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Investigating the role of Emotions on the learning effectiveness in VR enabled teaching interventions in school

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Abstract

Technology advancements are known to frequently have direct and significant effects on the educational sector. There is an increasing trend in the academic use of Virtual Reality to demonstrates usability, utility, and amusement of the learner. The use of technological tools like virtual reality (VR) helps people develop the digital-age literacy, creative thinking, communication, teamwork, and problem-solving abilities that are required to transform information rather than merely consume it. VR improves standard courses to accommodate students' various learning demands. Applications for skill mastery and training are now possible because to recent advancements in digital reality generation. The learning is made more enjoyable and productive for the user by using real like photos, videos, animations etc., which provide augmented knowledge about the surroundings. Learners commitment is a significant predictor of attainment, retention and diligence for enhanced learning. The research papers findings reported that the VR environment increases the learning outcomes and offer many benefits for devoting time and money to them in higher and tertiary educational settings. For current research 347 students had been assigned to VR technology for learning. The outcome of this research supports the objective that the emotions affect learning using the VR technologies. The results revealed that the positive emotions affect the Ergonomic, Learning, Hedonic and overall learning. Emotions influence students' desire to study, based on their eagerness, inquisitiveness and willingness to accomplishing their goals of positive outcomes. Emotions make the implementation of learning approaches easier. Additionally, emotions can influence self-control techniques.

Key words: virtual reality, learning quality, ergonomic quality, hedonic quality, positive and negative emotions.

Introduction:

With the rapid expansion and explosion of information technologies are being utilised in education, there is a growing desire for educators to adopt technology in order to inspire students to study actively and motivate them to achieve an effective learning process. Technology advancements are known to frequently have direct and significant effects on the educational sector (Guttentag, 2010). Virtual reality (VR) and augmented reality (AR) are two ICTs that are quickly growing in popularity. Virtual reality (VR) has been defined as a computer-generated setting that offers a complete immersion in the online world (Guttentag, 2010). VR technology has the ability to give perceptual representations of actual circumstances while also allowing users to move around a virtual environment. The most thorough and widely used definition of augmented reality (AR) comes from Danado et al. (2005, p. 1), who describe it as: a technology that allows the superimposition of synthetic images over real images, providing augmented knowledge about the environment in the user's vicinity that makes the user's environment more familiar and useful. The activity is made more enjoyable and productive for the user by using genuine photos, which provide augmented knowledge about the surroundings around.

AR technology emphasises the capacity to deliver virtual information that is placed on the real world view without impairing it, as opposed to a completely immersive 3D experience as provided by VR (Han et al., 2013). A mobile application that overlays text, audio, 3D animations, and avatars is an illustration of AR technology. Consequently, VR and AR are not interchangeable in the strictest sense (Yung and Khoo-Lattimore, 2017). Because AR is seen as a form of VR (Guttentag, 2010) said that "AR and VR are connected and it is fairly valid to analyse the two ideas together," this review paper decided to adopt their methodology (2017) and jointly reported the results of the research in these two fields. Virtual Reality apps have the potential to make learning more active, productive, and engaging for students. Technology has become a part of education and makes use of innovative teaching methods and also affects the outcomes of learning. The usefulness of Virtual Reality (VR) has seen substantial growth in last decade, particularly in the educational sphere. Surprisingly, educational scholars believe that the way VR technologies support and facilitate meaningful learning is more significant than the technology itself.

The learners are engaged in learning by doing and critical thinking rather than memorising concepts. The active learners derive great benefits from the technology and makes the learning collaborative and very pleasant. Engagement as per the

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researcher Horstmanshof and Zimitat (2007) is the amount of physical and psychological energy and effort individuals devote to their university experience. The dominance of teacher-directed learning environments in educational institutions, can be assigned as the reason for the loss of learning motivation and can be linked to poorer learning behavior where the need for self-determination is largely ignored (Harackiewicz and Knogler 2017). Student participation is often limited despite the that it is recognized as a significant element. Despite the fact we choose to technology as it is applied, familiar, flexible, convenient and cost-effective. Few people still prefer to books rather than screens.

Educational institutions are now experimenting with self-directed/self-paced learning as a supplement to teacher-directed learning, while the impacts of this type of learning environment have not yet been properly examined. Impartial material, such as encyclopedia entries, contain emotive language, photos, other media in online content. According to Mather & Sutherland (2011) content which is emotional tend to draw more attention, enhances online engagement. Emotions have important role in learning as they alter cognitive resources, learning strategies, and motivation.

