (Tan et. al., 2011). SDL is a process, in which students are

directed themselves for learning particular abilities or skills for example, what should be learned, which techniques and resources ought to be utilized, and which standards should be use to assess educational outcomes are managed by students (Brookfield, 2009; Kim et al., 2014). Although, this doesn't imply that SDL is only related to students or learners individually engaging in the learning process but it also involves learning through a specific network or learning community which consists of instructors, peers, or experts (Garrison, 1997; Brookfield, 2009; Merriam & Bierema, 2014).

Self-directed learning has been explained from three perspectives, for example, (1) an individual trait, (2) a process, or/and (3) a design characteristic of the learning condition/environment (Song & Hill, 2007). According to first perspective, individual's personal characteristics or attributes such as motivation, self-control, self-monitoring, and self-management are mainly related to self-directed learning (Oddi, 1986; Guglielmino, 1977; Garrison, 1997; Fisher, King, & Tague, 2001; Merriam, 2001). Self-directed learner must have a certain degree of these necessary skills (Guglielmino, 1977; Fisher et al., 2001), because these skills or abilities are predictors of learners control over their learning. In the Second perspective, SDL refers to a process where individual takes hold of the instructional steps, consisting of planning, implementing, and evaluating learning (Song & Hill, 2007; Merriam & Bierema, 2014). In last perspective, SDL is referred to as a design characteristic of learning conditions which cultivates the control of individuals in the learning process (Loyens, Magda, & Rikers, 2008).

Learning conditions need to be planned in such a way that foster self-control and self-direction, for example, e-learning environments consist of structures, resources, tasks, collaboration with peers, and instructors' feedback to improve SDL among learners (Song &

Hill, 2007). Moreover, e-learning has been perceived as a self-directed process where learners control their learning process actively and take responsibility for their learning needs and decisions (Corbeil, 2003). Therefore, self-discipline, motivation, and self-direction are the general prerequisites for distance learning or e-learning (Moore, 1987). Therefore, present study examines self-directed learning among adolescent students and gender differences will be tested. Furthermore, the work of Knowles about SDL which was on adults will be extended by focusing on adolescents.

Theoretical Background

There are several theoretical perspectives in literature which mentioned the significance of SDL in the process of learning. Some of the pertinent theories or approaches are mentioned below:

Piaget's Theory of Cognitive. In accordance with Piaget's cognitive development theory, Arsic stated that this theory is clearly related with self-directed learning. As curiosity is main element to learn new ideas or skills and knowledge accomplishment (Arsic, 2014). The main idea of this constructivist theory of development is that more advanced cognitions are developed by the learners through a process of self-regulated or self-directed action (Kuhn & Ho, 1980).

Arsic stated that the three theorists (John Dewey, Jean-Jacques Rousseau, & Alexander Neill) are the actual fathers of self-directed learning. For instance, concepts of socialization and cooperation from Dewey, freedom and discovery from Rousseau, and democracy and self-management from Neill, together these ideas develop an environment which is helpful in promoting self-directed learning (Arsic, 2014).

Humanistic Theory. According to this theory human beings are unique and this uniqueness requires an individualized way of learning. This perspective views self-direction as

the process, as well as the outcome of learning. Motivation to learn is an intrinsic process and it originates from the learners (Loeng, 2020). The major purpose of Humanistic theory is to produce learners with the potential of self-actualization, internal motivation and self-direction (Taylor & Hamdy, p. 1562). Self-actualized individuals are at the highest level of growth with fullest potentiality. Therefore, in this regard it is stated that, learners are viewed as the best evaluator of whether their learning fulfill needs and interest. Teacher acts as a partner or a facilitator in the process of learning (Loeng, 2020).

Self-Determination Theory (SDT). SDT of Deci and Ryan (1985) is based on humanistic perspective of motivation and well-being. The main assumption of SDT is that people have inborn propensities to attain personal growth or /and power of endurance, which are sometimes satisfied or dissatisfied depending upon their current environment (Hill, 2011). Self-determination theory claimed that humans have three intrinsic psychological needs of autonomy, competence, and relatedness. These psychological needs promote motivation (Zhao & Shen, 2012). Autonomy is referred to as an individuals' freedom in his/her choices (Walsh, 2011). Deci et al. (1991) stated that when people engage in an activity because of their own choice they have high autonomy as compared to when they feel pressured by external reasons or people to do so. Competence is referred to as person's belief about his ability that he will perform better in an activity or a task, while relatedness is referred to as a feeling of shared experience (Walsh, 2011). Therefore, Deci and Ryan (2000) stated that if these three psychological needs of humans are fulfilled they exhibit optimal motivation and psychological well-being and are highly determined. However, if these needs remain unfulfilled individuals become undetermined (Deci & Ryan, 2000).

Garrison's Model. The model established by Garrison consisted of three overlapping dimensions for self-directed learning i.e. self-management, motivation, and self-monitoring. Garrison asserted that self-management is referred to as the individual's control over his or her learning, how he manages his/her learning support and resources. Further, Garrison stated that motivation affects self-directed learning by playing major role in person's decision to take participation in learning tasks, the effort, and persistence required to stick to the learning which once has started. This influence how learners use cognitive and metacognitive processes. Lastly, self-monitoring is referred to as the process in which person takes the responsibility for the construction of personal meaning from his already existing information (Garrison, 1997).

Vygotsky's Developmental Theory. According to Lev Vygotsky, educators and peers are significant in the cognitive development of a learner. The major concepts of this theory which are mainly linked with self-directed learning are: the Zone of Proximal Development (ZPD) and scaffolding. ZPD can be distinguished by giving learner an activity or problem situation that is beyond the learners present level of problem-solving, however, this problem can be solved with the assistance of a 'skilled member of the culture' (O'Donnell et al., 2011, p. 52), this skilled member could be a teacher, or instructor, or with the collaboration of peers. The ZPD lies in the middle of two another zones, which include zone of pre-development and zone of actual development. Predevelopment is the zone in which learners are unable to solve a problem even with assistance or guidance, whereas, actual development is the zone in which learners are able to attain a targeted activity without any guidance or assistance (O'Donnell et al, 2011). Therefore, ZPD plays crucial role as it zone where cognitive development advances (O'Donnell et al, 2011).

Scaffolding is referred to as strategy through which learners attain specific skills and knowledge by providing teachers' support, assistance and social guidance to learners (O'Donnell et al, 2011). "Scaffolding" as the name indicates, is compulsory for learners' progression to complete a task at hand by providing him or her with information or pertinent tools. It does not suggest being a teacher-directed assistance, but being present for students when it is compulsory. "Scaffolding is the learning strategy used by teachers to provide support to the learners in the zone of proximal development by helping students what they need most but still cannot provide expert knowledge, planning, methodologies or skills" (O'Donnell et al, 2011, p. 54). Therefore, it is claimed that teachers and peers play key role in promoting an environment that better fits self-directed learning. Moreover, for SDL curiosity also plays a key role for learning new information or knowledge attainment according to cognitive theory.

Prefrontal Cortex. The prefrontal cortex performs primary role in executive functioning of brain. In order to keep the SDL in flow, advanced executive control of brain is required to withstand distraction (Rutherford et al., 2018) so that related knowledge remains in the focus of our attention (Engle, 2018). Though, if the executive control is immature it causes problems in monitoring, implementing, and regulating person's performance and brings down working memory (Anderson, 2002).

A more recent research conducted by Schweder and Raufelder (2019) claimed that several researches have explored gender related differences in learning. Findings revealed that adolescent girls have more inclination for putting effort in learning than boys of similar age. Boys have reported lesser control strategies than girls. This is because; in male adolescents advanced executive control takes more time maturation as compared to female adolescents (Weber et al., 2021). Moreover, female adolescents are considered to bear lower effect of

changes specifically in cerebral structure brought by the effect of testosterone on the gray matter volume and cortical thickness in the frontal lobe of brain (Delevich et al., 2018).

E-learning provides an environment which promotes an individual's SDL as a personal trait/characteristic or as a process. These environments provide flexible structure that facilitates individuals to manage their needs in their own pace, time, and place and eventually, enables them to control their learning process (Beach, 2017; Vonderwell & Turner, 2005). A meta-analytic study conducted by Stubbe and Theunissen (2008) claimed that self-directed learning helps learner to be more efficient and strategic in his learning process. They further asserted that learners are managers of their own learning and are self-directed in their educational choices. Moreover, Tan, Divaharan, Tan and Cheah (2011) revealed that SDL is the major element of 21st century skills and every student must acquire SDL skills in order to face the problems or challenges of 21st century. Furthermore, a research study executed by Sandars et al. (2020) claimed that learners who have accomplished SDL abilities or skills revealed more determination in e-learning environment along with greater engagement and motivation in e-learning environment.

E-Learning Readiness (ELR)

In accordance with Borotis and Poulymenakou (2004), e-learning readiness (ELR) is referred to as "the physical or mental preparedness of a learner or an organization for any e-learning activity or e-learning experience" (p. 1622). Moreover, Kaur and Abas (2004) explained ELR as the capacity of learners to avail information and communication technologies and resources for improved and better status of learning process. Furthermore, researchers asserted that e-learning readiness include factors such as management of learner's own learning, understanding of styles, their experience with learning, convenience with e-learning, time

management, self-control, and intrinsic motivation are important that influence online learning or e-learning (Smith, 2005; Smith, Murphy, & Mahoney, 2003).

ELR is also referred to as the extent to which an organization or community maybe ambitious and prepared to get advantage by utilization of information and communication (ICT) technology (Dada, 2006). Similarly, Lopes (2007) defined ELR as the capacity of a learner or community to take benefit of e-learning technology. E-learning readiness is considered as the individual's capability to conform to the challenges of technology and adapt to collaborative learning, asynchronous or/and synchronous self-determined learning (Schreurs, Ehlers, & Sammour, 2008). Furthermore, Parlakkılıç (2015) explained e-learning readiness as "the preparedness of the trainee or student in the context of interest and discipline towards online learning, time commitment to online learning, and the perception of others about the status of qualifications obtained through online learning".

It has been acknowledged that successful execution of e-learning in institutions and acceptance of online learning by higher education institutions (HEIs) are the components that are influenced by e-learning readiness (Rohayani, Kurniabudi, & Sharipuddin, 2015). For the management of distant learning environments it is essential for learners and teachers to adapt to the constantly changing technological learning and get benefits by acquiring technical skills necessary for e-learning (Ouma et al., 2013). These skills are not acquired by learning about the e-learning technology but rather these are acquired by learning with technology (Broadley, 2012). Along with these technical skills learners should be prepared to utilize technology for their learning and teaching purposes (Ouma et al., 2013). Hence, it is significant to examine the levels of preparedness (readiness) of adolescent students for e-learning.

Theoretical Background

According to the existing literature, there are many theories which provide in-depth knowledge about the operation of technology rich environments to learners and teachers like behaviorism, social learning theory, cognitivism, constructivism, social exclusion, connectivism, and self-determination (Bawa, 2016; Drumm, 2019). Bawa (2016) further asserted that theories that are related to motivation deals with self-efficacy and self-determination are applicable for exploring readiness of learners for e-learning environments. Moreover, in order to build models, conceptualize, and promote utilization of e-learning in education, these theories are most constantly used (Drumm, 2019). Some of most relevant theories are as follows:

Constructivism. According to constructivism, an educational theory, individuals assemble information from their beliefs and experiences and construct their own knowledge. This construction of knowledge is refined through mental structures (Hein, 1991). Individuals in an e-learning environment, which is composed of self-regulated learning build or construct their own knowledge related to their subject. For example, a student of computer science in e-learning environment builds his own knowledge slowly and gradually. Based on constructivist' learning theory Hein (1991) recognized five principles, which are: (1) Students build the meaning of information with what they learn actively. They also need to accomplish from the learnt material, in order to show engagement with the real world. (2) Learning includes both "constructing meaning" and "constructing systems of meaning" (3) Learning is a mental process, as it occurs in the minds of learners. (4) According to 'Constructivism' of Vygotsky, learning and language of learning are completely intertwined. (5) Learning is largely dependent on our interaction with other individuals such as peers, family, teachers etc., as it is a social activity. (6) Finally, it is identified that learning is context related, as it takes place in the real world and is an active

process. These principles indicated that e-learning is a self-directed learning which includes complex mental processes. Therefore, in order to get fruitful outcomes in e-learning environments adolescents must have self-motivation, confidence about their competence, and willingness for e-learning (Ismail & Sambanthan, 2021).

Self-Determination Theory (SDT). SDT claims that humans have three intrinsic psychological needs of autonomy, competence, and relatedness. These psychological demands promote motivation to complete tasks (Deci & Ryan, 2000). Autonomy is referred to as freedom of choice (Walsh, 2011). Deci et al. (1991) stated that when people engage in an activity because of their own choice they have high autonomy as compared to when they feel pressured by external reasons or people to do so. Competence is referred to as person's belief about his ability that he will perform better in any activity or action, and relatedness is referred to as a feeling of mutual experience (Walsh, 2011). Therefore, Deci and Ryan (2000) stated that if these three psychological needs of humans are fulfilled they exhibit optimal motivation and psychological well-being and are highly determined. However, if these needs remain unfulfilled individuals become undetermined (Deci & Ryan, 2000). Hence, it is suggested that if a person has motivation to complete a task in e-learning environment, his will also have readiness for e-learning.

Cognitive Load Theory (CLT). CLT has been widely used to explore the implications of human cognitive structure and mechanism for learning and guidance in various domains (Sweller, Ayres, & Kalyuga, 2011). CLT brings out various attributes of major elements of human cognitive structure and mechanism to promote learning and teaching strategies. These two predominant components are; working memory which is a conscious processor of information and long-term memory which is our knowledge base. According to cognitive load

theory, working memory has limited capability (Miller, 1956; Baddeley, 1992) when encounters with new information along with vital role of long-term memory consisting of available knowledge structures for learning and performance (Chase & Simon, 1973; De Groot, 1965). These two components regulate the magnitude of working memory load which is basically referred to as cognitive load. This framework explained three features of cognitive load which are intrinsic, extraneous, and germane. The intrinsic load is associated with the task difficulty and the expertise level of learners. The extraneous load is associated with presentation of task and with elements that are unconnected to the goals of the task and are not important for learning. The germane load is associated with the level of concentration among learners, which is essential for novel information to be stored for long-term (Young et al., 2014; Van Merriënboer & Sweller, 2010; Naismith et al., 2015).

Therefore, in accordance with cognitive load theory, if the capability of learners to utilize the e-learning devices for learning process is lower, then it will result in higher level of learners' mental workload. Therefore, intrinsic workload is of vital importance for the present study. By increasing learners' perceived competence or expertise, intrinsic workload can be reduced and learners will have high level of preparedness for online learning.

A study conducted by Aydin and Tasci (2005) explored four major areas that influence readiness of learners in e-learning adoption which are; innovation, people, technology, and self-development. Smith (2005) asserted online learning as the type of learning in which learning resources are accessible by electronic means and assisted by group communication in which learner interact with their instructors and peers. Online learning readiness includes learners' technical skills to utilize computer and internet, their positive attitude towards technology, and adequate strategies to engage learners in e-learning environment (Alexander et al., 2003; Smith,

2005). Similarly, Lopes (2007) asserted that the culture, content, technology, financial reserves, and human reserves influence the e-learning readiness. Schreurs, Ehlers, and Sammour (2008) claimed that for learners' readiness to adopt e-learning they must have motivation to learn by themselves, to acclimatize the challenges of technology, to respond to instruction, and should have enough discipline to learn in a self-directed e-learning environment. ELR has been explored in classical face-to-face learning and e-learning or/and teaching. But, there is scarcity of studies in which readiness of students have been explored (Yilmaz, 2017). Unless, students and educators do not have readiness for e-learning, application of e-learning will remain unsuccessful with wasted resources and investments, is imminent. Therefore, it is significant to investigate the students' e-learning readiness and enhance the quality of learning by using technology (Coşkun et al., 2018).

Student Engagement (SE)

According to Astin (1984) student engagement (SE) is referred to as "the extent to which learners dedicate their psychological and physical energy towards educational activities or actions" (p. 297). Furthermore, Connell et al. (1995) classified SE into three kinds: (1) behavioral type is referred to as having persistence in learning, putting effort, and constant concentration in learning, (2) psychological type is defined as having preference to adapt to challenges, independence in learning, and involvement in tasks, and (3) lastly, emotional type is referred to have interest and happiness in learning. According to Kuh (2001), student engagement is referred to as students' participation in educational activities occurs when they put their effort, time, and energy by communicating with others.

