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The educational technology's impact on youth creativity and innovation: A case of Ha'il region of Saudi Arabia

تأثير تكنولوجيا التعليم على إبداع الشباب وابتكارهم :حالة منطقة حائل بالمملكة العربية السعودية

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Abstract

Educational technology can play a prominent role in fostering youth creativity and innovation. However, only limited studies have examined the impact of educational technology on youth creativity and innovation. This assessment is especially critical in the context of Saudi Arabia, which has been investing significant resources in higher education and digital transformation initiatives as part of the Saudi Vision 2030. Thus, this research examines the effect of educational technology on university students' creative and innovative capabilities. We used quantitative methodology to accomplish the study's objectives and employed questionnaires. The questionnaires were conducted at the University of Ha'il, Saudi Arabia. The study's findings establish critical parameters for utilizing educational technology to promote university students' creativity and innovativeness throughout their learning process in Saudi Arabia, particularly in developing regions such as Ha'il. The research contributes to the body of knowledge about youth innovation and creativity, particularly in developing countries. Additionally, the study's findings contribute to the realization of Saudi Vision 2030 by raising awareness of the value of accessibility and effective utilization of educational technology in fostering youth creativity and innovation.

Keywords: Creativity, innovation, educational technology, Saudi Arabia, Saudi Vision 2030.

خلاصة

يمكن أن تلعب تكنولوجيا التعليم دورًا بارزًا في تعزيز الإبداع والابتكار لدى الشباب .ومع ذلك، فإن دراسات محدودة فقط هي التي درست تأثير تكنولوجيا التعليم على الإبداع والابتكار لدى الشباب .ونظرا للأهمية الكبيرة التي توليها المملكة العربية السعودية في تأهيل وإعداد الشباب من خلال استثمار موارد كبيرة في التعليم العالي ومبادرات التحول الرقمي كجزء من رؤية المملكة العربية السعودية 2030، فإن هذا البحث سوف يدرس تأثير التكنولوجيا التعليمية على القدرات الإبداعية والابتكارية لطلاب الجامعات .تم استخدام منهجية كمية لتحقيق أهداف الدراسة واعتمدت على الدراسات الاستقصائية .كم تم اجراء الاستطلاعات في جامعة حائل بالمملكة العربية السعودية وحددت نتائج ،الدراسة المعايير الحاسمة لاستخدام تكنولوجيا التعليم لتعزيز إبداع وابتكار طلاب الجامعات خلال عملية التعلم في المملكة العربية السعودية لا سيما في المناطق النامية مثل حائل .يساهم البحث في زيادة المعرفة حول الابتكار والإبداع الشبابي، لا سيما في البلدان النامية .بالإضافة إلى ذلك، تساهم نتائج الدراسة في تحقيق رؤية المملكة العربية السعودية 2030 من خلال زيادة الوعي بقيمة التكنولوجيا التعليمية الفعالة في تعزيز الإبداع والابتكار لدى الشباب..

الكلمات المفتاحية :إبداع ، ابتكار ، تكنولوجيا تعليمية ، السعودية ، رؤية المملكة 2030

Introduction

In the present age, communication, and learning mechanisms have undergone tremendous transformation due to rapid technological advancements in the educational sector (Singh & Chand, 2012; Singh et al.,

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2011a; Singh et al., 2011b). In today's time, developing the creativity and innovation of youth has become the principal educational objective due to their considerable socioeconomic benefits (Vincent-Lancrin et al., 2019). Educational technology provides novel avenues for inspiring the minds of the youth (Dori et al., 2003; Singh & Agarwal, 2011; Alam et al., 2022) and considered critical for the development of the nation's human capital (Singh & Alhamad, 2022a; Singh & Alhamad, 2022b). Educational technology can play a vital role in developing and enhancing youth creativity and innovation by providing novel apparatuses and smart learning environments (Singh et al., 2013; Peffer et al., 2015; Glaveanu et al., 2019). Educators in various countries also believe that educational technology has the potential to foster creativity and innovation among youth (Cachia & Ferrari, 2010).

