



RESEARCH PAPER

The Mediating Role of Self-Directed learning and E-Learning Readiness in Relationship between ICT self-efficacy and Student Engagement

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ABSTRACT

The present study was aimed to explore the role of ICT self-efficacy and self-directed learning in e-learning readiness and student engagement among middle and late adolescents. Convenient sampling was used to collect data from students in schools, colleges, and universities located in Islamabad and Rawalpindi. The total sample comprised of (N=300) students with both boys (n=144) and girls (n=156) in the age range of 15 to 21. This study used several scales to examine the relationship between ICT self-efficacy, self-directed learning with technology, e-learning readiness, and student engagement. The results showed that ICT- SE was positively correlated with self-directed learning, e-learning readiness and student engagement. The study found that self-directed learning and e-learning readiness played a mediating role in the relationship between ICT self-efficacy and student engagement. These findings could be useful for policymakers and educators to promote adolescents' engagement in e-learning environments.

KEYWORDS E-learning Readiness, Self-directed Learning, Self-efficacy, Student Engagement

Introduction

Today information and communication technology (ICT) has a magnanimous impact on different facets of our lives that cannot be negated, neither one can refute its developing prominence and use in the academic arena. It has gained popularity in the education sector besides the progressing COVID situation which has caused the closure of educational institutions all over the world and thus giving rise to numerous challenges, particularly for students at all stages and levels of education. Therefore, the progression of ICTs in this arena has provided a solution for educators and policymakers 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 it was never viewed as part of formal education in Pakistan till the spread of COVID. Therefore, the success of the e-learning will hinge not only on the users' technology acceptance of an e-learning system but also on their state of technology readiness and internet self-efficacy (Lai, 2008). So, the present study aims to find out the role of students' personal characteristics/ abilities i.e. ICT self-efficacy and self-directed learning in e-learning readiness and student engagement. It is significant to consider the role of ICT self-efficacy and self-directed learning ability of students to alter the social changes and enhance their learning competitiveness. Moreover, the present study helps students to cultivate ICT self-efficacy and self-learning ability, which could further help students to be ready to adopt e-learning to adapt from face-to-face learning to an e-learning environment, and eventually, their greater engagement in e-learning would result in less dropout and more academic success.

ICT self-efficacy, or perceived ICT competence, is understood as "the individual's perception of his or her own knowledge about ICT and about how to use it" (Goldhammer, Gniewosz, & Zylka, 2016, p. 342). Studies succinctly indicate the importance of elevating

students' level of ICT self-efficacy in order to develop their ICT competencies and improve their use and feelings towards ICT. For example, Teo, Huang, & Hoi, (2018) found that individuals with high perceived computer self-efficacy were more successful at using technologies and were more willing to take responsibilities than those with low perceived computer self-efficacy. It can be inferred that such individuals are more open to embracing innovative technologies and are keen to experiment with new pedagogical methods that integrate ICTs. Therefore, it is significant to consider the role of task specific self efficacy i.e. ICT self-efficacy. There is only one study which suggested computer self-efficacy as the significant determinant of e-learning adoption in our local context (Kanwal & Rehman, 2017).

Self-directed learning refers to the psychological processes of learners that purposively direct themselves to gain knowledge and understand how to solve problems (Long, 1994). Tan, Divaharan, Tan and Cheah (2011) listed self-directed learning as a key component of 21st century skills that every student must possess in order to prepare them to face any incoming challenges in twenty-first century. It is stated that individuals who have acquired self-directed learning skills will show persistence in learning with increased motivation and engagement with online learning (Sandars et al., 2020). The research on self-directed learning has been around for several decades, the context has changed with online learning, greater access to technology and opportunities for more personalized learning experiences. Therefore, it is significant to know levels of 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 is centered on adolescent students and technology rich environment that will help influence the development of self-directed learning.