According to Hu and Kuh (2002) SE is referred to as the amount of effort that learners devote to their learning activities or assignments to exhibit optimal achievement. Schaufeli et al.

(2002) determine student engagement as learners' propitious, work-related and positive frame of mind that is distinguished by absorption, dedication, and vigor. Moreover, Fredricks, Blumenfeld, and Paris (2004) defined student engagement as a meta-construct which consists individual's persistence, attention, concentration, willingness, and thoughtfulness to apply mental effort; and emotional responses i.e. happiness, interest, boredom, sadness, and anxiety. Furthermore, Fredricks et al. (2004) categorized SE into three dimensions:

• Behavioral engagement: Learners who are engaged behaviorally will conform to the behavioral norms such as by involving and attendance in the learning task. Moreover, these learners will not show any negative or disruptive behavior.

• Emotional engagement: Learners who are engaged emotionally will demonstrate affective responses such as happiness, interest, and a sense of belonging to the educationally purposeful activities.

• Cognitive engagement: Learners, who are cognitively engaged students will show devotion in their learning task by going beyond the demands and adapt to challenges.

Lewis et al. (2011) referred engagement as "the extent to which students have involvement including their activities, feelings and thoughts in academic assignments". Furthermore, Chakraborty and Nafukho (2014) claimed that building and maintaining positive learning environment; giving consistent feedback at appropriate time; composing learning community; and utilizing the right technology for provision of accurate content are determined as four factors which are essential to engage learners in e-learning.

In literature many researchers have defined engaged e-learners as having psychological motivation for learning activities, use e-learning competently and actively, and regulate their learning schedule. Moreover, these learners have proficiency in self-directed learning and

cooperative learning along with prominent communication skills (Golladay, Prybutok, & Huff, 2000; Hong, 2009; Dixson, 2015). Hence, it is asserted that student engagement have always been a required outcome in learning and teaching, especially in e-learning environments (Schwarz & Zhu, 2015). Furthermore, daily life stressors and academic challenges are better coped with engagement as it an active resource and vital aspect of academic resilience. Eventually, from episodic coping through the help of engagement students may attain long-term motivational resilience and skills i.e. self-regulated learning, positive academic identity, self-direction in one's own progress in high school and beyond (Skinner & Pitzer, 2012). Therefore, it would be significant to explore student engagement in e-learning environment among adolescent students in their school years and beyond.

Theoretical Background

There are several approaches in literature which highlighted the importance of learners' engagement in process of learning. Moreover, Skinner, Kindermann, and Furrer (2009), claimed that engagement is an important outcome of motivational process. Hence, in this regard, some of the most relevant approaches are as follows:

Self-Determination Theory (SDT). One of the vital factors in student engagement variable is motivation. A theory established by researchers Deci and Ryan (1985), known as SDT, is a theory on motivation that comprised upon three primary psychological needs of humans such as competence, relatedness, and autonomy. The authors claimed that learners with intrinsic motivation and more autonomous behaviors are most probably to engage in learning tasks actively in comparison to learners who are motivated extrinsically by apprehension from teachers or grade evaluations (Deci & Ryan, 1985; Lee & Hannafin, 2016). Therefore, Schunk and Zimmerman (2012), asserted that intrinsic motivation is associated with learners enjoyment

and interest while performing a learning task, whereas, extrinsic motivation is associated with external rewards like recognition, wealth etc. These two types of motivation influence learners' motivation but intrinsic motivation plays important role in advocating learners' accomplishment in autonomy and competence needs, and their performance (Chen & Jang, 2010; Schunk & Zimmerman, 2012).

A quantitative study conducted by Yoo and Huang (2013) encourages two levels of extrinsic motivation (Short-term & Long-term), and these levels suggested the need of adult students to comply what they have learnt in dealing problems of real life. Moreover, other research revealed that when learners have the chance to engage in tasks or assignments that grant them to avail their particular abilities and interests, are presented with constructive instruction, unnecessary assessment or avoid demeaning, then they are intrinsically motivated (Shillingford & Karlin, 2013).

Self-System Model (SSMMD). The self-system model of motivational development (SSMMD) is claimed as the most suitable perspective of student engagement. The SSMMD conceptualized the variable of student engagement along with a model of motivation development (Skinner et al., 2009; Skinner et al., 2008). SSMMD postulates student engagement as an active manifestation of motivation in a learning process, in which personal psychological aspects and external contextual aspects affect the manifestation of motivation (Skinner et al., 2009). By deriving from self-determination perspective of Deci and Ryan (2000), SSMMD model also hypothesizes individuals have three needs of motivation. These needs when satisfied allow learners to actively engage in learning activities such as by attention, interest, and participation (Connell & Wellborn, 1991). The three needs of motivation are known as (1) sense of autonomy, (2) sense of relatedness, and (3) sense of competence. Self-System Model supposes

that learner self-efficacy causes academic achievement, but hypothesizes that the whole process works via engagement of learners (Connell, 1990; Connell & Wellborn, 1991).

SSMMG is of great interest for the present study as self competence and autonomy are comparable to self-efficacy and self-directed learning respectively. Furthermore, as stated by SSMMD self competence is the significant predictor of behavioral and emotional engagement. Likewise, in present study self-directed learning and self-efficacy are assumed to be the significant predictors of student engagement.

Engagement Theory. This theory was suggested by Kearsley and Shneiderman (1998). The central concept of theory hypothesizes that learners should have purposefully engaged in learning activities by interacting with learning tasks and collaboration with instructors and peers. In other words, this theory has offered a theoretical structure for technology based learning. Authors established their work on the fundamental idea that technology could provide encouragement in learners' engagement in many ways that traditional face-to-face learning cannot. They supported collaborative work by designing learning activities that are project-based, can take place in a group, and have an authentic or purposeful focus. Furthermore, they claimed that project orientation promotes problem based learning techniques (Kearsley & Shneiderman, 1998).

A qualitative study was conducted by O'Brien and Toms (2008) to deconstruct the term engagement as it is related with learners' experiences utilizing technology. Based upon their research results, O'Brien and Toms (2008) established a definition of engagement, as well as a conceptual model, that referred the engagement as a process that included four different stages which are; point of engagement, duration of sustained engagement, disengagement, and re-engagement. Moreover, O'Brien and Toms (2008) claimed that their research findings were

associated with Kearsley and Scheiderman's theory (1998), because participants of their study demonstrated self-directed, meaningful involvement as prerequisites of motivation to attain personal interest and external incentives to accomplish activities.

Expectancy Value Theory (EVT). According to this theory there are complex interrelationships among self-efficacy, engagement, and achievement (Wigfield & Eccles, 2000; Eccles et al., 1983). It hypothesizes that earlier self-efficacy caused emotional engagement and behavioral engagement, and then leads to achievement. EVT also postulates that emotional engagement afterwards associates with behavioral engagement and then achievement. Hence, according to the hypothesis of EVT various suppositions are explained one after another. Firstly, EVT postulates that learner self-efficacy, which is referred to as their judgment about their present capabilities, is associated with later expectation of task value and success. Task value can also be understand as learners positive emotion and interest in task, which can otherwise referred to as intrinsic value. It is interconnected with emotional engagement that also involves enjoyment and interest (Wigfield & Eccles, 2000; Fredricks et al., 2004). Hence, based on EVT, self-efficacy should cause emotional engagement. Secondly, self-efficacy and emotional engagement both causes behavioral engagement that involves compliance, attention, and effort. These behaviors are precedent of learners' choices related to achievement exhibiting their preferences for learning and proficiency in learning activities. EVT thus hypothesizes that learners' behavioral engagement is the outcome of an intrinsic motivation for learning that is characterized by emotional engagement and self-efficacy (Olivier et al., 2019).

Researchers demonstrate that sustained student engagement is a dominant factor for assuring learner's success in an e-learning environment (Street, 2010; Fredrickson, 2015; Wolverton, 2018). Dörnyei (2000) claimed that even with increased level of self-efficacy

learners are unable to understand the whole unless they are engaged in learning actively. Researchers have proposed various strategies for enhancing student engagement in e-learning environment. For example, researches conducted by Thurmond and Wambach (2004), and Laird and Kuh (2005), asserted that information technology and collaborative work play fundamental role for enhancing student engagement. Furthermore, Coy, Marino and Serianni (2014) claimed that to support enthusiasm and student engagement, online educators must have recognized the differences in the learning of students and the variables that bring about these differing characteristics. Hence, e-learning system could generate obstacles or convenience for engagement based on the personal characteristics of learners.

Aspects that contribute to individual's engagement in online leaning are exhibited from learning behaviors of successful individuals in online learning system. For instance, a study conducted by Golladay, Prybutok, and Huff (2000), reported that successful students in e-learning environments should have motivation to learn, they invest enough amount of time for lesson preparation, collaborate with their peers for learning, and they have better understanding to use technology for their online lessons. Moreover, Dabbagh (2007) suggested that online learners can develop their learning concepts themselves, they have self-directed learning skills, communicate with peers, use online learning technology easily, and have a sense of belonging with other learners. Furthermore, Hong (2009) explored the behaviors of successful students in online learning in Korea. These behaviors comprised upon constructing knowledge, planning a learning schedule, applying their learning to real life, interacting with the instructor, choosing learning contents, learning collaboratively, possessing motivation for learning, and developing their own learning strategies.

Literature Review

Relationship of ICT Self-Efficacy and Self-Directed Learning

Drawing from the previous literature it is suggested that people with increased level of self-efficacy are thought to be compatible for online learning conditions as these individuals are adaptable, passionate, and cooperative to participate in learning situations and they are more prepared to master challenging situations rather than ignoring them (Chen, 2014).

A study conducted by McCoy (2001) explored the association among technological self-efficacy, self-directed learning, and satisfaction on a sample adult learners in a technology based learning system. Findings from this research study revealed that technological self-efficacy and self-directed learning skills had significant and positive association with each other. Moreover, it was also revealed that technological self-efficacy and self-directed learning has positive and significant association with satisfaction. Similarly, another research study executed by Teo et al. (2002) explored the impact of computer self-efficacy (CSE) on self-directed learning (SDL) from a sample of more than 5000 students of middle school. Findings revealed that CSE and SDL had positive correlation. Moreover, findings also indicated that technology rich environment influenced CSE, and CSE influenced SDL.

A study was conducted by Corbeil (2003) determined the direction and strength of relationship among online technologies self-efficacy, self-directed learning readiness. Finding of the research revealed that online technologies self-efficacy and self-directed learning were significantly and positively correlated with each other. Similarly, another study was conducted by Simmering, Posey, and Piccoli (2009) explored association of computer self-efficacy (CSE) and motivation to online learning in a course of self-directed learning. Findings revealed that computer self-efficacy had significantly positive association with online learning in a self-

directed online course. Holt and Brockett (2012) examined the associations in self-directed learning and factors that influence ICT usage particularly from the perspective of computer self-efficacy. Sample comprised of 572 graduating students. Findings of the research showed that weak and significant correlation existed between computer self-efficacy (CSE) and self-directed learning (SDL).

Sadi and Uyar (2013) determined the correlation among self-efficacy, self-regulated learning strategies and achievement among Turkish students. Findings manifested that self-efficacy had positive correlation with effort regulation strategies, cognitive self-regulated strategies and metacognitive self-regulated strategies. Furthermore, a research conducted by Lenahan-Bernard (2014) explored the correlation among computer self-efficacy, self-directed learning, and online courses completion. The data were collected from 98 civilian employees. Finding manifested that computer self-efficacy was significantly and positively related with self-directed learning, while it was reported that online course completion has no significant association with self-directed learning and computer self-efficacy. Qualitative analysis showed that online courses that were expected to use by employees were old and inappropriate. Moreover, research determined by Demir et al. (2014) explored the association between attitude towards computer and self-directed learning with technology on a sample comprised of 2219 middle and secondary school. Findings revealed that attitude towards computer had high positive and significant correlation with self-directed learning with technology. Another study conducted by Karataş and Başbay (2014) explored the relationship among general self-efficacy, critical thinking disposition, academic achievement, and self-directed learning readiness. Study included 649 pre-service teachers as sample. Findings indicated that self-efficacy, critical thinking disposition, and academic achievement significantly predicted by self-directed learning.

Basereh and Pishkar (2016) accomplished a research to explore the association among self-directed learning, self-efficacy beliefs and critical thinking. The research comprised of 60 students as sample. Findings of the research indicated that self-efficacy has significant association with self-directed learning. Furthermore, a study conducted by Lee and Kim (2016) explored the effect of self-efficacy and self-directed learning on self leadership. Findings revealed that self-directed learning (SDL), self-efficacy, and self leadership were significantly correlated.

Oh (2017) determined the effect of learning motivation, academic self-efficacy, and communication skill on self-directed learning among students of nursing. Sample comprised 194 second year students. Findings revealed that learning motivation, academic self-efficacy, and communication skill significantly predicted self-directed learning. Another study conducted by Langshaw (2017) determined the correlation between self-efficacy and self-directed learning on undergraduate learners in US. According to the findings, it was indicated that self-efficacy has significantly strong association with self-directed learning. Saeid and Eslaminejad (2017) explored the association of self-directed learning readiness with academic self-efficacy and achievement motivation among university students. This study executed on a sample comprised of 322 bachelor students from a university of Rafsanjani. Findings showed that self-directed learning readiness had significant and positive association with self-efficacy. Moreover, self-directed learning readiness also positively correlated with achievement motivation.

Research study established by Zhang et al. in (2018) determined the correlation among self-directed learning, self-efficacy, and problem-solving ability on undergraduate learners. According to findings, it was suggested that significant positive correlation existed among self-efficacy, self-directed learning readiness and problem-solving ability. Moreover, self-efficacy

partially mediated the association of self-directed learning readiness and problem-solving ability. Similarly, another research conducted by Sumuer (2018) explored factors effecting self-directed learning with technology on students of college. Sample of the study comprised of 153 college students. Findings showed that a significantly weak association existed between computer self-efficacy (CSE) and self-directed learning with technology. Also, it was reported that weak and significant correlation exists between online-communication self-efficacy (OCSE) and self-directed learning (SDL).

Another study was conducted by Hatlevik, Throndsen, and Gudmundsdottir (2018) explored the determinants and association between ICT self-efficacy and computer and information literacy (CIL). Findings from this research demonstrated that autonomous learning and experience with computers were positively and significantly related with ICT self-efficacy in all 14 countries. Moreover, ICT self-efficacy significantly predicted computer and information literacy (CIL). In addition, Li and Zheng (2018) examined the association of self-regulated learning and self-efficacy along with task value as a mediator. The study sample comprised of 299 seventh grade students. Results of this research study demonstrated that self-regulated learning has significantly positive association with self-efficacy. Moreover, findings reported that self-efficacy significantly predicted self-regulated learning and utility value as the mediator between self-regulated learning and self-efficacy.

Relationship of ICT Self-Efficacy and E-Learning Readiness

A research study by Clarke, Ayres, and Sweller (2005) explored that if learner does not have sufficient technological ability or confidence for the utilization of technology for learning process, then consequently learner will feel pressured to use technology for learning process. Similarly, another study conducted by Hove and Corcoran (2008), explored that as compared to

classical methods of learning or teaching, use of e-learning increases learners level of frustration. For e-learning, user must have the competence or ability to conduct high technological devices i.e. computers and internet.

In accordance with earlier literature, it is suggested that positive association existed in ICT self-efficacy and e-learning readiness. For instance, Al-Mushasha (2013) examined the determinants of acceptance of e-learning on a sample comprised of 224 students of higher education. Findings revealed that computer self-efficacy was important factor that influence acceptance of e-learning among learners. Similarly, other research study accomplished by Hsia, Chang, and Tseng (2014) examined the influence of computer self-efficacy and individual locus of control in online learning acceptance among employees. Findings indicated that computer self-efficacy had significantly affected behavioral intention (BI) for e-learning usage and perceived ease of use (PEOU) and. Similarly, a study conducted by Lee, Hsiao, and Purnomo (2014) investigated the individual and system characteristics that affect e-learning acceptance among Indonesian students. The data collected from two universities of Indonesia constituting many faculties. Findings indicated that computer self-efficacy (CSE) and internet self-efficacy (ISE) directly affect perceived ease of use (PEOU) and indirectly affect perceived intention to use e-learning. Moreover, perceived ease of use (PEOU) and perceived usefulness (PU) were significant predictor of perceived intention to use e-learning.