In the last decade, endeavors have been made to modernize the education sector (Almaiah et al., 2019). This includes integrating digital technology into the education sector (Akçayır & Akçayır; 2017; Alhamad & Singh, 2022). Examples include smartboards, learning management systems, multimedia projectors, virtual reality (VR), smart learning, adaptive learning, etc. (Pence, 2019; Steele et al., 2020; Singh & Alodaynan, 2023). In today's era, educational technology developments enable educators to disseminate knowledge effectively and efficiently (Jones, 1991; Singh et al., 2011c; Roschelle et al., 2000). It helps youth hone their creative thinking and innovative problem-solving capabilities (Neo & Neo, 2009). Technology-driven education is vital in today's age as the new generation of learners' youth learners are 'tech-savvy' and increasingly use digital education technologies in their learning activities (Prensky, 2001; Herseim, 2019; Singh & Alshammari, 2021). New education technology apparatuses enable youth learners to be efficient and effectively deal with real-world situations (Courts & Tucker, 2012). So, educational technology can be a potent tool to develop youth creativity and innovation.

Despite educational technology's benefits, only a few prior studies have investigated its use to foster youth creativity and innovation. The limited studies that have been conducted on this aspect have focused on schools and young children (Griffiths, 2002; Cecilia et al., 2015; Cofini et al., 2012; Di Giacomo et al., 2016; Di Giacomo et al., 2017). The processes and applicability of educational technology to foster creativity and innovation vary between youth and school children. So, further research is required to investigate the impact of educational technology on youth creativity and innovation.

As university students are the youth of any country and its future, the research is conducted on university students. Accordingly, this research investigates educational technology's impact on youth creativity and innovation. This is particularly important for Saudi Arabia as it has invested tremendous resources in digital technologies to modernize its education sector under its Vision 2030 government program (Saudi Gazette, 2016; Singh et al., 2022a). We selected the Ha'il region for this study as it is a swiftly growing region in Saudi Arabia. A study of the Ha'il region will benefit other developing regions in Saudi Arabia and other developing countries to foster youth creativity and innovation.

Objectives of the Study

The objectives of this study are:

1. To analyze the impact of educational technology on youth creativity and innovation.
2. To propose mechanisms for developing the creativity and innovation of the youth.
3. To recognize the study's contribution to educational technology and youth creativity and innovation literature.

Literature Review

Creativity is an individual or group procedure that leads to pertinent and relevant knowledge for peculiar circumstances (Runco & Leckelt, 2012). Innovation is a novelty that leads to improving or replacing processes, products, or services (Baregheh et al., 2009). Creativity and innovation can be enhanced in an appropriate and enabling environment (Plucker et al., 2004). Numerous studies have demonstrated that creativity and innovation can be fostered in children inside as well as outside school (Valgeirsdottir & Onarheim, 2017). However, there is no universally accepted standard mechanism (Lai et al., 2018). Examining the impact of educational technology and students' creativity and innovation are critical issues in the 21st-century educational system (Henriksen et al., 2018).

Historically, researchers in information and educational technology have examined educational technology's contribution to teaching and learning processes. Several researchers focused on streamlining communication among professors and learners through educational technology (Verenikina et al., 2003; Bharti, 2014). Numerous published works have theorized educational technology's role in fostering school children's creativity and innovation (Glaveanu et al., 2019; Loveless, 2007). For instance, Loveless (2007) contends that novel educational technologies foster creativity and innovation by developing learners' self-expression capabilities and enhancing confidence. Some investigators assess the role of educational technology in enhancing creativity and innovation through the lens of human-computer interaction (Glaveanu al., 2019; Lubart, 2005). Educational technology can act as a caregiver and provide an enabling environment to foster creativity and innovation (Glaveanu al., 2019). Educational technology can act as a facilitator and allow sharing of information openly among learners (Glaveanu al., 2019). Educational technology can act as a trainer and provide digital lessons and drills in a personalized and need-based manner (Glaveanu al., 2019). Educational technology can act as a fellow and partner with learners for producing, evaluating, and refining ideas (Glaveanu al., 2019).