Borotis and Poulymenakou (2004) defined E-Learning Readiness as the "mental or physical preparedness of an organization for some e-learning experience or action" (p. 1622). Likewise, Parlakkılıç (2015) referred to online learning style readiness as: "users' online learning style readiness defined as the readiness of the learner or trainee in terms of time commitment to e-learning, discipline and interest in e-learning and the perception of the status of qualifications obtained via e-learning". Research conducted by Hove and Corcoran (2008), they found that the use of e-learning increases the frustration level of its users compared with classical methods. E-Learning required users to have the ability to operate high-tech equipment such as computers and the Internet. Moreover, Schreurs, Ehlers, and Sammour (2008) have suggested that before the implementation of e-learning that learners' readiness should be determined. To them 'readiness includes learners' ability to adapt to technological challenges, collaborative training and synchronous as well as asynchronous self-paced training.

It relates to "how actively learners' thoughts, feelings, and activities are involved in learning" (Lewis et al., 2011). According to Chakraborty and Nafukho (2014), "creating and maintaining good learning environment; forming learning community; offering consistent feedback in a timely manner" are essential variables in online student engagement. Student involvement is a key determinant in online learning success, according to research (Wolverton 2018; Fredrickson, 2015). According to Dörnyei (2000), even students with high levels of self-efficacy struggle to comprehend the whole unless actively engaged in learning. Thus, considering student engagement in e-learning can help them adapt to social changes and improve their learning competitiveness. Moreover, some research imply that a student's confidence in their technology skills influences their willingness to participate in technologically enhanced learning environments (see, for example, Tzeng, 2009). Thus, it is vital to investigate the role of student characteristics in e-learning engagement. The current study sample includes adolescent pupils who are more accustomed to teacher-centered learning. This study will aid educators in encouraging children to self-learn early on to meet

challenges and benefit from increasing educational competences. In our local environment, e-learning literature is more qualitative than quantitative. Thus, the current study will help policymakers understand the significance of student characteristics on e-learning readiness and engagement.

Literature Review

ICT self-efficacy and Self-directed learning

According to the previous literature it has been asserted that individuals with high self-efficacies are said to be well-suited for e-learning environments because such persons are cooperative, accommodating, enthusiastic to share in social situations and are more than ready to tackle difficult tasks instead of avoiding them (Chen, 2014). A study conducted by Simmering, Posey, and Piccoli in 2009 explored association of computer self-efficacy and motivation to online learning in a self-directed course. Findings revealed that computer self-efficacy was positively correlated with online learning in a self-directed online course. Furthermore, a study conducted by Sumuer in 2018 explored factors effecting self-directed learning with technology among college students. The sample of the study comprised of 153 college students. Findings showed a significant weak correlation between computers self-efficacy and self-directed learning with technology. Also, it was reported that weak and significant correlation exist between online-communication self-efficacy and self-directed learning.

ICT Self-efficacy and E-learning readiness

Based on the previous literature, there was a positive association between ICT self-efficacy and e-learning readiness. For instance, a study conducted by Hsia, Chang, and Tseng in 2014 examined the influence of computer self-efficacy and individual locus of control in e-learning acceptance among employees. Sample of the study consisted of 223 employees from five high-tech companies. Findings indicated that computer self-efficacy has significant direct effect on perceived ease of use and behavioral intention to use e-learning. Similarly, A study conducted by Achukwu et al. in 2015 explored the relationship among computer self-efficacy, computer-related technology dependence, and online learning readiness among undergraduate students. Findings showed that computer self-efficacy and online learning readiness were significantly and positively correlated. Moreover, it also reported that Computer self-efficacy and computer-related technology dependence predicted students' online learning readiness. Furthermore, another 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 predictor of perceived ease of use.

ICT Self-efficacy and Student Engagement

Students with high levels of self-efficacy demonstrate positive social behaviors, both directly and indirectly (Bandura, 2006), and prefer deep learning to superficial learning (Liem et al., 2008). In research studies of student engagement and self-efficacy, these variables were seen to be highly related (Majer, 2009; Thijs & Verkuyten, 2008). Several studies suggest that a student's belief about their abilities related to the use of technologies is a critical factor in determining the level at which they will engage in learning environments that are technologically integrated (Tzeng, 2009). Laird and Kuh in 2005 discovered that a higher level of computer self-efficacy is related to a higher level of information and communications technology (ICT) engagement. For instance, a study by Chen (2017) examined the relationship between computer self-efficacy, learning performance, and learning engagement as a mediator. Findings indicated that computer self-efficacy and learning engagement were positively correlated. It also reported that

relationship between computer self-efficacy and learning performance was fully mediated by learning engagement.