Achukwu et al. (2015) executed a research study and explored the correlation among computer self-efficacy, computer-related technology dependence, and online learning readiness among undergraduate learners. Findings showed that computer self-efficacy and online learning readiness were significantly and positively correlated. Moreover, it also reported that Computer self-efficacy significantly predicted students' online learning readiness. Furthermore, another

study was conducted by Lwoga and Komba in (2015) explored the antecedents that affect continued usage intention of internet based learning. Findings indicated that self-efficacy effect actual usage of technology while various factors predicted continued usage intention of internet based learning which include self-efficacy, effort expectancy, performance expectancy and actual usage of technology.

Study conducted by Kanwal and Rehman (2017) investigated the factors that influence e-learning adoption in Pakistan. Sample comprised of 354 students from graduate and post graduate students. According to findings computer self-efficacy, internet experience, system characteristics and enjoyment were reported as the significant determinants of perceived ease of use (PEOU). A research study established by Ayub et al. in (2017) determined the associations among mobile self-efficacy, readiness, and attitude towards technology based learning and teaching. The study comprised of 223 registered undergraduate in mobile learning class. Findings indicated that students have positive attitudes towards mobile learning and teaching. Moreover, findings indicated that mobile self-efficacy and readiness were significant predictors of attitude towards mobile learning and teaching. Similarly, another research executed by Tarhini et al. (2017) asserted self-efficacy as the significant component of behavioral intention to use technology based learning environments.

Research conducted by Nyagorme (2018) investigated the determinants of e-learning uptake; it included 472 students as a sample from the distance education college. Result showed that e-learning self-efficacy predicted e-learning adoption significantly. Similarly a study conducted by Al-Rahmi et al. (2018) analyzed the intention of students to utilize e-learning among students of higher education institution in Malaysia. Findings showed that content of e-learning and self-efficacy were positively associated with perceived usefulness (PU) and student

satisfaction. Student satisfaction and perceived usefulness impact intentions of students in e-learning utilization. Coşkun et al. in (2018) investigated the e-learning readiness among Turkish medical students. Findings showed that undergraduate medical students have acceptable levels of e-learning readiness. Moreover, results also demonstrated that internet self-efficacy (ISE) was the highest factor for readiness among medical students. Then, another study was conducted by Kim and Park (2018) investigated the influence of individual factors to ICT usage for e-learning adoption. Findings showed that CSE and performance expectation were the significant elements that affect intention of e-learning usage. Dar, Kateel, and Lakshminarayanan (2018) examined the role of CSE in e-learning adoption in India. Sample comprised of post graduate students age ranged from 21-29 years old. Findings showed that computer self-efficacy mediated the association among perceived ease of use (PEOU), perceived usefulness (PU) and students' attitude towards technology adoption.

Rafiee and Abbasian-Naghneh (2019) executed a research to examine the factors that influence e-learning readiness and e-learning acceptance among English learners. Findings indicated that online communication self-efficacy was significantly and positively associated with e-learning readiness and e-learning acceptance by mediating effect of PEOU and PU. Similarly, research conducted by Salloum et al. in (2019) investigated the factors that influence technology acceptance of students for e-learning. Study included 435 students as sample from five universities of UAE. Findings indicated that computer self-efficacy, computer playfulness, and system quality emerged as the significant factors that influence e-learning acceptance among university students. Moreover, research executed by Jacobs et al. (2019) determined the role of self-efficacy, flexibility, and gender in health information technology (HIT) readiness among pharmacy students. Sample comprised of 148 first year pharmacy students above age of 18.

Findings showed that high level of technology self-efficacy was associated with high readiness for health information technology. Furthermore, a study conducted by Alqurashi in (2019) explored the factors in predicting perceived learning and satisfaction in online learning conditions. Study comprised of 167 students as sample. Findings of research demonstrated that online learning self-efficacy significantly and strongly predicted perceived learning. Therefore, findings revealed that if students have increased online learning self-efficacies then their readiness for online learning would also be enhanced.

Thongsri, Shen, and Bao (2020), in a research study explored the differences in academic majors in the perceptions of computer self-efficacy (CSE) and e-learning adoption. Sample comprised of 432 STEM (mathematics, science, technology, & engineering) and non-STEM pupils. Findings indicated that student's CSE has significant correlation with behavioral intention of e-learning usage. Moreover, STEM pupils scored higher in CSE than non-STEM students. Similarly, another study by Bubou and Job (2020) investigated the relationship in e-learning self-efficacy and e-learning readiness on a sample comprised of 217 university learners. Findings of the research exhibited that e-learning self-efficacy has significantly positive correlation with e-learning readiness.

Another study conducted by Pan (2020) determined the correlation among technological self-efficacy, technology acceptance, and attitude towards technological self-directed learning while learning motivation acts as a mediator. Findings indicated that technological self-efficacy was correlated significantly with technology acceptance. Moreover, it was reported that learning motivation mediated the relationship among technological self-efficacy, technology acceptance, and attitude towards technological self-directed learning. Warden et al. in (2020) explored technology readiness and learner's self-efficacy in an online class among 102 millennial.

Findings showed that learners who are less confident with technology have lower levels of self-efficacy in general social interaction and in academic related social interaction.

Karunarathne et al. in (2020) investigated perceived self-efficacy, perceived usefulness, and technological factor with respect to e-learning readiness. Data collected from undergraduate students of National University of Sri Lanka. Findings showed that undergraduates have mean scores above the average scores for the three indicators i.e. perceived self-efficacy, perceived usefulness and technological factor. Therefore, it can be asserted that undergraduate pupils have positive perceptions for e-learning readiness. Latip et al. (2020) determined the influence of self-efficacy on e-learning acceptance among Malaysian students. Data collected from 414 students of higher education in Malaysia. Findings revealed that self-efficacy had significant and positive association with e-learning acceptance. Moreover, the exogenous variables i.e. performance expectancy, social influence, and perceived enjoyment had significant and positive association with e-learning acceptance also. Siron et al. (2020) explored factors that influence e-learning adoption among 210 respondents in Indonesia. Findings indicated that perceived self-efficacy, computer anxiety, perceived enjoyment and experience of students were the factors that influenced e-learning adoption in Indonesia.

A more recent study conducted by Badrul (2021) explored the influence of technological access, technical self-efficacy, and attitude on readiness of blended learning. The sample comprised of 101 lecturers. Findings showed that attitude mediated the association of technical self-efficacy and readiness. However, attitude did not mediate the relationship between technical access and readiness. Ferrera et al. (2021) explored the role of big five personality traits and self-efficacy on technology readiness through the influence of individual entrepreneurial orientation as a mediator. The study comprised of 150 entrepreneurs sampled from Generation X,

Generation Y, and Generation Z. Findings showed that self-efficacy directly affect technology readiness as well as indirectly affect technology readiness through individual entrepreneurial orientation. Moreover, individual entrepreneurial orientation fully mediated the association between big five personality traits and technology readiness. Similarly, a study conducted by Ahmad and Salim in (2021) explore the correlation among self-efficacy, emotional intelligence, and readiness for online learning. Sample included 356 postgraduate students. Findings revealed that self-efficacy has significant and positive association with readiness for online learning readiness. Moreover, independent variables significantly predicted online learning readiness.

Relationship of ICT Self-Efficacy and Student Engagement

Learners with increased self-efficacies reveal positive behaviors, either directly or indirectly (Bandura, 2006), and they are likely to choose deep learning to basic learning (Liem et al., 2008). Earlier literature has showed that self efficacy and student engagement have been found highly correlated (Thijs & Verkuyten, 2008; Majer, 2009). Various studies demonstrated that a learner's judgments regarding their capabilities related to technological usage are a major factor in examining their sustained engagement in learning environments that are based on rich technology (Tzeng, 2009).

Laird and Kuh (2005) revealed that increased computer self-efficacy (CSE) was associated with increased information and communications technology (ICT) engagement. For example, a research study was executed by Green et al. (2012) explored the relationship among self-concept, motivation, engagement and academic performance on a large sample comprised of 1866 high school students of Australia. Study followed a longitudinal design. Findings showed that self-concept and academic motivation positively predicted affective engagement, while affective engagement positively predicted behavioral engagement. Similarly, in a study

conducted by Pellas (2014) explored the effect of computer self-efficacy (CSE) and self-esteem on student engagement in e-learning courses. Sample comprised of 305 graduate and undergraduate students. Results of the research manifested that computer self-efficacy and self-esteem have positive association with different factors of student engagement including cognitive and emotional factors. Moreover, computer self-efficacy predicted the overall student engagement in highest levels than other variables of research.

Research study conducted by Dogan (2015) explored the correlation among self-efficacy, student engagement, academic motivation, and academic performance on a sample comprised of 578 students (middle & high school). Findings showed that self-efficacy and student engagement were significantly and positively correlated. Moreover, all the independent variables significantly and positively predicted cognitive and emotional engagement. Another research executed by Martin and Rimm-Kaufman in (2015) inquired the relation of self-efficacy and teacher-student interaction on social and emotional engagement. Findings showed that self-efficacy and student engagement (social & emotional) were strongly and significantly correlated. However, no significant correlation existed between self-efficacy and student-teacher interaction. Therefore, it can be asserted that students personal beliefs about themselves are significant indictors of their engagement in any task they are efficacious. A meta-analytic study conducted by Chang and Chien (2015) explored the association in academic self-efficacy and engagement. Research comprised 25 research papers from 1990 to 2014. Findings exhibited that academic self-efficacy and student engagement has significant and positive correlation with each other.

A study conducted by Major (2016) explored the relationship among sources of self-efficacy, self-efficacy for self-regulated learning (SESRL), and student engagement. The research comprised of 98 adolescents among which 47 adolescents were classified as ADHD and

51 placed in control group. Findings indicated that sources of self-efficacy and SESRL mediated the association between student engagement and inattention. Moreover, as compared to control group, adolescents with ADHD exhibited decreased levels of self-efficacy, student engagement, and SESRL. Furthermore, male showed decreased levels of sources of self-efficacy in comparison with females. Another study was conducted by Prior et al. (2016), which include 151 postgraduate students menifested that self-efficacy was significantly related with peer engagement and learning management systems (LMS).

Chen (2017) determined the association in computer self-efficacy, learning performance, and learning engagement acted as a mediator. Findings showed that computer self-efficacy has positive relation with learning engagement. It also reported that association in computer self-efficacy and learning performance was fully mediated by learning engagement. Furthermore, research establised by Manwaring et al. (2017) examined the components that affect student engagement in blended learning environment. Sample consisted of 67 students registered in blended learning courses. Findings of the research study indicated that academic self-efficacy as well as computer self-efficacy was significantly correlated with different dimensions of student engagement. Furthermore, a study conducted by Vayre and Vonthron (2017) explored the influence of academic self-efficacy on psychological engagement in online learning. Findings exhibited that academic self-efficacy has significant direct relationship with psychological engagement. Moreover, academic self-efficacy mediated the association between sense of community and engagement.

Research by Chong et al. (2018) explored the relationship among self-efficacy perceptions of students, teacher support for learning, and student's engagement as a mediator. Study comprised of large sample of 3776 students from 7^{th} and 8^{th} grade. Findings revealed that

self-efficacy was directly correlated with student engagement. Moreover, components of student engagement mediated the influence of self-efficacy and teacher support on different student's competencies. Jung and Lee in (2018) explored the elements that effect student engagement and persistence in e-learning environment. Study included 360 South Korean learners who were enrolled in Massive Open Online Courses (MOOCs). Findings showed that academic self-efficacy had significant direct relationship with student engagement. In turn, student engagement mediated the relationship between self-efficacy and learning persistence in MOOCs. Research study accomplished by Ahmed et al. in (2018) explored the correlation in academic self-efficacy and academic resilience on student engagement among 350 university students of Bahrain. Findings indicated that self-efficacy and resilience were significantly correlated with student engagement.

Olivier (2019) administered a research study to investigate the assumptions of theoretical perspectives mainly theory of self-efficacy and expectancy value theory on a sample comprised of 671 students of 4th, 5th and 6th grade. Findings of the research study indicated that self-efficacy has positive association with emotional engagement. Moreover, self-efficacy was also correlated with academic achievement of 4th, 5th, and 6th grade learners. In addition, a research executed by Sökmen in (2019) explored the role of self-efficacy and learning environment on student engagement among Turkish students. Study comprised of 407 middle school students. Findings indicated that self-efficacy has positive association with all the dimensions of student engagement (behavioral, affective, & cognitive). Moreover, it was reported that different dimensions of learning environment predicted self-efficacy. Maricuțoiu and Sulea in (2019) examined the association of self-efficacy, student engagement and student burnout from 135

undergraduate students. Study used a longitudinal design. Findings revealed that self-efficacy has significantly positive association with student engagement.

Azila-Gbettor and Abiemo (2020) conducted a research and examined the relationship among academic self-efficacy, study engagement, and perceived lecturer support on a sample consisted of 376 university students of Ghana. Findings menifested that academic self-efficacy has significantly positive correlation with study engagement. Moreover, academic self-efficacy as well as perceived lecturer support significantly predicted study engagement. Similarly, another study conducted by Kim, Seo, and Ki (2020) examined the affect of self-efficacy and task value on learners' engagement. Study consisted of 186 students as sample. Findings exhibited that self-efficacy and task value had a positively significant influence on learning engagement.

A recent study conducted by El-Sayad, Saad and Thurasamy (2021) explored the influence of academic self-efficacy, perceived usefulness of e-learning, social presence on student engagement and student satisfaction. Sample consisted of undergraduates who were registered in online learning during Pandemic. Result of the study indicated that academic self-efficacy and students engagement dimensions (emotional & behavioral) were significantly and directed related correlated. Moreover, perceived usefulness of online learning and social presence were also significantly and directly related with different dimensions of student engagement. Similarly, a study was administered by Bowden, Tickle, and Naumann in (2021) also reported that self-efficacy has significantly positive association with student engagement.

Furthermore, a study administered by koob et al. (2021) investigated the factors that affect study engagement during pandemic. Sample comprised of 559 students of university from different departments of health and social sciences in Germany. Findings from the research study

indicated that personal factors e.g. academic self-efficacy, active self-care and emotional resilience were identified as significant predictors of student engagement. Alemayehu and Chen (2021) explored the affect of learners' motivation, learning self-efficacy, and self-monitoring on learning engagement in e-learning environment. Sample comprised of 354 students from higher education institutions. Findings of the research manifested that learning self-efficacy was directly associated with learning engagement and self-monitoring. Moreover, learning self-efficacy and self-monitoring mediated the relationship between motivation and learning engagement. Han, Geng, and Wang (2021) explored the associations among self-efficacy, satisfaction and student engagement in e-learning on a sample comprised of 428 English language learners. Findings indicted that self-efficacy had significant direct influence on online engagement. Moreover, self-efficacy significantly mediated the effect of student involvement and student cohesiveness on online engagement.

Hence, based on the reported literature it can be asserted that if technology/ICT self-efficacy of students will be enhanced students may have higher engagement levels in e-learning environment and more students would be benefited from technology rich environments.

Relationship of Self-Directed Learning and E-Learning Readiness

Theorists claimed that learners must have self-directed learning skills and autonomy for online learning activities (Hung et al., 2010; Abdelaziz, 2012). For instance, a research study executed by Chou (2012) explored the correlation between self-directed learning abilities and online learning performances of engineering students reported that SDL has positive and significant correlation with online learning performances. Similarly, a study conducted by Kaymak and Horzum (2013) showed agreement that individuals' self-directed learning readiness and their readiness for online learning were positively related with each other. Another study

conducted by Demir and Yurdugül (2015) conducted an exploratory study to find out the component models that were related to e-learning readiness. Findings indicated self-directed learning (SDL) as the significant component of e-learning readiness. Furthermore, study conducted by Cigdem and Ozturk (2016) exhibited the critical components for online learning readiness and their association with end-of course achievement on a sample comprised of 155 Turkish students from post-secondary military school. Findings indicated that SDL emerged as a significant predictor of achievement.