Griffiths (2002) underscores that educational technology helps school children beyond entertainment purposes, including developing their creative capabilities. According to Kerawalla & Crook (2002), learners can get a technological advantage by accessing educational technology in their homes. This may help them to sharpen their skills. Early access to educational technology can help foster school children's creativity and innovation capabilities (Cecilia et al., 2015). Cofini et al. (2012) study shows that educational technology enhances children's learning capabilities with limited comprehension abilities. Educational technology can benefit young children's learning, which can greatly help develop their creative and innovative capabilities (Hsin et al., 2014). Di Giacomo et al., (2016) showed increased performance in cognitive learning of school children using educational technology. Despite the importance of educational technology in influencing students' creativity and innovation, there is a dearth of research on how educational technology influences creativity and innovation (Henriksen et al., 2021). Additionally, the majority of prior research has concentrated on schoolchildren, not adult learners. The mechanics of youth learning are distinct from those of school children, which this research will attempt to address.
In a nutshell, the literature review reveals that

- Educational technology can potentially impact young learners' creative and innovative capabilities.
- There is a shortage of research that has analyzed the impact of educational technology on adult learners' creativity and innovation.
- Most of the prior research on the impact of educational technology on learners' creativity and innovation capacities has taken place in developed countries. Additional research in developing countries such as Saudi Arabia is necessary.

Accordingly, this study endeavors to generate knowledge to utilize educational technology's potential to enhance youth creativity and innovation. Additionally, this study endeavors to address the research gaps we have identified in the literature.

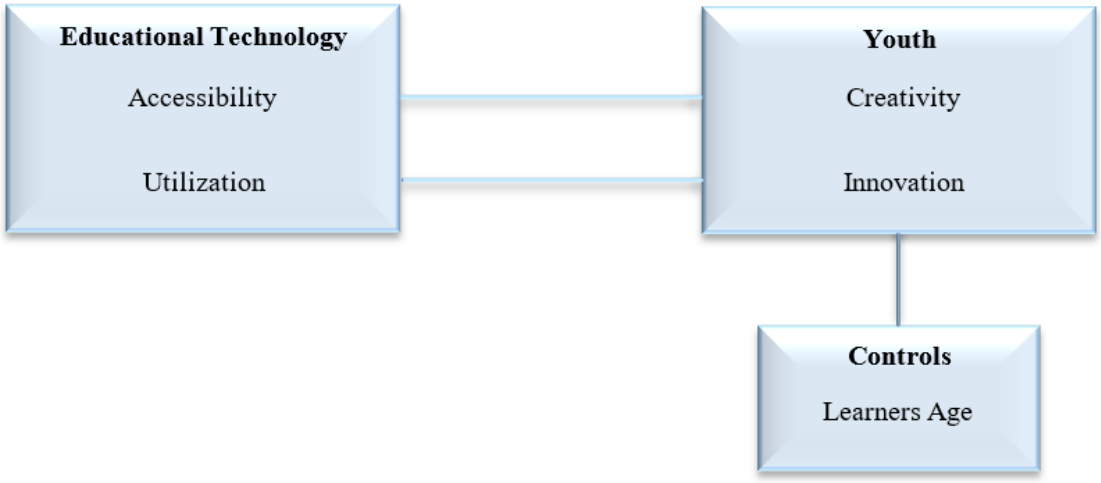

Figure 1. Study's Conceptual Model
(Developed by the authors)

Figure 1 presents the conceptual model for this study. The model portrays the educational technology's impact on developing young learners' creativity and innovation. The study's model introduces the learners' age as a control variable.

The following are the current study's hypotheses:

H1: There is a positive impact of educational technology on youth creativity.
H2: There is a positive impact of educational technology on youth innovation.

Methods

A quantitative research approach employing questionnaires was utilized to achieve the study's objectives. Accordingly, this section explains the study's sample, data collection procedures, variables, regression models, and analysis techniques.