Relationship of Self-directed learning with E-learning readiness

Theorists express that learners should be autonomous and have self-directed skills for online learning activities (Zanjani, Ajam, & Badnava in 2017). For example, a study conducted by Cavusoglu (2019) explored the relationship between self-directed learning and online learning readiness. Study comprised of 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 there was significant difference in the mean scores of self-directed learning readiness between college students and industry professionals.

Relationship of Self-directed learning and Student Engagement

The student engagement (e.g. a sense of confidence arises from joining group discussions frequently) may enhance the SDL (Merriam, S. B. 2001). Yang (2016) established significant correlation between student engagement and SDL. Similarly, in a study by Pacheco-Velázquez and Viscarra-Campos in 2019 investigated the critical factors related to reflection, engagement, and self-directed learning. Results of the study reported positive correlation between self-directed learning and student engagement.

Relationship of E-learning Readiness and Student Engagement

Gay and Dringus (2012) conducted a conference on e-learning explored the technological e-readiness levels of instructors and effectiveness in the online learning. Results indicated that e-readiness of instructors was the significant predictor of e-learning effectiveness of system i.e. system design, system delivery, and system outcomes. User satisfaction was also reported as the significant predictor. Similarly, in order to get students' engaged in e-learning system it is asserted that e-learning readiness is a significant predictor. For instance, another more recent study conducted by Jiang, Meng, and Zhou (2021) examined the relationship between 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, it was reported that attitude and environmental support moderated the relationship between readiness of students and motivation and engagement.

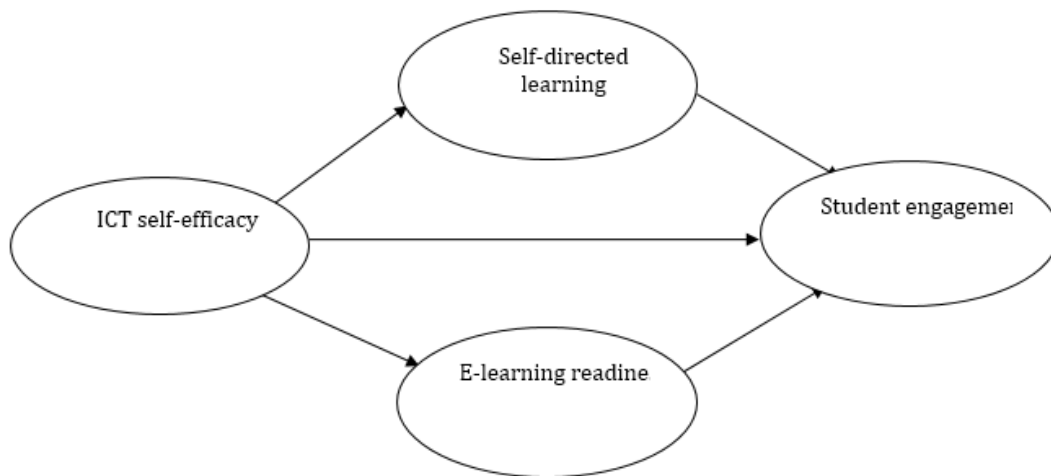
Mediation Studies

In a study Kim, Hong, and Song (2019) found that digital readiness mediated the relationship between e-learning adoptions, e-learning attitude and academic engagement. Moreover, digital readiness and academic engagement mediated the relationship between e-learning adoptions, e-learning attitude and academic achievement. Similarly another study by Osman, Mohamad, and Mohamad in (2021) explored the role of digital readiness as a mediator on the relationship between 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 as a mediator on the relationship between e-learning attitude and online engagement.

Kara in 2021 explored the role of learners' characteristics on their engagement during pandemic. Results showed that learners' characteristics i.e. digital literacy, self-directed learning and motivation significantly predicted online learner engagement.