Ayub, Wei, and Yue (2017) examined the factors that influence learner's acceptance of Massive Open Online Course (MOOC). Findings indicated that self-directed learning as one of the factors that influence acceptance of MOOC. Another study was conducted by Zanjani, Ajam, and Badnava (2017) explored the relationship among self-directed learning readiness, e-learning acceptance and academic progress on a sample comprised of 200 M.S students of Nursing and Midwifery school. Findings indicated that significant relationship existed among self-directed learning readiness, e-learning acceptance and academic progress. Moreover, self-directed learning readiness significantly predicted e-learning acceptance and academic achievement.

A research executed by Cavusoglu (2019) explored the association in self-directed leaning and online learning readiness. Study comprised upon 550 students and professional from hospitality and tourism college and hospitality and tourism industry. Findings indicated that self-directed learning readiness and online learning readiness were positively and significantly correlated. Moreover, it was reported that significant differences emerged in the mean scores of industry professionals and college students on self-directed learning readiness. A research study administered by Shimizu et al. (2019) examined the effects of blended problem based learning

on acceptance of blended learning. Findings from the study showed that self-directed learning dimension of problem based learning was positively related to acceptance of blended learning.

In addition, a research study led by Durnali (2020) explored the correlation among self-directed learning (SDL), self-leadership and online learning on a sample comprised of 835 Turkish students. Findings indicated that self-directed learning has positive and significant association with online learning. Moreover, SDL significantly mediated the association in self-leadership and online learning. In another study conducted by Dadgar, Fallah, and Taheri (2020) explored the influence of metacognitive learning and self-directed learning on e-learning, while emotional well-being as a mediator. Sample comprised of 260 managers age ranged from 30-60. Findings showed that self-directed learning had significant direct effect on e-learning. A study conducted by Ismail and Khalid (2020) explored the association between self-directed learning and understanding of e-learning. Sample comprised of 306 diploma students from three universities. Findings indicated that self-directed learning has significant and positive correlation with understanding of e-learning, although the correlation was weak.

Chau, Law, and Tang in (2021) administered a research study and explored the influence of self-directed learning (SDL) and technology readiness (TR) on synchronous e-learning. Data collected from three universities of Hong Kong. Findings from the research study indicated that self-directed learning has significant and positive association with technology readiness. Moreover, it was also reported that SDL and TR were significant predictors of synchronous e-learning environment. Another study conducted by Boon, Bakar, and Yusop (2021) explored the association in self-directed learning and acceptance of e-learning. The research comprised of 106 culinary students as sample. Findings indicated students had high levels of e-learning acceptance and moderate level for self-directed learning. Moreover, findings exhibited that self-directed

learning has significant and positive relation with acceptance of e-learning, although the relationship was weak. Yavuzalp and Bahcivan (2021) explored the association among e-learning readiness, self-regulation skills, and academic achievement. Study comprised of 749 university students as sample. Findings indicated that e-learning readiness was significantly related with self-regulation skills. Moreover, e-learning readiness significantly predicted self-regulation skills. A recent study conducted by Karatas and Arpaci (2021) examined the role of self-directed learning, meta-cognition, and 21st century skills predicting the readiness for online learning on a sample comprised of 834 prospective teachers. Findings indicated significant correlation existed among self-directed learning, meta-cognition, 21st century competencies, and e-learning readiness. Moreover, self-directed learning positively and significantly predicted e-learning readiness.

Relationship of Self-Directed Learning and Student Engagement

Several studies have suggested that self-directed learning and student engagement were positively correlated with each other. For example, a research study was executed by Sun and Rueda (2012) examined the association among self-efficacy, self-regulation, and student engagement. Study comprised of 203 university students from south-western USA as a sample. Findings revealed that self-regulation was significantly positive association with all the three dimensions of student engagement (emotional, cognitive, & behavioral). Another study conducted by Lee, Choi, and Kim (2013) explored factors that differentiate between dropout students and persistent students in an online learning. Study comprised of 169 students as sample. Findings demonstrated that levels of metacognitive self-regulation and locus of control were high among persistent learner as compared to dropout students. Another study conducted by Pellas (2014) explored the effect of computer self-efficacy and metacognitive self-regulation

on student engagement. Sample comprised of 305 learners both undergraduate and postgraduate. Findings of the research demonstrated that metacognitive self-regulation has significant and positive association with cognitive and emotional engagement, while correlation with behavioral engagement was negative.

Research study established by Rashid and Asghar (2016) explored the associations among technology use, self-directed learning, and student engagement. Findings demonstrated that technology use has significant and direct relation with students' engagement and self-directed learning. Moreover, self-directed learning and student engagement were positively correlated with each other. Another research administered by Song and Bonk (2016) explored the motivational components of self-directed informal learning from online learning resources. Findings indicated that interest and engagement, control, freedom and choice were the significant factors contributing in self-directed informal learning. Cho and Jang (2016) explored the effects of flipped learning on academic engagement, self-directed learning and social interaction. Sample comprised of 129 middle school students divided in two groups. One group was placed in traditionally instructed learning method whereas other group was placed flipped learning method. Findings indicated that students in flipped learning had high self-directed learning, academic engagement, and social interaction as compared to students in traditionally instructed learning. Furthermore, Yang (2016) demonstrated that self-directed learning and student engagement has significant and positive association with each other.

Research executed by Tao et al. (2018) explored the association among Smartphone use, self-directed learning, student engagement and individual impact. Study included 258 students of secondary school, college, and bachelor's as sample. Findings manifested that self-directed learning has positive and significant association with student engagement. Another study

conducted by Ghasemi, Moonaghi, and Heydari in (2018) explored the factors that affect academic engagement among nursing students. Study comprised of 7 to 16 undergraduates of nursing for qualitative data collection. Findings of the study revealed that self-directedness emerged as one of the significant factors that influence academic engagement.

Similarly, in a research executed by Pacheco-Velázquez and Viscarra-Campos (2019) investigated the crucial elements associated with reflection, engagement, and self-directed learning. Findings of the research reported that self-directed learning was positively related with student engagement. A research study executed by An et al. (2019) investigated the factors affecting self-directed learning on a sample comprised of 196 undergraduate students. Findings revealed that academic engagement significantly predicted self-directed learning while negatively predicted psychological tendency (i.e. Type D personality).

Another study conducted by Ergun and Adibatmaz (2020) investigated the role of e-learning readiness and e-learning style on student engagement. Their findings manifested that self-directed learning, which is also the sub-dimension of e-learning readiness, predicted all the three dimensions of student engagement (cognitive, behavioral, & affective engagement). In a recent study conducted by Alomair (2021) explored the perception of students' engagement and self-directed learning while using Smartphone for learning on a sample included 333 undergraduate and graduate students of Saudi Arabia. Findings indicated that self-directed learning and student engagement were significantly correlated while using Smartphone for learning.

Relationship of E-Learning Readiness and Student Engagement

The review of literature has suggested that e-learning readiness and student engagement are significantly and positively related. For instance, Gay and Dringus in (2012) conducted a conference on e-learning explored the technological e-readiness levels of instructors and effectives in the online learning. Results indicated that e-readiness of instructors was the significant predictor of e-learning effectives of system i.e. system design, system delivery, and system outcomes. User satisfaction was also reported as the significant predictor. Therefore, for an e-learning system to be successful e-readiness is significant variable. Similarly, in order to get students' engaged in e-learning system it is asserted that e-learning readiness is a significant predictor. For example, a study conducted was by Parkes, Stein, and Reading (2015) claimed that students who are unprepared are less likely to take part in online learning and utilize critical thinking skills. Researchers explored the perceptions about the online learning readiness among university students using learning management system (LMS). The findings of the research study demonstrated that participants were ready to engage in online learning conditions; however they were not ready for other activities such as being clear and precise in responses, planning methodologies, reading and writing, arranging ideas, having discussions, and working with other learners.

Similarly, Hong and Gardner (2018) revealed that e-readiness includes factors which included self-efficacy, digital competence, self-regulation, and social competence. Furthermore, they claimed that decreased level of readiness has a significant influence on the engagement level of learners and depth of learning. Research study conducted by Kim, Hong, and Song (2019) investigated the learners' perceptions of e-learning on their academic achievement with digital readiness and academic engagement acted as mediators. Sample comprised of 614

undergraduate students. Findings indicated that digital readiness and academic engagement were significantly and positively related. Moreover, digital readiness and academic engagement were reported as the significant mediators in students' perception of e-learning and academic achievement.

Prihastiwi, Prastuti, and Eva (2020) determined the effects of e-learning readiness on student engagement on a sample of 125 students from different faculties. Findings of their research manifested that e-learning readiness (ELR) significantly predicted student engagement. Moreover, all the sub-dimension of ELR specifically self-directed learning was the highest predictor of student engagement then computer or internet self-efficacy and online communication self-efficacy. Furthermore, a research study administered by Sengsouliya et al. in (2020) explored the predictors of academic engagement. Study comprised of 71 senior high schools students. Findings indicated that students had increased levels of academic engagement. Moreover, it was reported that peer interaction (which is also the sub-dimension of e-learning readiness) was a significant factor contributed to student engagement.

A more recent study conducted by Jiang, Meng, and Zhou (2021) determined the association among readiness of students in flipped learning, and motivation and engagement along with attitude as a moderator. Study included large sample of 6364 English students from 11 universities of china. Findings indicated that students have high level of readiness for flipped learning. Moreover, results of the research reported that attitude and environmental support moderated the relationship between readiness of students and motivation and engagement.

Role of Self-Directed Learning and E-Learning Readiness in Student Engagement

Kim, Hong, and Song (2019) investigated the roles of academic engagement and digital readiness in learners' achievements in university e-learning conditions. Results indicated that digital readiness mediated the associations among e-learning adoptions, e-learning attitude and academic engagement. Moreover, digital readiness and academic engagement mediated the associations among e-learning adoptions, e-learning attitude and academic achievement.

In a study conducted by Schweder (2019) investigated the role of control strategies, self-efficacy, and learning behavior in self-directed learning. Findings indicated that control strategies (a metacognitive aspect of self-directed learning) partially mediated the association of self efficacy with effort investment and absorption while control strategies fully mediated the relation of self-efficacy and elaboration.

Research study by Samavi and Najjarpourian (2019) examined the associations among academic engagement, academic motivation, and self-regulation with academic performance along with self-directed learning as a mediator. Study included 390 high school students as sample. Findings indicated that significant relationship existed among academic engagement, academic motivation, and self-regulation with academic performance. Findings also manifested that self-directed learning significantly mediated the association of academic engagement and academic performance.

Osman, Mohamad, and Mohamad (2021), explored the role of digital readiness as a mediator in the relation of e-learning attitude and online engagement. Results indicated that e-learning attitude predicted digital readiness and digital readiness predicted online engagement. Moreover, results further indicated digital readiness acted as a mediator in the association of e-learning attitude and online engagement.

Kara (2021) investigated the role of learners' characteristics in their engagement in the time of pandemic. Results showed that learners' characteristics i.e. digital literacy, self-directed learning and motivation predicted online learner engagement significantly. Moreover, self-directed learning and motivation significantly mediate the association of digital literacy and engagement.

Demographics (Gender & Age) Related Studies Regarding ICT self-efficacy

Gender

According to previous literature there are mixed findings regarding gender differences in ICT self-efficacy. For example, a study conducted by Durndell and Haag (2002), reported positive correlation existed among computer self-efficacy, computer attitude, computer experience while negative relation of computer anxiety with other three variables. Moreover, males reported high computer self-efficacy as compared to females. Similarly, Hargittai and Shafer in (2006) explored the role of gender differences in actual and perceived online skills. Findings indicated that men's self-perceived online abilities are significantly higher than women's self-perceived online abilities. Another study conducted by Tømte and Hatlevik (2011) explored gender related differences in ICT self-efficacy and ICT user profile in Finland and Norway. Findings indicated that the two countries have variations in their self-efficacies in ICT. Male participants in Finland reported high ICT self-efficacy in internet and high level tasks in comparison with female participants. While, in Norway female reported increased ICT self-efficacy in internet tasks and males reported increased ICT self-efficacy in high level tasks.

Yau and cheng (2012) explored gender related differences in confidence in technology usage for learning. Findings indicated that male participants have more confidence in using technology as compared to female participants. Another study conducted by Janneck, Vincent-

Höper and Ehrhardt (2013) on a sample of 1100 highly qualified computing professionals, explored the gender differences on computer related self-concept. Findings indicated that males have more positive computer related self-concept than females. Another, study was conducted by Bao et al. in (2013) explored the gender differences in general computer self-efficacy and specific computer self-efficacy on a sample comprised of 137 students of university in Wuhan. Findings showed that males scored higher on general computer self-efficacy while no gender differences were emerged on specific computer self-efficacy.

Another study conducted by Hohlfeld, Ritzhaupt, and Barron (2013) comprised of eighth grade students. The t-test analysis revealed that significant age related differences exist among males and females. Further, findings revealed that females scored higher in perceived ICT skills. Moreover, females have better attitudes toward computers. Similarly, a research executed by Shen et al. (2013) explored the association in online learning self-efficacy and learning satisfaction along with role of gender in online learning self-efficacy. Sample consisted of 406 graduate and undergraduate students registered in online courses. Findings revealed that female learners attained increased scores as compared to male learners. Moreover, online learning self-efficacy significantly predicted learning satisfaction. Furthermore, International Computer and Information Literacy Study (ICILS) (2013) reported that significant gender differences exist on basic ICT self-efficacy and advanced ICT self-efficacy. Findings revealed that females scored higher on basic ICT self-efficacy than males. Whereas, males scored higher on advanced ICT self-efficacy scale (Fraillon et al., 2014).

Research conducted by Scherer and Siddiq (2015) investigated gender related disparity in computer self-efficacy among teachers. Findings of the study indicated that male teachers scored higher computer self-efficacy in basic and advanced operational skills than female teachers. Cai

et al. in (2017) conducted meta-analytic research to explore the gender related differences in attitude towards technology use. Findings indicated that males have more positive attitude towards technology use as compared to females although this difference was small in dimensions of self-efficacy and affect. Similarly, a meta-analytic study conducted by Borokhovski (2018) explored gender differences in ICT perceptions. Findings revealed that males have more positive attitude towards technology as compared to females although this gap has been narrowing from the previous meta-analytic research studies.

In a more recent research conducted by Ejdys in (2021) explored the factors that influence e-learning adoption on a sample comprised of 982 students who responded to an online survey. Findings showed that males had higher scores on computer self-efficacy as compared to female students. Similarly, another study conducted by Gnambs (2021) explored gender related differences in ICT self-confidence and ICT literacy. The study included large sample of around thirteen thousand middle adolescents. Findings indicated that male adolescents had higher ICT self-confidence than female adolescents. However, small gender differences emerged on ICT literacy in favor of male adolescents at the age of 18.

Age

Simsek (2011) administered a research study to determine the association between computer anxiety and computer self-efficacy on a sample comprised of 845 teachers and students of elementary and secondary schools. Findings demonstrated that computer self-efficacy was significantly and negatively associated with computer anxiety. Moreover, findings showed that male learners have more self-efficacy scores in accordance with female students. Also results showed that elementary school pupils have more self-efficacy scores than secondary school pupils. However, another study conducted by Aesaert and Braak in (2014) determined the

factors that were associated with ICT self-efficacy of primary school pupils. Findings exhibited that ICT self-efficacy did not correlated with age significantly. Moreover, findings indicated that ICT self-efficacy is a student or pupil phenomenon instead of classroom or school phenomenon.

Another study conducted by Jan (2015) showed contrasting results. Sample comprised of 103 graduate students. The results indicated that male and female participants scored same on computer self-efficacy. However, participants over the age of thirty five and above showed higher scores on computer self-efficacy as compared to participants' age ranged from eighteen to thirty four.

Demographics (Gender & Age) Related Studies Regarding Self-Directed Learning

Gender

Gender related studies regarding self-directed learning are contrasting. Some studies indicated males having more self-directed learning than females and while others reported vice versa or no significant differences in gender. For example, a study conducted by Carson (2012) explored self-directed learning among secondary school learners of online courses. Findings indicated that no significant gender related differences were emerged on self-directed learning while significant difference emerged on grade level of students although the difference was very small. Similarly, a study conducted by Demir et al. in (2014) explored relationship between attitude towards computer and self-directed learning with technology among secondary and middle school students reported that attitude towards computer was strongly and positively related with self-directed learning with technology. Moreover, results indicated that male and female participants scored same on self-directed learning. However, a study accomplished by Kar et al. in (2014) explored self-directed learning readiness where sample comprised of 87

MBBS students from fifth semester. Findings revealed that males had more self-directed learning readiness as compared to female students.