Study Sample

This study collected primary data using questionnaires. The questionnaires were distributed at the University of Ha'il in Saudi Arabia to examine educational technology's impact on young learners' creativity and innovation. As university students are the youth and future of any nation, they were selected as the study's sample. Responses from 324 students' were acquired by non-probabilistic sampling. Table 1 displays the characteristics of the study sample.

Table 1.
Sample Characteristics

Variable	Category	Number(s)	Proportion
Age	1st	84	25.93
	2nd	82	25.31
	3rd	80	24.69
	4th	78	24.07
	18-21	171	52.78
	22-25	96	29.63
	26-29	36	11.11
	30-33	21	6.48
Sex	Males	161	49.69
	Females	163	50.31

Data Collection Procedures

We designed a questionnaire to obtain the primary data for this investigation. The questionnaire was devised using a 5-point Likert scale (strongly agree to strongly disagree) to capture students' opinions on the impact of educational technology on their creativity and innovation. We included an Arabic translation of the questionnaire to increase the understanding and participation of the students. Online distribution and collection of questionnaires allowed us to survey a sizable number of students while simultaneously eliminating potential sources of bias (Singh & Alhulail, 2022). Students were briefed on the study's goals and informed that their responses would be kept anonymous and confidential before being asked to participate in the study. The questionnaires were distributed to the students who supplied their informed consent.

Variables

We present the variables employed in this study and their definitions in Table 2.

Table 2.
Variables and Definitions

Variable(s)	Definition(s)
Dependent Variables	
Creativity (CRE)	An individual or group procedure that leads to pertinent and relevant knowledge for peculiar circumstances (Runco & Leckelt, 2012)
Innovation (INN)	A novelty that leads to improving or replacing processes, products, or services (Baregheh et al., 2009)
Independent Variables	
Accessibility (ACC)	The accessibility of various forms of educational technology (such as learning management systems, hardware, software, etc.) to university students (Fichten et al., 2000)
Utilization (UTI)	Students' effective utilization of educational technology for learning purposes (such as classworks, exercises, presentations, quizzes, examinations, etc.) (Azlim et al., 2015)
Control Variable	
Learner's Age (LA)	Age of the learner

(Developed by the authors)

Students' levels of creativity (CRE) and innovation (INN) are the dependent variables in this paper. Educational technology's accessibility (ACC) and utilization (UTI) are independent variables. Since students' propensity for creativity and innovation may vary with their age, we employed learner's age (LA) as a control variable.

Regression Models

The following regression models are evaluated to investigate the impact of educational technology on young learners' creativity and innovation:

$CRE_t = \beta_0 + \beta_1 ACC_t + \beta_2 UTI_t + \beta_3 LA_t + \varepsilon_t$ ***(1)***
$INN_t = \beta_0 + \beta_1 ACC_t + \beta_2 UTI_t + \beta_3 LA_t + \varepsilon_t$ ***(2)***
Where,
CRE – Creativity
INN – Innovation
ACC – Accessibility
UTI – Utilization
LA – Learner's Age
ε – Error term

Analysis Techniques

This study employed ordinary least squares (OLS) regression analysis to examine how educational technology impacts students' creativity and innovation. The objective of OLS regression analysis is to estimate linear regression coefficients in an effort to close the gap between estimated and actual values (Bravo & Godfrey, 2012; Kim, 2020; Singh et al., 2022b). Since OLS regression methodology effectively meets this investigation's objectives, it was utilized in this study.

Analyses and Results

Statistics for Data Description and Pearson Correlations

The descriptive statistics of the study's variables are shown in Table 3. The mean values for creativity (4.04), innovation (3.92), the accessibility of technology in education (4.09), the effective utilization of technology in education (3.95), and the age of the learner (22.35) are all displayed. The coefficient of variation (CV) measures data dispersion relative to a reference population (Singh & Alhulail, 2023). The CV of all the study's variables is low (Table 3).