Moreover, self-directed learning and motivation significantly mediate the relationship between digital literacy and engagement.

Proposed Model



Hypotheses

1. Self-directed learning mediates the relationship between ICT self-efficacy and student engagement
2. E-learning readiness mediates the relationship between ICT self-efficacy and student engagement.

Material and Methods

Instruments

ICT self- efficacy scale (ICTSES)

This scale was developed by Alahakoon & Somaratne (2020), and it comprised of 23 items. It is a 5-point Likert scale ranging from (Not at all confident = 1) to (Very confident = 5). Cronbach’s alpha reliability for the scale is =.94.

Self-directed learning with technology scale (SDLTS)

This scale was developed by Teo, Tan, Lee, Chai and Koh (2010), comprised of 6 items which are divided into two factors, self-management (item numbers 1, 2) and intentional learning (3, 4, 5, and 6). It is a 6-point Likert scale ranging from (All the time=6) to (Not at all=1).Scale demonstrated good reliability (Cronbach’s $\alpha=0.63$ for self-management; $\alpha=0.85$ for intentional learning).

E-learning readiness scale

This scale was developed by Alem, Plaisent, Zuccaro, and Bernard (2016), comprised of 17 items which are divided into 5 dimensions. Self-competence (item numbers 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). A 7-point Likert scale ranging from (strongly disagree=1) to (strongly agree=7) with (neutral=4). Scale demonstrated good internal consistency and Cronbach’s alpha reliability coefficients calculated by the author were as .96 for self competence sub-dimension, .91 for self directed learning, .76 for motivation, .75 for financial and .94 for perceived usefulness sub-dimension.

Student engagement scale in E-learning environment

This scale was developed by Lee, Song, & Hong (2019), consisted of 24 items. This scale is further divided into 6 factors; Psychological motivation (item numbers 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 ranging from (strongly agree=1) to (strongly disagree=5).The scale demonstrated good reliability (Cronbach's α coefficient was 0.89 for (psychological motivation), 0.88 for (peer collaboration), 0.83 for Factor 3 (cognitive problem solving), 0.76 for (interactions with instructors), 0.82 for (community support), and 0.72 for (learning management).

Sample

For the present study a comparative cross-sectional research design was used .To collect the data from the sample of 300 adolescents a convenient based sampling technique was applied . Further, data was divided on the basis of gender (N=300; males, n= 150; females, n= 150) and age groups (middle adolescence and late adolescence) with age ranged from (15-21). Data was collected from different schools and colleges of twin cities of Rawalpindi and Islamabad.

Exclusion Criteria

- Adolescents who have not attended online classes were not considered for the purpose of data collection.
- Two age groups (children and adults) have not approached as part of present study from twin cities.
- Adolescents from rural areas and who do not enroll in academic institutes have not been approached for data collection.

Procedure

Initially, researcher has selected a sample of N=300 students including both boys and girls with the age range of 15 to 21 from different universities, colleges and schools of Islamabad. After permission from the higher authorities of universities, colleges and schools, students' sample has been selected from the schools, colleges and universities of Islamabad. At first, informed consent has given to participants and after gotten their willingness, a booklet of informed consent, demographic sheets 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 were administered. Participants were given complete instructions before distributing questionnaire. They were instructed to rate each item according to their opinion and asked them not to leave any item unanswered. At the end, participants were appreciated for their participation after all the questionnaires have completed. Before leaving the institute, researcher said special thanks to the head of the institute and the class teacher for their cooperation.

Results and Discussion

Table 1
Details of Sample Characteristics of Main Study (N=300)

Sample characteristics	Categories	f%
Gender	Boys	144 (48)
	Girls	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 1 represents the demographic details of study variables (Gender, age & socioeconomic status) of total sample (N=300). It comprised of 144 (48%) boys and 156 (52 %) girls. 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.