Research study conducted by Asfar and Zainuddin (2015) explored the perceptions of students' ICT use in promoting self-directed learning among secondary schools students. Findings revealed that female participants had higher self-directed learning abilities as compared to males although the significance was not that high. Moreover, urban students reported more self-directed learning students as compared to rural students. However, a research accomplished by Said et al. (2015) examined self-directed learning readiness, sample in their research comprised of 91 nursing undergraduate learners in Peshawar, Pakistan. Results showed that undergraduates have acceptable levels of self-directed learning. Moreover, male undergraduates scored higher on self-directed learning skills as compared to female undergraduates.

Tekkol and Demirel (2018) in a research explored self-directed learning skills of undergraduate pupils. Findings demonstrated that female pupils scored higher on self-directed learning skills as compared to male pupils. Similarly, Swart (2018) explored that the level of self-directed learning same in undergraduate African Americans reported that they do not have same level of self-directed learning in undergraduates. Moreover, females reported as high self-directed learners as compared to males. Furthermore, a research administered by Zeb et al. (2018) explored gender differences in self-directed learning readiness among Pakistani pupils of medical college. Results revealed that significant gender related differences were not emerged among medical pupils. Similarly, a study by Hussain, Sabar and Jabeen (2019) examined relationship between self-directed learning readiness and academic achievement among Pakistani prospective teachers. Results showed that prospective teachers had increased self-directed

learning readiness. Though, male and female prospective teachers indicated no significant gender disparity in self-directed learning scores.

A more recent study conducted by Demir and İlhan (2022) determined self-directed learning among online undergraduate students. Findings indicated that female undergraduates have more self-directed learning skills as compared to male undergraduates. Moreover, it was reported that junior undergraduates have significantly higher metacognitive skills as compared to senior undergraduates. Another recent study conducted by Labonté and Smith (2022) explored perception of middle school students about their self-directed learning skills and collaborative learning skills with or without technology. Findings revealed that students are engaging in self-directed learning and collaborative learning depending on the quality of instruction. Moreover, it was reported that small significant effect favored female participants on self-directed learning without technology, while no significant gender difference emerged on self-directed learning with technology among male and female participants.

Age

A study led by Yuan et al. (2012) examined self-directed learning readiness among students of nursing in china, on a sample comprised of 536 students. Findings of the research indicated that 63.3% participants had increased self-directed learning readiness scores whereas 37.7% had low level self-directed learning skills. Moreover, findings also demonstrated that senior students scored high on self-directed learning in comparison with junior students. Another study conducted by William et al. in (2013) explored self-directed learning readiness levels of paramedic students. Findings of the research indicated that paramedic undergraduates had adequate levels of self-directed learning. Moreover, results exhibited that self-directed learning had strong link with age. Self-directed learning of undergraduates increases as they matured.

On contrary, a study conducted by El-Gilany and Abusaad in (2013) determined the association in self-directed learning and learning style among undergraduates in Saudi Arabia. Findings showed self-directed learning was not significantly associated with learning styles. Moreover, no significant difference occurred on age and gender. Similarly, another study conducted by Said et al. in (2015) explored self-directed learning readiness and research sample comprised of 91 nursing undergraduate learners in Peshawar, Pakistan. Finding revealed that undergraduates have acceptable levels of self-directed learning. Moreover, results showed that no significant age related differences were found.

Another study administered by Slater, Cusick, and Louie in (2017) explored the associations in self-directed learning and demographic variables. Sample of their research comprised of 407 undergraduate students from different health professions. Findings indicated that older students had increased self-directed learning scores as compared to younger students. Moreover, females scored increased self-directed learning skills in accordance with males. Furthermore, a study conducted Agonács and Matos (2019) explored self-directed learning in a population of Massive Open Online Course (MOOCs) learning environment. Result indicated that self-directed learning was significantly related with age. Self-directed learning scores were higher among older learners.

Demographic (Gender & Age) Related Studies in E-Learning Readiness

Gender

Gender related studies in e-learning readiness have mixed findings. For instance, a research accomplished by Lau and Shaikh (2012) explored the effect of demographic variables on readiness for online learning among 304 university students. Findings indicated that no significant gender related differences emerged on readiness for online learning. Similarly,

another study conducted by Achukwu et al. in (2015) explored associations among computer self-efficacy, computer related technology dependence and online learning readiness on a sample of 129 undergraduates. Findings revealed that CSE was significantly associated with online learning readiness. Moreover, results showed that significant gender related difference were not existed in male and female participants' scores in online learning readiness. However, a research executed by Formoso (2017) explored e-learning readiness among tertiary level students. Findings revealed that students have moderate levels of readiness for e-learning. Moreover, female participants have increased levels of e-learning readiness as compared to male participants. Furthermore female students on high level of education scored significantly higher than male students.

Contrarily, Coşkun et al. (2018) administered a study and investigated e-learning readiness among students of medical in Turkey. Findings showed that medical students have adequate levels of e-learning readiness. Students who had more interaction with internet for academic purposes had significantly higher levels of e-learning readiness. Moreover, male learners had more e-learning readiness than female learners. Another study conducted by Yilmaz, Sezer, and Yurdugül in (2019) explored e-learning readiness on a large sample comprised of 5021 students. Findings indicated that students had increased levels of e-learning readiness. Moreover, it was reported that males had higher scores of e-learning readiness than females. Similarly, another study conducted by Bubou and Job in (2020) investigated the role of e-learning self-efficacy in e-learning readiness among university students of Nigeria. Results showed that e-learning self-efficacy was significantly correlated with e-learning readiness. Moreover, results showed that males scored higher on e-learning readiness as compared to female students.

Similarly, Firat and Bozkurt in (2020) explored demographic variables as indicators in online learning readiness in distance and open learning university. Findings showed that online learning readiness has significant association with preferred technological devices of Open and Distance Learning students. Moreover, further it was revealed that females scored significantly higher in online learning readiness as compared to male participants. Furthermore, Chung, Subramaniam, and Dass (2020) explored online learning readiness among 399 Malaysian students of university. Findings indicated that female students scored higher as compared to male university students. Another study conducted by Chung, Noor, and Mathew in (2020) explored online learning readiness on a sample of 91 students of university. Findings manifested that learners had high levels of readiness for internet/computer self-efficacy, moderate for self-directed learning dimension and low level for online communication self-efficacy. Moreover, results showed not significant gender disparity among male and female students.

A study conducted by Elçiçek and Erdemci in (2021) determined the association between 21st century competencies and e-learning readiness. Sample comprised of 2100 learners of different age groups. Findings indicated that 21st century skills and e-learning readiness were significantly and positively correlated although the correlation was weak. Moreover, female learners had increased levels of e-learning readiness as compared to male learners. A more recent study conducted by Ulaş (2022) explored the impact ICT instruction on E-learning readiness and gender differences among pre-service teachers. Findings demonstrated that e-learning readiness was significantly related with ICT instruction. However, it was reported that no significant gender related difference was emerged among male and female participants.

Age

Formoso (2017) explored e-learning readiness among tertiary level students. Findings revealed that students have moderate high level of readiness for e-learning. Moreover, results indicated that older participants scored high on e-learning readiness as compared to younger students. Furthermore, students on high level of education scored significantly higher than male students. Similarly, another study by Adams et al. in (2018) explored e-learning readiness (ELR) in higher education institutions of Malaysian students. Finding revealed that students had acceptable levels of e-learning. Significant age related differences were reported, older students were more confident and independent as compared to younger students below 29 years of age, while younger students had more interaction with mobile technologies as compared to older students above 29 years.

Firat and Bozkurt (2020) investigated variables in e-learning readiness (ELR) in distance and open learning university students. Findings showed that significant relation existed between ELR and time spent online. Moreover, findings showed that participants over the age of 35 scored significantly higher than the students below 35. Further it was reported that female students have significant high scores in online learning readiness than male students.

A study conducted by Rafique et al. in (2021) examined readiness for online learning on a sample comprised of 340 library and information management students in Pakistan during pandemic. Results indicated that students were not fully ready for online learning although they were confident about their technological skills and motivated. Moreover, significant age related differences were reported in two dimensions of computer/internet self-efficacy and online communications self-efficacy; illustrating those older students had more skills related to computer and internet and to use these skills for communication.

Demographic (Gender & Age) Related Studies in Student Engagement

Gender

A review of literature has suggested that most of the recent literature have not reported significant influence of gender, while others reported females showing more engagement as compared to males. For example, a study conducted by Ituma (2011) investigated the perceptions and engagement of students in e-learning components with the sample of 80 students. Findings revealed that mostly university learners had positive perception about e-learning and their e-learning usage was also higher. Moreover, no significant difference of gender, age and nationality was indicated. Contrarily, a research executed by Lietaert et al. in (2015) explored gender differences in student engagement on a sample comprised of 385 secondary school students. Findings indicated that girls had higher engagement as compared to male students. Similarly, a meta-analytic study conducted by Lei, Cui and Zhou in (2018) explored the association in student engagement and academic achievement. Findings revealed that a significant strong positive association existed in student engagement and academic achievement. Moreover, moderation analyses showed that with the increase of female participants the association of student engagement and academic achievement became strong, while male participants weakened the correlation of student engagement and academic achievement.

Research accomplished by Santos et al. (2021) explored the role of emotional regulation strategies on student engagement and mediating role of age and gender. Findings revealed that students have medium levels of engagement and used more adaptive emotional regulatory strategies than maladaptive strategies. Moreover, females scored higher on student engagement as compared to male students. Whereas, another recent study conducted by Krasodomska and Godawska in (2021) investigated the role of students characteristics on student engagement and

performance. Findings indicated that positive relationship existed between student engagement and performance and student engagement had positive effect on performance. Moreover, results revealed that significant gender related differences were not present among male and female students. However, average scores of females showed that they were more engaged as compared to male students in online courses.

Kew and Tasir (2021) examined the cognitive engagement of students in a discussion forum of e-learning through content analysis. Results indicated that 50% of the participants reported decreased level of engagement. Moreover, findings showed that no statistically significant relationship existed between gender and student engagement. Similarly, another study conducted by Al-Nimer and Alsheikh in (2021) explored the relationship between student engagement and accounting professional competencies (APCs) and mediating role of e-learning as well as moderating role of demographic variables (gender & age). Findings revealed that significant relationship existed between student engagement, e-learning and APCs along with partial mediating role of e-learning. Whereas, moderating role of demographic variables was insignificant. Chan et al. in (2021) determined the relation of online learning engagement and learning satisfaction on a sample comprised of 56 students. Findings indicated that online learning engagement and learning satisfaction were positively and significantly correlated. Moreover, findings also showed that no significant gender related differences were emerged between male and female students.

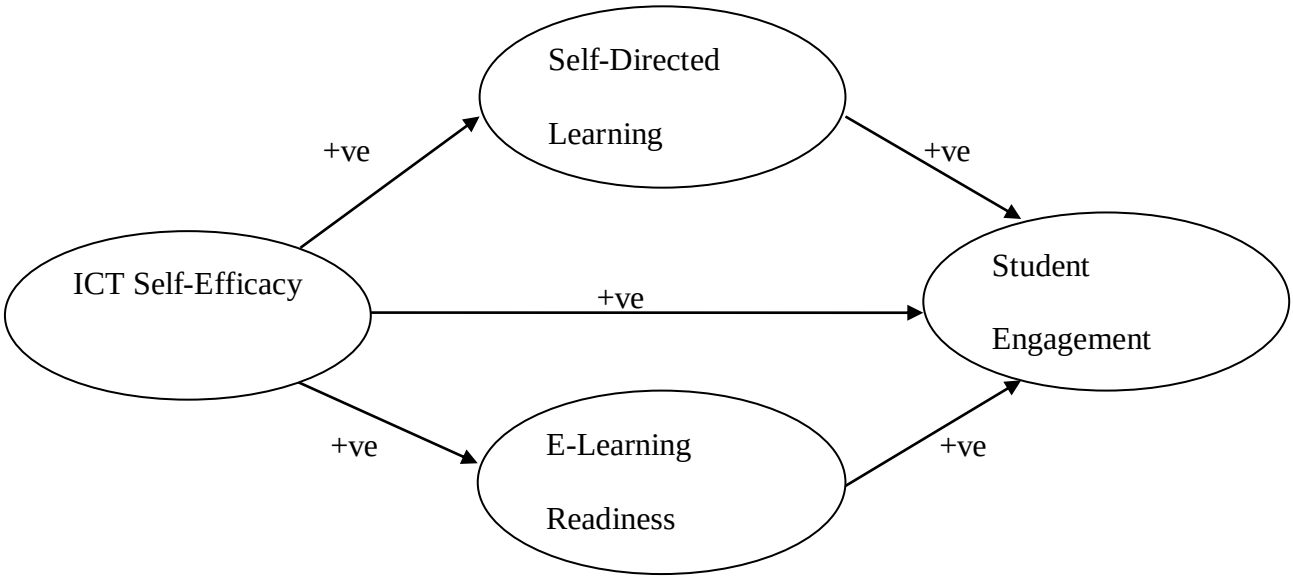
Age

A study conducted by Diemer, Fernandez and Streepey in (2012) examined students perception about their engagement and learning using iPads. Findings revealed that students who reported high level of engagement have high level of learning as well. Moreover, it was further

revealed that no significant age related differences found in engagement levels of students. Gender and language also did not influence engagement and learning. Another study conducted by González and Glasserman-Morales in (2020) investigated the factors that affect student engagement and completion rates in Massive Open Online Course (MOOC) among Mexican students. Findings indicated that students who were older than 33 years had more completion rates than other younger age groups. Moreover, it was reported that students who had master's degree or bachelor's degree and full time jobbers were more engaged in MOOC with more completion rates.

Santos et al. in (2021) administered a research study on the role of emotional regulation strategies in student engagement and mediating role of age and gender among adolescents. Findings showed that students had adequate levels of engagement and used more adaptive emotional regulatory strategies than maladaptive strategies. Moreover, late adolescents and younger adolescents scored higher on student engagement as compared to middle adolescents. Adaptive emotional regulation strategies related with student engagement at different ages. Furthermore, a study conducted by Cole, Lennon and Weber in (2021) explored the predictive role of students' perception about active learning practices and online learning climate on student engagement. Results showed that active learning practices were the positive predictor of student engagement while uncertainty about social belonging in college negatively related with student engagement. Moreover, finding revealed that age was the positive predictor of student engagement. This means as the age increases student engagement will also increase.

Proposed Model



Rationale of the Present Study

The emergency shift of e-learning system from face-to-face classical learning system due to pandemic situation in Pakistan and the world over has brought insights to explore and incorporate such abilities in students or learners that would help them to enhance their engagement in e-learning environment. Therefore, the present research was intended to investigate the role of student's personal characteristics/ abilities i.e. ICT self-efficacy (ICTSE) and self-directed learning (SDL) in e-learning readiness (ELR) and student engagement (SE). It was significant to consider the effects of ICT self-efficacy and self-directed learning ability of learners to alter social changes and enhance their learning competitiveness. Moreover, the present study helped students to cultivate ICT self-efficacy and self learning ability, which could further help students to be prepared to adopt e-learning to adapt from face to face learning to e-learning system self-directed learning and eventually, their greater engagement in e-learning would result in less dropout and more academic success. Furthermore, current study provided

insights to administrators to design such structures in e-learning systems that enhance students' abilities, which could help them even after the pandemic and to deal with such emergency situations in future.

It is asserted that students judgment about their abilities play important role in the choice of their activities they perform and their environmental settings. They avoid such activities that exceed their capabilities and choose those they consider themselves of being proficient (Bandura, 1977; Meng et al., 2019). Hence, for a learner self-efficacy is a vital aspect to engage in e-learning environment and it is also a significant personal characteristic of a learner. Therefore, for e-learning context it is significant to consider task specific self efficacy i.e. ICT self-efficacy than general self-efficacy. There is scarcity of literature which explored computer self-efficacy (CSE) as the significant determinant of e-learning adoption in our local context (Kanwal & Rehman, 2017). However, studies specifically exploring ICT self-efficacy in the prediction of student engagement in e-learning environment are very scarce in local literature. Therefore, the present study was aimed at finding out the associations of ICT self-efficacy along with self-directed learning and e-learning readiness in student engagement. The current research could fill the gap by developing new knowledge and relationships between study variables.