Table 3.
Statistics for Data Description

Variable	Mean	Min.	Max.	Std. Dev.	Coeff. of Variation
Creativity (CRE)	4.04	1.00	5.00	0.67	0.17
Innovation (INN)	3.92	1.00	5.00	0.61	0.16
Accessibility (ACC)	4.09	1.00	5.00	0.79	0.19
Utilization (UTI)	3.95	1.00	5.00	0.91	0.23
Learner's Age (LA)	22.35	18.00	33.00	3.31	0.15

(Developed by the authors)

Table 4 shows the Pearson correlation matrix for all the study's variables. In the event that the explanatory variables exhibit substantial bilateral correlation, multicollinearity concerns may be present (Kim, 2019). Coefficients will have less precision, and p-values will not correctly predict the relevance of independent variables if multicollinearity exists between the variables (Thompson et al., 2017). Table 4 shows that there are no significant correlations between the explanatory variables (Schober et al., 2018).

Table 4.
Pearson Correlations

Variable	CRE	INN	ACC	UTI	LA
Creativity (CRE)	1				
Innovation (INN)	0.199	1			
Accessibility (ACC)	0.295	0.202	1		
Utilization (UTI)	0.312	0.302	0.298	1	
Learner's Age (LA)	0.363	0.336	0.287	0.342	1

(Developed by the authors)

Multicollinearity and Heteroscedasticity Tests

The researchers in this study took extra measures to check for multicollinearity and heteroscedasticity in the data (Table 5). Multicollinearity was evaluated using variance inflation factor (VIF) values. All VIF values were under 5; hence there were no worries about multicollinearity (Table 5) (Hair et al., 2011; Jiehong et al., 2022). Second, heteroscedasticity was assessed using Breusch-Pagan & Koenker (B-P.K) test. The B-P.K test p-values were all less than 0.05; hence we could conclude there were no heteroscedasticity issues (Halunga et al., 2017; Buallay, 2019).

Table 5.
Multicollinearity and Heteroscedasticity Tests

Variable	VIF-Value	B-P.K P-Value
Creativity (CRE)	2.985	0.018
Innovation (INN)	3.067	0.031
Accessibility (ACC)	3.321	0.021
Utilization (UTI)	3.004	0.025
Learner's Age (LA)	3.132	0.029

(Developed by the authors)

Multivariate Regression Analysis

The outcomes of the multivariate regression analysis are shown in Table 6.

Table 6's model I (CRE) shows an adjusted R^2 of 0.604, which indicates that accessibility and utilization of educational technology account for 60.4% of the variance (McCausland et al., 2021). The model's p-value is 0.015, which is statistically significant at the 5% level. This suggests that the use of educational technology has a salutary effect on young learners' creative capacities. This lends credence to hypothesis H1. Furthermore, there appears to be a positive and significant relationship between young learners'

utilization and accessibility to educational technology and their creative capabilities. This indicates that access to and effective utilization of educational technology is necessary to nurture young learners' creative capacities.

Access to and use of educational technology account for 61.1% of the variation, as shown by the adjusted R^2 of 0.611 in model II (INN) in Table 6. The model has a significant p-value of 0.013 at the 5% confidence level. This suggests that students' innovative thinking improves as a result of using educational technology. As a result, we can accept hypothesis H2. Additionally, there is a positive and strong relationship between youth innovation and the accessibility and utilization of educational technology. This indicates that both access to and utilization of educational technology are necessary to foster innovation among young learners.

Table 6.
Multivariate Regression Analysis

Variable	Model I (CRE)				Model II (INN)			
	Coeff. (B)	Std. Error	T-Stat	P-Value	Coeff. (B)	Std. Error	T-Stat	P-Value
Accessibility (ACC)	4.546**	1.645	2.764	0.006	4.563**	1.711	2.667	0.008
Utilization (UTI)	4.483**	1.651	2.715	0.007	4.497**	1.712	2.627	0.009
Learner's Age (LA)	0.796	0.559	1.424	0.155	0.795	0.561	1.417	0.157
R^2	0.577				0.582			
Adjusted R^2	0.604				0.611			
P-Value	0.015*				0.013*			

Note: * and ** indicate a statistically significant result at the 0.05 and 0.01 levels, respectively.
(Developed by the authors)