Table 2
Descriptive and Psychometric Properties for Main Study

Scales/dimensions	No. of items	M	SD	α	Score range		Skewness	Kurtosis
					Actual	Potential		
ICTSES	23	86.68	16.78	.93	27-115	23-115	-.64	.34
SDLTS	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
ELRS	17	81.73	15.04	.89	34-119	17-119	-.47	.24
SC	3	15.16	3.45	.80	5-21	3-21	-.75	.41
SDL	5	26.10	5.15	.81	9-35	5-35	-.85	.78
MO	3	14.32	3.86	.78	3-21	3-21	-.54	-.09
FI	3	11.89	3.58	.50	3-21	3-21	.16	.16
PU	3	14.27	4.08	.88	3-21	3-21	-.62	-.13
SES	24	77.22	18.58	.96	24-120	24-120	-.36	.14
PM	6	17.77	5.61	.91	6-30	6-30	-.09	-.43
PC	5	17.24	4.16	.85	5-25	5-25	-.70	.49
CPS	5	16.16	4.41	.90	5-25	5-25	-.47	.29
IWI	2	6.52	2.02	.85	2-10	2-10	-.38	-.23
CS	3	9.60	2.99	.90	3-15	3-15	-.36	-.24
LM	3	9.93	2.77	.83	3-15	3-15	-.36	.07

Note. ICTSES = ICT self-efficacy scale, SDLTS = Self-directed learning with technology scale, SM = Self-management, IL= Intentional learning, ELRS= E-learning readiness scale, SC= Self-competence, SDL= Self-directed learning dimension, MO= Motivation, FI= Financial, PU= Perceived usefulness, SES= Student engagement scale, PM= Psychological motivation, PC= Peer collaboration, CPS= Cognitive problem solving, IWI= Interaction with instructor, CS= Community support, LM= Learning management.

Table 2 shows descriptive statistics of the main study, which include mean (M), standard deviation (SD), Alpha coefficients (α), range, Skewness and Kurtosis on a large sample of study variables (N=300). The values for ICTSE (M= 86.36, SD= 16.78 , α = .93, Skewness= -.64, kurtosis=.34), for SDL (M=25.64, SD= 5.93, α = .82, Skewness= -.74, Kurtosis= .08), for ELR (M=81.73, SD=15.04, α =.89, Skewness=-.47, kurtosis=.24), for SE (M=77.22, SD=18.58, α =.96, Skewness=-.36, Kurtosis=.14). All the values of Skewness and kurtosis are lying within the range of (-1 to +1) thus, conforming the normality of the data for regression.

Table 3
Inter-correlation for ICT self-efficacy, self-directed learning, E-learning learning readiness and Student engagement

Variables	1	2	3	4
1.ICT Self-efficacy	-			
2.Self-directed Learning	.655**	-		
3.E-learning Readiness	.646**	.699**	-	
4.Student Engagement	.420**	.571**	.594**	-

Note: N=300 * $p < .05$ ** $p < .01$

The ICT self-efficacy has a strong and positive correlation with self-directed learning ($r=.655$, $p < .01$), which means with the increase in ICT self-efficacy, self-directed learning will also increase. The ICT self-efficacy has a strong and positive correlation with e-learning readiness ($r=.646$, $p < .01$). Also, ICT self-efficacy has a positive and moderate correlation with student engagement ($r=.420$, $p < .01$). The self-directed learning has a strong and positive correlation with e-learning readiness ($r=.699$, $p < .01$). The relationship of self-directed learning with student engagement is moderate and positive ($r=.571$, $p < .01$). Also, e-learning readiness has a moderate and positive relationship with student engagement ($r=.594$, $p < .01$).

Table 4
Inter-Scale Correlation of Main Study variables

	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.