There have been many research studies on self-directed learning for several decades, but context has changed with the emergence of e-learning system, as this learning system exhibits higher access to technology and demands more self-directed learning experiences. SDL has always been a pertinent skill and with the higher access to technology, it has provided researchers new opportunities for further exploration under the current e-learning contexts (Fahnoe & Mishra, 2013). Allen and Seaman (2005) asserted that learners in e-learning courses require more self-discipline to achieve success as compared to their counterparts in traditional

and face-to-face learning. Learners also need to become more responsible in e-learning system as there is no direct interaction with peers, instructors, and other campus resources (Kember, 1995; Boyles, 2000; Summers, 2003; LaPointe & Reisetter, 2008). Therefore, it was significant to know about students' self-directed learning and its role to make them successful in e-learning. Moreover, none of the research study in our local context investigated the self-directed learning with other study variables under one framework. Additionally, researches in the area of Self-directed learning are centered on adult learning with little attention on adolescent students. The present research was centered on adolescent students and technology rich environment that could help influence the development of SDL.

The utilization of e-learning or distance learning has increased multiple times in training and education sector, so it is significant to explore the readiness of pupils for e-learning in order to direct them to the challenges and opportunities presented by the medium of delivery systems (Leigh & Watkins, 2005). Therefore, in the success of e-learning the first step is to explore the role of e-learning readiness of learners to shift from face to face learning to e-learning in order to deal with the challenges of pandemic and adjust to the e-learning environment. Moreover, most of the research studies conducted on e-learning context have determined the levels of e-learning and attitude towards e-learning in the recent literature in Pakistan (for example see, Rafiq, Hussain & Abbas, 2020; Abbasi, Ayoob, Malik & Memon,2020; Alhumaid, Ali, Waheed, Zahid & Habes, 2020). Furthermore, we have found just one study in our local context that investigated the readiness of online learners but the sample comprised of just one discipline (Library and information sciences) of adult students that cannot be generalized to students of other discipline (Rafique, Mahmood, Warraich, & Rehman, 2021), therefore, the present research study was executed for investigating the role of learner's characteristics along with e-learning readiness in

student engagement among adolescent students as learners must be prepared to use e-learning conditions since it is an alternative method to have access to learning.

Previous literature has claimed that sustained student engagement is an essential construct for learners regarding their accomplishments in e-learning environment (Phipps & Merisotis, 1999; Street, 2010; Fredrickson, 2015; Wolverton, 2018). Learners who have confident attitudes regarding e-learning and adapt to its challenges actively are still required to make effort and remain committed for utilization of digital resources (Kim, Hong & Song, 2019). Therefore, it would be significant to explore student engagement in e-learning context to alter the social changes and enhance their learning competitiveness. As there is continuous growth of distance learning, still attrition rates have increased frequently from 10%-20% for online learning as compared to classical learning environments (Holder, 2007; Nash, 2005). Researchers stated that online learning conditions can bring out opportunities or barriers for student engagement based on learners' traits (Wolverton, Hollier & Lanier, 2020). Therefore, it was significant to find out student engagement among adolescents in e-learning environment and the role of students' characteristics in student engagement to check whether it creates barriers or opportunities in our local context. Moreover, various researchers have claimed that a learner's judgment about their capabilities to utilize digital technology is primary factor in examining their level of engagement in technology based learning environments (e.g. see, Tzeng, 2009). Therefore it was significant to find out the role of student's individual characteristics in engagement in e learning environment.

Hence, after reviewing the significance of study's constructs, the aim of current research was to explore the correlation among study variables. Secondly, current study explored the role of self-directed learning and e-learning readiness in student engagement. Moreover, there were

mixed findings regarding the gender differences on study variables. Therefore, in that perspective, the present study also explored different demographic variables within our local context. Furthermore, in the present research sample was comprised of adolescent students, who are more habituated to face to face and teacher-centered learning. This study could help educators to endorse self-learning abilities in students at initial stage to cope with challenges and get benefits from evolving educational competencies. In our local context, the literature regarding e-learning was more qualitative in nature than quantitative. Therefore, the present study provided empirical evidence to policy makers to recognize role of students' characteristics in e-learning readiness and student engagement in e-learning system.

Chapter-II

Method

Objectives

1. The first objective of the current research study was to investigate the associations among ICT self-efficacy, self-directed learning, E-learning readiness, and student engagement.
2. The second objective of the current research study was to investigate the role of self-directed learning and e-learning readiness in the relationship of ICT self-efficacy and student engagement.
3. The third objective of the current research study was to investigate the Gender and Age related differences on study variables.

Hypotheses

1. There is a positive association between ICT self-efficacy and student engagement.
2. There is a positive association between ICT self-efficacy and self-directed learning.
3. There is a positive association between ICT self-efficacy and E-learning readiness.
4. There is a positive association between Self-directed learning and student engagement.
5. There is a positive association between E-learning readiness and student engagement.
6. Self-directed learning mediates the relationship between ICT self-efficacy and student engagement
7. E-learning readiness mediates the relationship between ICT self-efficacy and student engagement.
8. Female adolescents will score high on ICT self-efficacy as compared to male adolescents.

9. Female adolescents will score high on self-directed learning as compared to male adolescents.
10. Female adolescents will score high on E-learning readiness as compared to male adolescents.

Operational Definitions of Variables

ICT Self-Efficacy

In present study, self efficacy has measured on ICT self-efficacy scale (ICTSES; Alahakoon & Somaratne, 2020). Higher scores indicated higher ICT self-efficacy; lower scores indicate lower ICT self-efficacy.

Self-Directed Learning

In the current study, self-directed learning has measured on Self directed learning with technology scale (SDLTS; Teo et al., 2010). Higher scores indicated higher levels of perception of one's self-directed learning with technology, whereas lower scores indicated lower levels of perception of one's self-directed learning with technology.

E-Learning Readiness

In the current study, e-learning readiness has measured on e-learning readiness scale (ELR, Alem et al., 2016). High scores showed higher levels of E learning readiness, whereas lower scores showed lower levels of E- learning readiness.

Student Engagement

In the current study, student engagement has measured on student engagement in e-learning environment (SES; Lee, Song, & Hong, 2019). Higher scores showed higher levels of Student engagement, whereas lower scores showed lower levels of Student engagement.

Instruments

ICT Self-Efficacy Scale (ICTSES)

This scale was developed by Alahakoon and Somaratne (2020), and it comprised upon 23 items. It is a 5-point Likert scale ranged from (Not at all confident = 1) to (Very confident = 5). Author reported Cronbach's alpha reliability estimate for the scale was α=.94. For the current research Cronbach's alpha reliability coefficient was α=.93, which indicated that scale was highly reliable.

Self-Directed Learning with Technology Scale (SDLTS)

This scale was developed by Teo et al. (2010), comprised of 6 items which are divided into two factors i.e. self-management (item numbers 1, 2) and intentional learning (3, 4, 5, & 6). It is a 6-point Likert scale ranged from (All the time=6) to (Not at all=1). Author reported the Cronbach's alpha reliability estimate for the scale was α=0.63 for self-management and α=0.85 for intentional learning. For the current research, the total SDLTS Cronbach's alpha reliability coefficient was α=.79 and for its subscales; self-management α=.52, intentional learning α=.84, which indicated that scale demonstrated good reliability.

E-Learning Readiness Scale

This scale was developed by Alem et al. (2016), comprised upon 17 items which are divided into 5-dimensions. Self-competence and its items (1, 2, 3) , Self-directed learning (4, 5, 6, 7, 8), Motivation (9, 10, 11), Financial (12, 13, 14) and Perceived usefulness (15, 16, 17). It is a 7-point Likert scale ranged from (strongly disagree=1) to (strongly agree=7) with (neutral=4). Author reported the Cronbach's alpha reliability estimate for the scale was α=.96 for self competence sub-dimension, α=.91 for self-directed learning sub-dimension, α=.76 for motivation, α=.75 for financial and α=.94 for perceived usefulness sub-dimension. For the

current research, the Cronbach's alpha reliability coefficient for total scale was α=.88; for its subscales self competence α=.71, Self-directed learning α=.83, motivation α=.79, financial α=.51 and for perceived usefulness α=.88, which indicated that scale was highly reliable.

Student Engagement Scale in E-Learning Environment

This scale was developed by Lee, Song, and Hong (2019), comprised upon 24 items. This scale is further divided into 6 factors; Psychological motivation and its items (1,2,3,4,5,6), Peer collaboration (7,8,9,10,11), Cognitive problem solving (12,13,14,15,16), interactions with instructors(17,18), community support (19.20,21), and learning management (22,23,24). A 5-point Likert scale ranged from (strongly agree=1) to (strongly disagree=5). Author reported the Cronbach's alpha reliability estimate for the scale was α=.89 for psychological motivation, α=.88 for peer collaboration, α=.83 for cognitive problem solving, α=.76 for interactions with instructors, α=.82 for community support, and α =.72 for learning management. For the current research study, the total Cronbach's alpha reliability coefficient of scale was estimated as α=.95; for subscales i.e. psychological motivation α=.85, peer collaboration α=.82, cognitive problem solving α=.91, interaction with instructor α=.86, community support α=.88, learning management α=.77, which indicated that scale was highly reliable.

Research Design

For the present research a cross-sectional research design was adopted. Current research explored the relationship among ICT self-efficacy (ICTSE), self-directed learning (SDL), e-learning readiness (ELR) and student engagement (SE). Four questionnaires were used for data collection on the sample of 300 adolescent students. The current research was comprised upon two phases; the first phase of the research was pilot study and the second phase was main study.

Phase-I: Pilot Study

This phase of the research was intended to find out the alpha reliability values of scales and for checking the participants' understanding about the scales i.e. ICT self efficacy scale, self-directed learning with technology scale, e-learning readiness scale and student engagement scale. The sample comprised of (N=100) students (both males, n=44; females, n=56) divided into two age groups (middle & late adolescents). Age of sample ranged from (15 to 21) and it was selected randomly from different public and private schools and colleges of Rawalpindi and Islamabad. A special permission from Federal Directorate and principals of different schools and colleges (public & private) has been taken. Information was given to the participants about the nature and objectives of the research and prior to the administration of four scales an informed consent was obtained.

Phase-II: Main Study

The main study was intended to find out the primary objectives of the research study which were; to determine the relationship among ICT self-efficacy, self-directed learning, e-learning readiness and student engagement. To determine the demographic related differences (Gender & Age) on variables of study. Another primary objective of the research was to investigate the role of self-directed learning (SDL) and e-learning readiness (ELR) in the association of ICT self-efficacy (ICTSE) and student engagement (SE) among adolescents. During this phase of research, sample comprised of N=300 (males, n=144; females, n=156) adolescents with two age groups (middle adolescents & late adolescents), while the age of the adolescents ranged from 15 -21 years.

Sample

For the present study sample consisted of total (N=300) adolescents and for sample selection convenient based sampling technique was implied. Further, data was divided on the basis of gender (N=300; males, n= 144; females, n= 156) and age groups (middle adolescents, n= 164; late adolescents, n= 136) with age ranged from (15-21). Students approached for data collection from various schools, colleges, and Universities of twin cities (Rawalpindi & Islamabad).

Inclusion Criteria

- For the current study only those adolescent students who were enrolled in schools, colleges and Universities has been approached for data collection.
- For the current study, researcher has been approached adolescents only from urban areas of twin cities (Rawalpindi & Islamabad).
- Two age groups of adolescents (middle adolescents & late adolescents) have been approached for data collection.

Exclusion Criteria

- Adolescents who have not attended online classes were not included.
- Adolescents with any Psychiatric or mental problem were not approached.

Procedure

Initially, researcher has selected a sample of students (N=300) including both male and female adolescents whose age ranged from of 15 to 21 from various schools, colleges, and Universities of twin cities (Rawalpindi & Islamabad). Sample has been selected from Rawalpindi

and Islamabad after approval from the higher authorities of schools, colleges, and Universities. At first, informed consent was given to the students and after their agreement, a booklet of demographic information sheet along with four scales, ICT self-efficacy scale, Self-directed Learning with Technology scale, E Learning readiness Scale, and Student Engagement measure in e-learning environment was administered. Participants were given complete instructions before distributing questionnaires. They were briefed to rate each item in accordance with their opinion and asked them to make sure that no item is left unanswered. Eventually, participants were appreciated for their cooperation during the research.

The Head of the institute and the class teacher were specially appreciated for their cooperation before leaving the centre. All responses were entered on SPSS-21 and following analyses were executed in order to achieve the objectives of the research. Descriptive were computed to check the psychometric properties and normality of data. In order to check the relationship among variables of study, Pearson Product Moment Correlation was performed. After that for checking the group differences (Gender & Age) t-test was computed. To check the direct effect on variables, Regression was computed. At the end, to check the role of self-directed learning and e-learning readiness in the relationship between ICT self-efficacy and student engagement mediation analyses were performed.

Chapter-III

Results

Pilot Study

Objective

- The objective of pilot research was to examine the alpha reliability values of the scales and understanding of the participants regarding the scales.

Table 1

Details of Sample Characteristics of Pilot Study (N=100)

Sample characteristics	Categories	Sample (N=100) *f %*
Gender	Males	44 (44)
	Females	56 (56)
Age group	Middle adolescents	39 (39)
	Late adolescents	61 (61)
Socioeconomic status	Upper class	18 (18)
	Middle class	77 (77)
	Lower class	5 (5)

The above table shows the demographic details of pilot research variables (Gender, age & socioeconomic status) of total sample (N=100). It comprised of 44% male adolescents and 56% female adolescents. The study comprised of 39% middle adolescents and 61% late adolescents. Further, data shows 18% upper class, 77% middle class, and 5% lower class adolescent students. Most of the adolescent students are of middle class.

Table 2

Descriptive statics and alpha reliability coefficient of the study variables for Pilot Study (N=100)

Scales/dimensions	No. of items	M	SD	α	Range		Skewness	Kurtosis
					Actual	Potential		
ICTSE	23	86.36	19.23	.93	31-115	23-115	-.57	-.05
SDL	6	25.27	6.40	.79	6-36	6-36	-.56	.17
SM	2	6.76	2.78	.52	2-12	2-12	.06	-.83
IL	4	18.51	4.68	.84	4-24	4-24	-.78	.19
ELR	17	81.86	16.19	.88	44-119	17-119	-.20	-.22
SES	24	75.93	18.06	.95	28-120	24-120	-.12	.66

Note. ICTSES = ICT self-efficacy scale, SDLTS = Self-directed learning with technology scale, SM = Self-management, IL= Intentional learning, ELRS= E-learning readiness scale, SES= Student engagement scale.

The above table shows descriptive statistics of the pilot study, which include mean (M), standard deviation (SD), Alpha coefficients (α), range, Skewness and Kurtosis on a small sample of study variables (N=100). Data were normally distributed thus conforming for regression as all the values of Skewness and kurtosis are within the range of -1 to +1.

Discussion

The pilot study was executed to examine the alpha reliability values of scales (ICT self-efficacy scale, Self-directed learning with technology scale, E-learning readiness scale and student engagement scale) and understanding of participants regarding the scales. The sample comprised of (N=100) with the age ranged from 15 to 21.

Table 1 shows the demographic details of pilot study variables including gender, age and socioeconomic status. Gender demonstrated by having 44% male adolescents and 56% female adolescents. 61% adolescents lie within the age range of 18 to 21 whereas rest of the adolescents lie within the age range of 15 to 17. Most of the adolescents were belong to middle class. Results demonstrated by Table 2 showed that the coefficients of alpha reliabilities for all the instruments of research variables are good and within the acceptable range, moreover, the data was normally distributed. The alpha values of scales were; ICT self efficacy scale (α=.93), Self-directed learning with technology scale (α=.79) two sub-scales i.e. self-management (α=.52), intentional learning (α=.84). The low alpha value for self-management dimension is due to the small number of items as suggested by Moss et al. (1998).