Discussion

The study results confirmed the initial hypothesis of the investigation. This indicates that educational technology stimulates the creativity of young learners. This finding is consistent with the claims made by researchers such as Glaveanu et al., (2019), Cecilia et al., (2015), Hsin et al., (2014), Loveless (2007), Lubart (2005), and Kerawalla & Crook (2002), who found that students' creative abilities improved after using educational technology tools. This finding lends credence to Glaveanu et al., (2019) and Loveless (2007) claim that educational technology helps students gain greater facility with and assurance in using their unique forms of self-expression. The findings support those of Kerawalla and Crook (2002), who found that using educational technology helped children learn more and better. Cofini et al., (2012)'s claim that the use of technology in the classroom helps students who struggle with comprehension is borne out by the study's findings. The vast majority of studies in this area have focused on elementary and secondary school students, but the current research demonstrates the importance of educational technology in fostering the creative potential of university students. The present research also adds to the body of knowledge by illustrating how important it is for learners to access and effectively utilize educational technology to foster their creativity and innovation.

The findings supported the study's second hypothesis. This demonstrates that educational technology has a favorable influence on students' capacity for inventiveness. This result supports the assertions stated by Glaveanu et al., (2019), Cecilia et al., (2015), Hsin et al., (2014), Loveless (2007), Lubart (2005), and Kerawalla & Crook (2002) who discovered that students' inventive skills improved after utilizing educational technology tools. This result supports Loveless's (2007) statements that educational technology helps students develop their ability to express themselves and builds their confidence. The study's findings are consistent with those made by Glaveanu et al., (2019), who claimed that educational technology helps students create, assess, and refine ideas. The study's findings concur with those made by Kerawalla & Crook (2002) and Cecilia et al., (2015), who discovered the beneficial effects of educational technology in fostering school students' innovative abilities. The majority of prior research has focused on school children. However, the results of this study demonstrate the critical role that educational technology plays in helping university students develop their innovation skills. The current study further adds to the body of knowledge by showing that the development of students' innovative skills depends on the accessibility and efficient utilization of educational technology.

Conclusions

This research took an empirical approach to how educational technology impacts youth creativity and innovation capacities. In contrast to previous studies, which mostly involved elementary and secondary school children, the current research involved university students at a Saudi institution. This study surveyed 324 Saudi university students using a quantitative research methodology. The survey's findings corroborated those in the previous research, which has long argued that educational technology advancements are crucial to nurturing youth creativity and innovation capacities. The new study adds to the body of knowledge on educational technology and skill building by illustrating how vital it is for youth to have access to and effectively utilize educational technology tools to foster innovation and creativity.

This research has important implications for Saudi Arabia, which is investing heavily in its higher education system as part of its Vision 2030 government program. Further, we conducted this research in Ha'il, a developing region in Saudi Arabia. The study's results will help other developing regions in Saudi Arabia and other developing nations to encourage creativity and innovation among young people. It is crucial that Saudi youth cultivate their creative and innovative skills to achieve the ideals of Saudi Vision 2030. The findings of this study indicate that technological advances in education may play a significant influence in fostering creativity and innovation among today's youth. Therefore, Saudi universities should work toward expanding student access to and utilization of educational technology to foster creative and innovative thinking among the country's youth. This research provides important insights into how to maximize the potential of technological advances in education for the benefit of young people's creative and innovative capacities.

Limitations and Future Research

There are some limitations to this study that can be worked out in follow-up studies. The current investigation included 324 students from a single Saudi Arabian public university. A larger sample size can be achieved in future studies by collecting data from a greater number of universities. In the future, researchers can gather information from both public and private universities to compare how they approach helping youth cultivate their creative and innovative skills. Data from higher education institutions (such as polytechnic colleges, teacher training colleges etc.) can be gathered in future research as well so that the effects of instructional technology on students' ability to think creatively and innovatively can be compared across settings. Graduates can be surveyed in future studies to further ascertain their orientation to hone their creativity and innovation abilities. Since the cultures of the other countries in the Gulf Cooperation Council (GCC) are similar to Saudi Arabia's, future researchers can also benefit from collecting data from these nations.

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