Table 4 shows correlation among all the study variables; ICT self-efficacy has significant positive correlation with the two dimensions of Self-directed learning i.e. SM($r=.37^{**}$) and IL ($r=.68$). ICT self-efficacy has significant positive correlation with all the five dimensions of e-learning readiness i.e. SC ($r=.65^{**}$), SDL ($r=.55^{**}$), MO ($r=.46^{**}$), FI ($.33^{**}$), PU($r=.42^{**}$). Similarly, all the dimensions of student engagement has significant positive correlation with ICT self-efficacy i.e. PM ($.32^{**}$), PC ($.39^{**}$), CPS($r=.41^{**}$), IWI ($r=.30^{**}$), CS ($r=.31^{**}$), LM ($r=.39^{**}$). On self-directed learning dimensions, self-management (SM) is significantly positively correlated with all the five dimensions (SC, SDL, MO, FI, PU) of e-learning readiness i.e. ($r=.33^{**}$, $r=.31^{**}$, $r=.40^{**}$, $r=.30^{**}$, $r=.30^{**}$) respectively. Similarly, learning management (LM) dimension of Self-directed learning (SDL) is significantly positively correlated with all the five dimensions of e-learning readiness i.e. ($r=.62^{**}$, $r=.60^{**}$, $r=.62^{**}$, $r=.25^{**}$, $r=.50^{**}$) respectively. On five dimensions of e-learning readiness, Self-competence (SC, SDL, MO, FI, and PU) significantly positively correlated with all the six dimensions of student engagement (PM, PC, CPS, IWI, CS, LM) i.e. ($r=.31^{**}$, $r=.36^{**}$, $r=.35^{**}$, $r=.25^{**}$, $r=.24^{**}$, $r=.37^{**}$) respectively. Similarly, self-directed learning dimension significantly positively correlated with all the six dimensions of student engagement (PM, PC, CPS, IWI, CS, LM) i.e. ($r=.29^{**}$, $r=.51^{**}$, $r=.40^{**}$, $r=.34^{**}$, $r=.30^{**}$, $r=.45^{**}$). Motivation dimension also significantly positively correlated with all the six dimensions of student engagement respectively i.e. ($r=.38^{**}$, $r=.49^{**}$, $r=.44^{**}$, $r=.40^{**}$, $r=.36^{**}$, $r=.48^{**}$). Financial dimension significantly positively correlated with all the six dimensions of student engagement respectively i.e. ($r=.35^{**}$, $r=.26^{**}$, $r=.39^{**}$, $r=.29^{**}$, $r=.32^{**}$, $r=.39^{**}$). Perceived usefulness dimension significantly positively correlated with all

the six dimensions of student engagement respectively i.e. ($r=.43^{**}$, $r=.43^{**}$, $r=.42^{**}$, $r=.31^{**}$, $r=.35^{**}$, $r=.43^{**}$).

Table 5
Mediation analyses of Self-directed learning as a mediator of ICT self-efficacy and student engagement.

		Estimate	SE	CI 95%		T	P
				LL	UL		
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 5 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 positive and significant 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 insignificant as zero exist within the confidence interval ($b=.089$, $t=1.278$, $p=.202$). This shows that the relationship between ICTSE and SE is fully mediated by SDL.

Table 6
Mediation analyses of E-learning readiness as a mediator of ICT self-efficacy and student engagement.

		Estimate	SE	CI 95%		T	P
				LL	UL		
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 6 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 positive and significant 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 insignificant as zero exist within the confidence interval ($b=.068$, $t=1.005$, $p=.316$). This shows that the relationship between ICTSE and SE is fully mediated by ELR.

The present study was intended to find out the mediating role of self-directed learning & E-learning readiness in relationship between ICT self-efficacy and student engagement among adolescents. The current research explored the features of a sample of adolescents drawn from different schools, colleges and universities of Rawalpindi and Islamabad, Pakistan. In order to meet the objectives of study first of all descriptive analysis of data was sorted out (see table 2). This table results confirmed that majority of the sample was taken from middle class and was normally distributed for current study.

The findings of correlational analysis suggested all the studied variables has a significant positive (moderate) correlation with each other. Findings revealed that adolescents with increased ICT self-efficacy are more prepared for e-learning and are willing to engage in e-learning environment. Several studies suggest that a student's belief about their abilities associated with the utilization of technologies maybe a critical factor in determining the extent at which they're going to engage in learning environments that are technologically integrated (Tzeng, 2009). The present study's results are in line with the previous literature in which there was a positive association among ICT self-efficacy, e-learning readiness and student engagement. For example. in a most recent study conducted by Okuonghae, Igbinovia, and Adebayo in 2021 explored the role of computer self-efficacy and technological readiness in e-learning adoption on a sample comprised of 223 students