Alpha value for total E-learning readiness scale (α=.88), five sub-scales i.e. self-competence (α=.71), self-directed learning dimension (α=.83), motivation (α=.79), financial (α=.51), and perceived usefulness (α=.88). Alpha value for total student engagement scale (α=.95), for subscales i.e. psychological motivation (α=.85), peer collaboration (α=.82), cognitive problem solving (α=.91), interaction with instructor (α=.86), community support (α=.88), and learning management (α=.77) were observed (see Table 2). In the financial dimension of e-learning readiness scale, adolescents were asked about their financial support from their institutions and families where most of the students scored low therefore their alpha

coefficient value were below 0.6. Moss et al. (1998) suggested acceptable range criteria if alpha values are above 0.6 while Nunnally and Berstein (1994) suggested above 0.7 as alpha reliability criteria.

Main study

Objectives

1. The first objective of the current research study was to investigate the association among ICT self-efficacy, self-directed learning, E-learning readiness, and student engagement.
2. The second objective of the current research was to examine the role of self-directed learning and e-learning readiness in the relationship of ICT self-efficacy and student engagement.
3. The third objective of the current research was to identify the Gender and Age related differences on study variables.

Demographic details of main study variables were computed for the main study (N=300); following descriptive statistics (mean, standard deviations, skewness, & kurtosis), Pearson Product Moment Correlation, T-test, Regression, and mediation were computed on SPSSv-21. Details of main study results are as under:

Table 3

Details of Sample Characteristics of Main Study (N=300)

Sample characteristics	Categories	Sample (N=200) *f %*
Gender	Males	144 (48)
	Females	156 (52)
Age group	Middle adolescents	164 (54.7)
	Late adolescents	136 (45.3)
Socioeconomic status	Upper class	36 (12)
	Middle class	256 (85.3)

	Lower class	8 (2.7)

Table 3 shows the demographic details of Main study variables (Gender, Age & socioeconomic status) of total sample (N=300). It comprised of 48% males and 52% females. The study comprised of 54.7 % middle adolescents and 45.3 % late adolescents. Further, data shows 12 % upper class, 85.3 % middle class and 2.7 % lower class adolescent students. Main study also comprised of most adolescents from middle class.

Table 4

Descriptive statics and alpha reliability coefficients of Main Study variables (N=300)

Scales/dimensions	No. of items	M	SD	α	Range		Skewness	Kurtosis
					Actual	Potential		
ICTSE	23	86.68	16.78	.93	27-115	23-115	-.64	.34
SDL	6	25.64	5.93	.82	6-36	6-36	-.74	.08
SM	2	7.01	2.47	.63	2-12	2-12	-.24	-.62
IL	4	18.63	4.35	.85	4-24	4-24	-.93	.32
ELR	17	81.73	15.04	.89	34-119	17-119	-.47	.24
SE	24	77.22	18.58	.96	24-120	24-120	-.36	.14

Note. ICTSES = ICT self-efficacy scale, SDLTS = Self-directed learning with technology scale, SM = Self-management, IL= Intentional learning, ELRS= E-learning readiness scale, SES= Student engagement scale.

Table 4 shows descriptive statics and alpha reliability coefficients of the main study variables, which include mean (M), standard deviation (SD), Alpha coefficients (α), range, Skewness and Kurtosis on a large sample of study variables (N=300). Data were normally distributed thus conforming for regression as all the values of Skewness and kurtosis are within the range of -1 to +1.

Table 5

Inter-correlation for ICT self-efficacy, self-directed learning, E-learning readiness and Student engagement (N=300)

Variables	**1**	**2**	**3**	**4**
1.ICT Self-efficacy	-	.66**	.65**	.42**
2.Self-directed Learning		-	.70**	.57**
3.E-learning Readiness			-	.59**
4.Student Engagement				-

*Note: **p<.01*

The above table demonstrates that ICT self-efficacy is positively and strongly correlated with self-directed learning (r=.66, p<.01), which means that as the ICT self-efficacy increases, self-directed learning will also increase. The ICT self-efficacy is strongly and positively correlated with e-learning readiness (r=.65, p<.01). Also, ICT self-efficacy has moderate and positive relation with student engagement (r=.42 p<.01). The self-directed learning is strongly and positively correlated with e-learning readiness (r=.70, p< .01). The relationship of self-directed learning with student engagement is moderate and positive (r=.57, p< .01). Also, e-learning readiness has a moderate and positive relationship with student engagement (r=.59, p< .01).

Table 6

Inter-Scale Correlation of Main Study variables (N=300)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
ICTSE		.37**	.68**	.65**	.55**	.46**	.33**	.42**	.32**	.39**	.41**	.30**	.31**	.39**
SM			.47**	.33**	.31**	.40**	.30**	.30**	.42**	.41**	.49**	.50**	.42**	.39**
IL				.62**	.60**	.62**	.25**	.50**	.35**	.52**	.44**	.38**	.34**	.46**
SC					.60**	.46**	.31**	.45**	.31**	.36**	.35**	.25**	.24**	.37**
SDL						.64**	.24**	.51**	.29**	.51**	.40**	.34**	.30**	.45**
MO							.39**	.46**	.38**	.49**	.44**	.40**	.36**	.48**
FI								.29**	.35**	.26**	.39**	.29**	.32**	.39**
PU									.43**	.43**	.42**	.31**	.35**	.43**
PM										.59**	.72**	.61**	.65**	.61**
PC											.63**	.62**	.68**	.67**
CPS												.67**	.69**	.72**
IWI													.64**	.57**
CS														.66**
LM														

Note. ICTSE= ICT Self-efficacy, SDL= Self-directed Learning, SM = Self-management, IL= Intentional learning, ELR= E-learning readiness, SC= Self-competence, SDL= Self-directed learning dimension, MO= Motivation, FI= Financial, PU= Perceived usefulness, SE= Student Engagement, PM= Psychological motivation, PC= Peer collaboration, CPS= Cognitive problem solving, IWI= Interaction with instructor, CS= Community support, LM= Learning management.

***p<.01*

Table 6 shows correlation among all the study variables; ICT self-efficacy has significant and positive relationship with the two dimensions of Self-directed learning i.e. SM(r=.37**) and IL (r=.68). Similarly, ICT self-efficacy has significant and positive correlation ranging from strong to weak with the five dimensions of e-learning readiness i.e. SC (r=.65**), SDL (r=.55**), MO (r=.46**), FI (.33**), PU (r=.42**) . Furthermore, ICT self-efficacy has significantly positive but weak correlation with all the dimensions of student engagement i.e. PM (.32**), PC (.39**), CPS(r=.41**), IWI (r=.30**), CS (r=.31**), LM (r=.39**). The two dimensions of self-directed learning (SM & IL) have significant and positive correlation with six dimensions of student engagement (PM, PC, CPS, IWI, CS, & LM). Five dimensions of e-learning readiness i.e. SC, SDL, MO, FI, and PU have significant and positive relationship with all the six dimensions of student engagement i.e. PM, PC, CPS, IWI, CS, and LM respectively.

Table 7

Gender-related differences of ICT self-efficacy, Self-directed learning, E-learning readiness and Student engagement (N=300)

	Males (n=144)		Females (n=156)				CI 95%		
Variables	M	SD	M	SD	t(298)	p	LL	UL	Cohen's d
ICTSE	90.06	17.62	83.56	15.37	3.41	.01	2.75	10.25	.39
SDL	25.63	6.27	25.64	5.62	.01	.99	1.36	1.34	.001
ELR	83.17	16.13	80.40	13.88	1.60	.11	.64	6.18	.18
SE	77.86	21.74	76.62	15.15	.57	.57	3.05	5.53	.07

Note. ICTSE= ICT Self-efficacy, SDL= Self-directed Learning, ELR= E-learning Readiness, SE= Student Engagement.

Table 7 shows that only one study variable shows significant gender related difference i.e. ICT self-efficacy shows that males have more ICT self-efficacy than females, while other study variables i.e. self-directed learning (SDL), e-learning readiness (ELR) and student engagement (SE) do not show any significant gender related differences.

Table 8

Age related differences of ICT Self-efficacy, Self-directed learning, E-learning readiness and Student engagement (N=300)

	Middle adolescents (n=164)		Late adolescents (n=136)				CI 95%		Cohen's d
Variables	M	SD	M	SD	t(298)	p	LL	UL	
ICTSE	85.29	15.74	88.37	17.86	1.59	.11	6.90	.74	.18
SDL	24.74	5.92	26.71	5.79	2.90	.004	3.31	.63	.34
ELR	79.63	14.39	84.27	15.46	2.69	.008	8.04	1.25	.31
SE	75.15	18.69	79.71	18.20	2.13	.03	8.77	.34	.25

Note. ICTSE= ICT Self-efficacy, SDL= Self-directed Learning, ELR= E-learning Readiness, SE= Student Engagement.

Table 8 shows significant age-related differences among three variables of study i.e. self-directed learning, e-learning readiness and student engagement variable, while no significant age related difference emerged on ICT self-efficacy.

Table 9

Simple linear regression ICT self-efficacy as predictor of Self-directed learning (N=300)

Variables	B	SE B	β	t	p
ICTSE	0.23	0.02	0.66	14.95	0.00
R= .66, R^2 = .43, F (223.54)**					

***p<.01*

As indicated in table 9, the value of R^2 is 0.43 which means that ICT self-efficacy causes 43% change in self-directed learning. ICT self-efficacy performs significant role in predicting the self-directed learning of adolescents.

Table 10

Simple linear regression ICT self-efficacy as predictor of E-learning readiness (N=300)

Variables	B	SE B	β	t	p
ICTSE	0.58	0.04	0.65	14.62	0.00
R= .65, R^2 = .42, F (213.87)**					

***p<.01*

As indicated in table 10, the value of R^2 is 0.42 which means that ICT self-efficacy causes 42% change in e-learning readiness. ICT self-efficacy performs significant role in predicting the e-learning readiness of adolescents.

Table 11

Simple linear regression ICT Self-efficacy as predictor of Student Engagement (N=300)

Variables	B	SE B	β	t	p
ICTSE	0.47	0.06	0.42	7.99	0.00
R=.42, R^2= .18, F (63.77)**					

***p<.01*

As indicated in table 11, the value of R^2 is 0.18 which means that ICT self-efficacy causes 18% change in student engagement. ICT self-efficacy performs significant role in predicting the student engagement.

Table 12

Multiple regression of Self-directed learning as predictor of student Engagement (N=300)

	Student Engagement				
				CI 95%	
Variables	B	SE	B	LL	UL
SM	2.66	.40	.35	1.86	3.45
IL	1.39	.23	.33	.94	1.84
$R=.58$, $R^2=.34$ $\Delta R^2=.33$, ($F=75.88$)**					

Note. SM= Self-management, IL= Intentional learning
***p<.01*

Table 12 shows the role of self-directed learning dimensions i.e. self-management and intentional learning in student engagement. Findings indicate that self-directed learning dimensions(SM & IL) account for 34% variance in student engagement.

Table 13

Simple linear regression E-learning readiness as predictor of Student Engagement (N=300)

Variables	B	SE B	β	t	p
ELR	0.73	0.06	0.59	12.75	0.00
R=.59, R^2= .35, F (162.68)**					

***p<.01*

As indicated in table 13, the value of R^2 is 0.35 which means that e-learning readiness causes 35% change in student engagement. E-learning readiness performs significant role in predicting the student engagement.

Table 14

Mediation analyses of Self-directed learning as a mediator of ICT self-efficacy and student engagement (N=300)

		Estimate	St. Error	CI 95% LL	CI 95% UL	t	p
Indirect effect	ICTSE→SDL→SE	.376	.06	.261	.504		
Direct effect	ICTSE→SE	.089	.07	-.048	.226	1.278	.202
Total effect	ICTSE→SE	.464	.06	.350	.580	7.985	.000

Note. ICTSE= ICT Self-efficacy, SDL= Self-directed Learning, SE= Student Engagement.

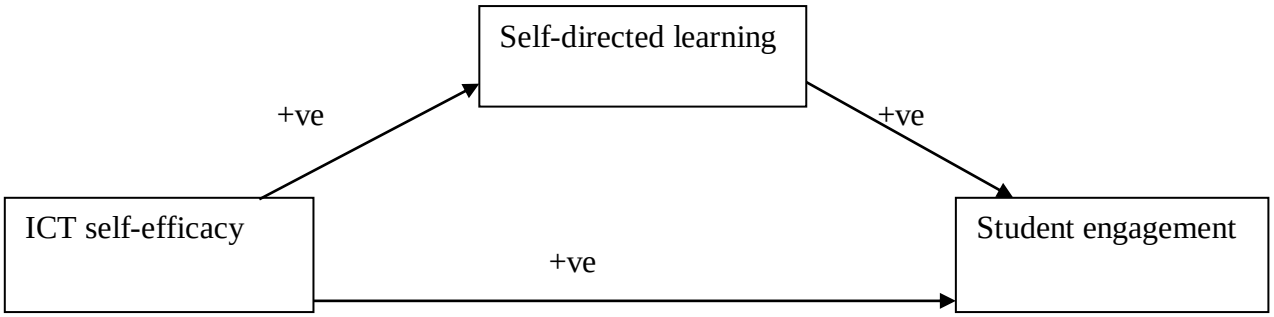


Table 14 shows the role of self-directed learning (SDL) as the mediator between ICT self-efficacy (ICTSE) and student engagement (SE). Findings reveal that the un-standardized indirect effect of ICTSE on SE is significantly positive as zero does not fall within the confidence interval (B=.376, 95% CI, .261 to .504). While the direct effect of ICTSE on SE is not significant as zero exist within the confidence interval (B=.089, t=1.278, p=.202). This shows that the relationship of ICTSE and SE is fully mediated by SDL.

Table 15

Mediation analyses of E-learning readiness as a mediator of ICT self-efficacy and student engagement (N=300)

		Estimate	St. Error	CI 95% LL	CI 95% UL	t	P
Indirect effect	ICTSE→ELR→SE	.397	.06	.292	.512		
Direct effect	ICTSE→SE	.068	.07	-.065	.201	1.005	.316
Total effect	ICTSE→SE	.465	.06	.350	.580	7.985	.000

Note. ICTSE= ICT Self-efficacy, ELR= E-learning Readiness, SE= Student Engagement.

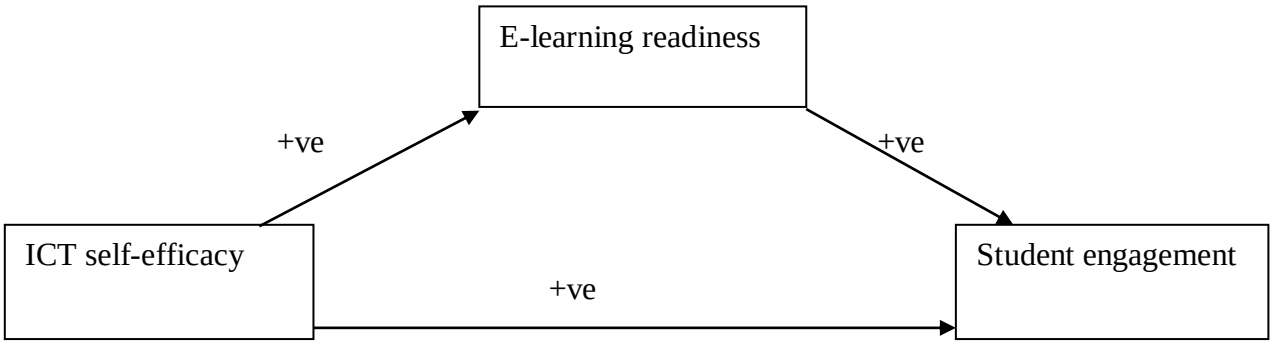


Table 15 shows the role of E-learning readiness (ELR) as the mediator between ICT self-efficacy (ICTSE) and student engagement (SE). Findings reveal that the un-standardized indirect effect of ICTSE on SE is significantly positive as zero does not fall within the confidence interval (B=.397, 95% CI, .292 to .512). While the direct effect of ICTSE on SE is not significant as zero exist within the confidence interval (B=.068, t=1.005, p=.316). This shows that the relationship of ICTSE and SE is fully mediated by ELR.