who were randomly selected. Findings showed that students have high levels of computer self-efficacy and technological readiness. Moreover, computer self-efficacy and technological readiness were significantly correlated. (see also., Achukwu et al., 2015; Mirabolghasemi, Choshaly, & Iahad, 2019; Chen, 2017). In addition, table 3 findings also revealed that more the students are responsible for their own learning, more they will be prepared for online learning and putting effort in order to take the advantage of online learning. As, Sandars et al., (2020) rightly pointed out that individuals who have acquired self-directed learning skills will show persistence in learning with increased motivation and engagement with online learning (Sandars et al., 2020). Similarly, Ergun and Adibatmaz (2020) stated that self-directed learning predicted all the three dimensions of student engagement (behavioral, cognitive and affective engagement). The current findings of the study are consistent with previous researches in which there was positive relationship among self-directed learning, e-learning readiness and student engagement. For instances, a recent study conducted by Owusu-Agyeman, Andoh, and Lanidune in 2021 explored the relationship between online learning and student engagement, while technology self-efficacy as the moderator. Sample comprised of 425 students enrolled in Technical University in Ghana. Findings indicated that technology self-efficacy significantly and positively strengthened the relationship between online learning and student engagement. (see also ., Zanjani, Ajam, & Badnava, 2017; Pacheco-Velázquez & Viscarra-Campos, 2019).

Mediational Findings

In first main hypothesis of the study assumed that “self-directed learning mediates the relationship between ICT self-efficacy and student engagement” (see table 5). The results of the study supported the hypothesis and findings revealed that self-directed learning positively and significantly mediated the relationship between ICT self-efficacy and student engagement (see Table 5). The findings revealed that adolescents with improved confidence on their ICT skills demonstrated improved skills of self-directed learning which in turn lead to 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 skills and the interaction of these skills lead to high level of student engagement in e-learning environment (Durnali ,2020; Kara, 2021). In 2nd hypothesis it was assumed that “E-learning readiness mediates the relationship between ICT self-efficacy and student engagement”. The results of the study supported the hypothesis and findings revealed that E-learning readiness positively and significantly mediated the relationship between ICT self-efficacy and student engagement (see Table 6). The findings showed that adolescents with high level of ICT self-efficacy have more e-learning readiness which in turn increased student engagement. The current results are consistent with the previous researches 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 (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 through the mediation of psychosocial factors (self-directed learning and e-learning readiness).

Conclusion

The core of this study is the mediating role of self-directed learning & E-learning readiness in relationship between ICT self-efficacy and student engagement among adolescents in Pakistan. The findings of the study indicated that among all the four variables positive and significant relationship exist. This means that with increase in ICT self-efficacy, self-directed learning and e-learning readiness student engagement will also increase. Findings also revealed 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 will increase student engagement.

Recommendations

Although the present study has provided huge 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 study is that it used a cross-sectional research design to examine the role of ICT self-efficacy and self-directed learning in e-learning readiness and student engagement while a longitudinal design could provide clearer picture of variables' patterns over time. Therefore, it is recommended for future researches to use longitudinal design for better and deeper 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.
- In the present study, sample comprised of urban adolescents enrolled in institutions of Islamabad and Rawalpindi. Urban students are more privileged than rural students. Hence, it is recommended 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 study 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 to online education in emergency situation. The variables used in this study 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 range of 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.

Hypothetically the current study has contributed to the literature while it has some practical implications as well. The results of the current study 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 have equal growth related to 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. Hence, e-learning should be enhanced to deal with such emergency situations in future.

Furthermore, the findings from the current research can be taken into consideration for practice by enhancing technology rich environments for self-directed learning especially in primary school students and younger adolescents. Teachers should provide younger students with strategies that could boost their skills of self-directed learning. One of the strategies is Scaffolding, where teachers provide assistance, social guidance and support to their students so that they can develop understanding and cognitive skills .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 to online distractions by other activities (chatting, texting, & online gaming) of adolescents. This can be done by incorporating a short quiz at the end of every online class and students are told about this quiz before the beginning of the 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.

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