Chapter-IV

DISCUSSION

The current research was intended to investigate the association among ICT self-efficacy (ICTSE), self-directed learning (SDL), e-learning readiness (ELR), and student engagement (SE). Moreover, it was intended to investigate the role of self-directed learning and e-learning readiness in the relationship of ICT self-efficacy and student engagement among adolescents. The current thesis explored characteristics of adolescent students from various schools, colleges and Universities of twin cities of Rawalpindi and Islamabad, Pakistan. Furthermore, gender and age related differences were also explored in the current thesis. In this section, results are going to be discussed with the consideration of existing theory and research. Moreover, this section will provide recommendations and implication, which are in accordance with current research's finding.

Results demonstrated by Table 3 showed the demographic details of main study variables including gender, age and socioeconomic status. Gender demonstrated by having 48% male adolescents and 52% female adolescents. 54.7% adolescents lie in the age group of middle adolescents (15 to 17) whereas 45.3% adolescents lie in the age group of late adolescents (18 to 21). The results demonstrated by Table 4 showed that the coefficients of alpha reliabilities for all the four instruments of research variables are good and within the acceptable range, moreover, the data was normally distributed. The alpha values of scales were; ICT self efficacy scale (α=.93), Self-directed learning with technology scale (α=.82) two sub-scales i.e. self-management (α=.63), intentional learning (α=.85). Alpha value for total E-learning readiness scale (α=.89), Alpha value for total student engagement scale (α=.96) were observed (see Table

2). Moss et al. (1998) suggested acceptable range criteria if alpha values are above 0.6 while Nunnally and Berstein (1994) suggested above 0.7 as alpha reliability criteria.

Correlational Findings

In First hypothesis of the research it was hypothesized that "There is a positive association between ICT self-efficacy and student engagement". The findings of the current research study approved the hypothesis and finding indicated that ICT self-efficacy and student engagement are significantly and positively correlated with each other (see Table 5). Findings showed that adolescents with increased ICT self-efficacy are more willing to engage in e-learning environment. Various research studies claimed that a learner's judgments about their capabilities associated with the utilization of digital technologies maybe a crucial factor in examining the extent to which adolescents will engage in such learning environments that are rich in technology (Tzeng, 2009). The findings of current research are conforming the previous literature in which ICT self-efficacy and student engagement are significantly and positively associated (Chen, 2017; Manwaring et al., 2017).

For example, a recent study executed by Owusu-Agyeman, Andoh, and Lanidune (2021) explored the association in online learning and student engagement, while technology self-efficacy as the moderator. Findings indicated that technology self-efficacy significantly and positively strengthened the association between online learning and student engagement.

In second assumption of the research it was hypothesized that "There is a positive association between ICT self-efficacy and self-directed learning". The results of the current research study approved the hypothesis and findings indicated that ICT self-efficacy and self-directed learning are significantly and positively related with each other (see Table 5). The results of current research study revealed that more the learners are efficacious in ICT or related

tasks, more they will be responsible for their own learning, and putting effort in order to avail the benefits of e-learning. The current results of the research study are corroborated with previous research studies in which there was positive correlation between ICT self-efficacy and self-directed learning (Lenahan-Bernard, 2014; Hatlevik, Throndsen, Gudmundsdottir, 2018).

In third hypothesis of the research it was hypothesized that "There is a positive association between ICT self-efficacy and E-learning readiness". The findings of the research verified the hypothesis and finding indicated that ICT self-efficacy and E-learning readiness are positively and significantly correlated (see Table 5). Findings showed that adolescents with increased ICT self-efficacy are more prepared for electronic learning and have more readiness for e-learning system. The findings from current research are in accordance with the previous literature in which there was a positive association between ICT self-efficacy and e-learning readiness (Achukwu et al., 2015).

A recent research conducted by Okuonghae, Igbinovia, and Adebayo (2021) explored the role of computer self-efficacy and technological readiness in adoption of e-learning. Findings showed that students have high levels of computer self-efficacy and technological readiness. Moreover, computer self-efficacy and technological readiness were significantly correlated.

In fourth hypothesis of the research it was hypothesized that "There is a positive association between self-directed learning and student engagement. The findings of the research study approved the hypothesis and finding indicated that self-directed learning and student engagement are positively and significantly related with each other (see Table 5). It is claimed that learners who have accomplished SDL abilities or skills revealed more determination in e-learning environment along with greater engagement and motivation in e-learning environment (Sandars et al., 2020). The current results of the research are corroborated with earlier research

where self-directed learning and student engagement are positively correlated (Pacheco-Velázquez & Viscarra-Campos, 2019).

In fifth hypothesis of the current research it was hypothesized that "There is a positive association between e-learning readiness and student engagement (see Table 5). The findings of the current research approved the hypothesis and these findings indicated that e-learning readiness and student engagement are positively and significantly correlated. Findings revealed that increase in e-learning readiness of adolescents have increased engagement in e-learning environment. These findings are in accordance with earlier research in which e-learning readiness and student engagement are significantly and positively correlated (Kim, Hong, & Song, 2019).

Regression Findings

The results from Table 9 indicated that ICT self-efficacy significantly and positively predicted self-directed learning. The current findings are corroborated with earlier researchers in which computer self-efficacy emerged as a significant factor that influenced self-directed learning among students (Teo et al., 2002; Sumuer, 2018). Similarly, results from Table 10 indicated that ICT self-efficacy significantly and positively predicted e-learning readiness. These findings are corroborated with earlier research studies such as a study conducted by Mirabolghasemi, Choshaly, and Iahad in (2019) investigated the determinants of e-learning readiness among students of university, comprised of 153 postgraduates a sample. Findings manifested that computer self-efficacy emerged as a significant predictor of e-learning readiness (also see, Nyagorme, 2018; Coşkun et al., 2018).

Results from Table 11 demonstrated that ICT self-efficacy positively and significantly predicted student engagement. These findings corroborated with previous studies such as a

research study accomplished by Wolverton, Hollier, and Lanier (2020) investigated the effect of computer self-efficacy on student engagement and group satisfaction in online courses reported that computer self-efficacy influenced student engagement while, additionally student engagement influenced group satisfaction (also see, Pellas, 2014). Results from Table 12 showed that self-directed learning significantly and positively predicted student engagement. These results corroborated with a study accomplished by Chukwuedo, Mbagwu, and Ogbuanya (2021) explored the effect of self-directed learning intervention on student engagement and lifelong learning. Study followed quasi-experimental design including 243 post-graduate students in total, in which 127 were placed in intervention group and 116 in control group. Findings showed that intervention group scored significantly higher engagement levels as compared to normal group. Similarly, intervention group had higher lifelong learning tendency as compared to control group.

Results from Table 13 showed that e-learning readiness significantly and positively predicted student engagement. Findings corroborated with a recent study conducted by Joseph, Thomas, and Nero (2021), in which they investigated the impact of technology readiness and techno stress on teachers' engagement. Sample comprised of principals, managers and students. Findings from their study showed that technology readiness influenced engagement (also see, Prihastiwi, Prastuti, & Eva, 2020).

Role of Self-Directed Learning and E-Learning Readiness in Student Engagement

The current research also explored the roles of self-directed learning and e-learning readiness in student engagement. Therefore, according to sixth assumption of the current research it was hypothesized that "Self-directed learning mediates the association between ICT self-efficacy and student engagement". The findings of the current research supported the

hypothesis and findings revealed that self-directed learning significantly and positively mediated the correlation between ICT self-efficacy and student engagement (see Table 14). The findings revealed that adolescents with improved confidence on their ICT skills demonstrated improved skills of self-directed learning and further self-directed learning results in improved engagement. In line with previous literature, it is therefore argued that adolescents with high level of ICT self efficacy have more self-directed learning abilities or skills and the interaction of these abilities with ICT self-efficacy lead to high level of student engagement in e-learning environment (for example see, Kara, 2021).

A recent research study executed by Azila-Gbettor et al. in 2021 explored the association among self-efficacy, autonomous motivation, and student engagement (intellectual & peer). Results showed that self-efficacy significantly and positively predicted student engagement and autonomous motivation. Moreover, autonomous motivation further predicted intellectual and peer engagement positively and significantly. Furthermore, it was reported that autonomous motivation mediated the association between self-efficacy and student engagement (peer & intellectual) significantly and positively.

In seventh hypothesis it was assumed that "E-learning readiness mediates the association between ICT self-efficacy and student engagement". Findings from the current research approved the hypothesis and findings showed that E-learning readiness positively and significantly mediated the association between ICT self-efficacy and student engagement (see Table 15). The findings showed that adolescents with increased ICT self-efficacies have increased e-learning readiness which further leads to increased student engagement. The results of current research are corroborated with the previous research in which it is stated that students must have confidence to use the technology and should be prepared for e-learning so that they

have increased and effective engagement in learning (for example see, Osman, Mohamad, & Mohamad, 2021).

Moreover, the current study findings are in line with the frameworks of Kahu (2013) in which it is stated that learner's factors (ICT self-efficacy) influenced student engagement via the mediation of psychosocial factors (i.e. self-directed learning & e-learning readiness).

Gender and Age Related Findings

In eighth hypothesis of the study it was assumed that "Female adolescents will score high on ICT self-efficacy scale as compared to male adolescents". It was hypothesized by considering intuitively that 21 century females are dominating in every field and are digital natives, moreover, in line with previous literature, where they said that female participants had stronger beliefs about their abilities and confidence in ICT related tasks as compared to male participants (Hohlfeld, Ritzhaupt, & Barron, 2013). Furthermore, a research executed by Hatlevik et al. (2018) explored the gender related differences in fifteen countries. Findings showed that females scored significantly higher as compared to males. However, results of the current study contradict the hypothesis and males outperformed females (see Table 7). This means that despite of being digital natives girls use ICT for leisure activities, consider computers as useful tools but they don't have deeper understanding of technology for educational purposes (Janneck, Vincent-Höper, & Ehrhardt, 2013), while boy's use of internet is more, they use it for longer periods of time and access more domains of internet (Kraut et al., 1998). The findings of current research study are in accordance with previous literature where boys were more confident than girls in ICT related tasks (Hargittai & Shafer, 2006; Bao et al., 2013; Gnambs, 2021). Moreover, current findings also confirm that a traditional perception about boys having more ICT skills and confidence still exists in Pakistan. Whereas, on all other study variables i.e. self-directed learning

(SDL), e-learning readiness (ELR), and student engagement (SE), significant gender differences were not emerged. The present study's results are in line with previous researches (Demir et al., 2014; Zeb et al., 2018; Chung et al., 2020; Hung et al., 2010).

Significant age related differences found among three variables of the study i.e. self-directed learning (SDL), e-learning readiness (ELR) and student engagement (SE) (see Table 8). The results of the current research showed that the level of SDL, ELR and SE were high in late adolescents than middle adolescents. In line with biological/ maturational perspective, self-directed learning skills are nearly linked with certain attributes of executive control functioning in the frontal cortex that mature in early adulthood or late adolescence (Long, 2000b; Goldberg, 2001). The current results are consistent with the previous literature in which it is stated that with increasing age individual's confidence, experience and skills also develop, therefore, with increasing age adolescents become more self-directed and are more ready to engage in e-learning environment. (Rafique et al., 2021; Agonács & Matos, 2019 ; Santos et al., 2021).

Conclusion

The core of present research is the ICT self-efficacy (ICTSE), Self-directed learning (SDL), E-learning readiness (ELR) and Student engagement (SE) among adolescents in Pakistan. The results of the current research showed that among all the four variables positive and significant relationship exist. This means that with increase in ICTSE, SDL, and ELR, SE will also increase. Findings also exhibited that self-directed learning and e-learning readiness fully mediated the relationship between ICT self-efficacy and student engagement in e-learning environment. This finding suggests that the interaction effects of ICT self-efficacy with self-directed learning and e-learning readiness increased student engagement in e-learning

environment. The current study also concluded that boys have more confidence on their ICT related skills than girls.

Moreover, late adolescents have more self-directed skills, e-learning readiness and engagement in e-learning as compared to middle adolescents. This means that as adolescents are growing their skills related to technology and autonomy also increases which in turn increase their engagement.

Limitations and Suggestions

Although the current research has provided contribution to the exiting literature in Pakistan, in the context of e-learning, still there are some limitations also, which are as follows;

- One of the significant limitations of current research is that it used a cross-sectional research design to investigate the role of learners' characteristics i.e. self-directed learning and e-learning readiness in student engagement while an experimental design could provide clearer picture of variables' patterns. Therefore, it is recommended for future researches to use experimental design for better and more specific understanding of the variable's relationship.
- Another limitation of the study is that current study utilized convenient sampling technique. However, there are benefits of using this technique but in this way generalize-able results cannot be obtained. Therefore, for future researches it is recommended to use random sampling in order to get more generalize-able results.
- For the current research, sample consisted of urban adolescents enrolled in institutions of Islamabad and Rawalpindi. Urban students are more privileged than rural students. Hence, it is suggested for future researchers to do comparative study by incorporating

rural adolescents in order to understand their interaction with technology and e-learning environment.

- Another limitation of the current research is that data were collected in the times of pandemic, where universities were suggested by Higher Education Commission (HEC) to shift from face to face learning to online learning in emergency situation. The variables used in this research are context specific i.e. e-learning readiness and student engagement. Therefore, future researchers are recommended to test the hypothesized model after the pandemic period.
- In the current study, sample comprised of two age groups (Middle adolescents & late adolescents) with the age ranged from 15 to 21 were concentrated. Hence, it is recommended for future researches to incorporate more age groups for deeper understanding of age related differences among learners' characteristics.
- Present study was centered on the role of learners' characteristics in student engagement. It is recommended for future researchers to carry out researches in which role of instructor's effort along with learners' characteristics in student engagement should be examined.

Implications

Hypothetically the current study has contributed to the literature while it has some practical implications as well. Although the ICT self-efficacy levels of adolescents are high still there exist gender differences as male adolescents have increased levels of ICT self-efficacy than female adolescents. The results of the current research may help policy makers, teachers and administrators in schools, colleges and Universities to incorporate ICT related programs or

courses as part of their curriculum so that adolescents may have equal improvement in their ICT skills and perform their best in online environment. Moreover, this study may help policy makers, educators and administrators about the characteristics that foster adolescents' engagement in e-learning environment. Therefore, the present study may provide deep insights regarding success of e-learning as sudden incorporation of e-learning system in Pakistan caused great trouble for educational institutions as they were not prepared for this emergency situation. Hence, e-learning should be enhanced to deal with such emergency and unprecedented situations in future.

Furthermore, the findings from the current research can be taken into account for practice by enhancing technology rich environments for self-directed learning (SDL) especially in primary school students and younger adolescents. Teachers should provide younger students with strategies that could boost their skills of SDL. One of the strategies is Scaffolding, where teachers provide assistance, social guidance and support to their learners so that they can develop understanding and cognitive skills (O'Donnell et al, 2011). It is not teacher directed assistance rather it suggests that a teacher can provide instructions only where it is necessary. Moreover, educators are crucial in successful adoption of e-learning system as well. Therefore, in order to bridge the gap in using technology and having autonomy in performing ICT related tasks, training and coaching should be provided to teachers.

Educators and administrators need to give attention towards online distractions by other activities (chatting, texting, & online gaming) of adolescents. This can be done by incorporating short quizzes at the end of every online class and students are told about this quiz before the beginning of online class (Chung et al., 2020). In this way students will remain focused and engaged with the e-learning environment. Moreover, students should be given financial support

from their institutions and government by giving tools (e.g. laptops or computers) that are necessary for e-learning access. Training should be given in case of technical difficulties starting from early school children to the University level.

Furthermore, administrators and stakeholders should incorporate such interventions like "online formative assessment" to encourage learners' engagement and promote their e-learning This type of formative assessment has identified with frequent quizzes, tests, and activities, which can be implied in both synchronous and asynchronous e-learning system. Such designs have bi-fold benefits for teaching instructions. For instance, firstly by accomplishing tasks, quizzes, and tests regularly during the entire e-learning process, the engagement of learners would be certain and it would further enhance learning performance. Secondly, by this intervention teachers can get a record of students' sustained learning on regular basis. Therefore, in this way teachers can provide students instant feedback about their learning and adapt to follow-up instructional activities immediately, thus enhancing teaching effect (Chen, Jiao, & Hu, 2021).

Finally, the age related differences reported in current findings necessitate further qualitative research on primary school students to determine their levels of skills in ICT and self-directed learning. So, that in-depth data could be collected about younger students exploring their opinions and factors that influence their understanding regarding e-learning environment.