Mather & Sutherland (2011) in their research reported that the emotional stimuli outperform memory systems involved attention, storage, recall, and cognitive strategies, resulting in winner-take-all situation. (Dolcos et. al., (2017) had found that emotional stimuli influence the storage and retrieval of new knowledge. The positive or neutral statements are not easily recalled as compared to the emotional negative sentences (Pedaste et. al., 2015). When compared to neutral stimuli, emotional stimuli orient and capture attention more quickly, and the effect is stronger for negative stimuli (Estes& Adelman, 2008). Photos of furious faces or words like massacre, draw more response than pictures of pleasant appearances and the phrases like applause (Larsen et al., 2008).

According to Burucuoglu and Erdogan (2016) how people adopt technologies are based on functional, emotional and social dimension of the consumption value. Individuals embrace technologies when they recognize that they can accomplish their requirements. Perceived ease of use, utility and enjoyment are the three primary quality factors that have been found to be requisite for the intent to use.

While using the VR/AR the users usually wear an opaque headset or visor that covers their entire field of vision, and they interact with the virtual environment via controllers, gloves, distance sensors, and other devices. External distractions are blocked by the helmet, which makes it easier to focus on the virtual learning activity. This method immerses students in an interactive environment, giving them a comprehensive understanding of a concept or skill. Visualization of complicated concepts, items, and locations through vibrant realistic 3D models are incredibly difficult to describe in a classroom or visualize in a textbook. It's a lot easier with VR/AR since it creates a rich, dynamic experience that merges the real and virtual worlds.

People tend to forget memorized things quickly because the existing educational system frequently focuses more on theory than practical approach. VR/AR applications, on the other hand, encourage active learning by allowing students to interact with content and practice in real-time. This type of hands-on experience improves understanding, information recall, retention, motivation, and engagement among learners. In the virtual world, one lesson may successfully replace dozens of traditional ones. The effectiveness of VR/AR may depend on the type of empathy being measured.

Davis (1983) suggested that empathy is cognitive and emotional both. Being multidimensional it has the capability to comprehend how an employee is feeling and reciprocate the same with concern &care, hence displaying both cognitive and emotional empathy. Empathy is a spontaneous and mindful process. Emotional empathy is rapid, automatic, and spontaneous (Neumann & Strack, 2000). According to Sagi & Hoffman (1976) the instinctive emotional response was triggered even in infants when they see another person's pain. Cognitive empathy, is a more conscious process when the children around the age of three-five years old learn and understand that other individuals think and feel differently from them. With age, cognitive empathy matures into a more radical mentalizing skill (Gweon & Saxe, 2013), requiring attention and effort to comprehend another person's thoughts and feelings (Roxßnagel, 2000).

The unprecedented success of VR can be assigned to its great impression on the individual through its exclusive feature of immersion. VR technology with electronic devices offers a wide variety of commercial applications in academics, showbiz, healthcare, buying and selling. VR superimposes information into the real world through a virtual scene, the consumer is immersed into a completely artificial world. According to Hong, Hwang, Liu, Ho, & Chen (2014) variables that affected the intention to use VR-based systems were: usability, effectiveness, attention, engagement, enjoyment, motivation, computer playfulness, state of flow, immersion.

“With the comprehensive understanding of the literature quoted, the study is an attempt to understand how emotions affects the VR/AR lead learning. The objective of the study is to identify does the emotions affects the learning effectiveness. Izard’s (1977) Differential Emotions Scale (DES) was modified by Fredrickson (2001) to include wider set of positive emotions. To the eight distinct positive emotions of amusement, awe, contentment, gratitude, hope, love, pride and sexual desire were added two more emotions joy and interest. There were eight negative emotions along with surprise and sympathy. The student respondents had to recall the time since they commenced using the VR device in the schools. They had to record how often they had felt 20 different emotions on a 5-point scale (0 = never, 4 = most of the time). The subscales comprised of 10 positive and 10 negative emotions. The Positive Emotions scale had a **coefficient α = 0.72** and the Negative Emotions scale had a with **coefficient α = 0.73.**

The conceptual model of Pribeanu, Balog and Iordache (2016) had three dimensions: Perceived Ergonomic Quality, Perceived Learning Quality and Perceived Hedonic Quality, that was used to measure the perceived quality of an VR/AR

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application. Each dimension has two sub-dimensions. The **Perceived Ergonomic Quality** is particularly important for applications that use novel technologies and the users face new interaction techniques and might experience usability problems (Bai &Blackwell, 2012). This dimension has two facets: learnability and ease of use. **Perceived Learning Quality** has two facets: perceived efficiency and perceived usefulness. Perceived efficiency indicates a better and faster understanding, and is a widely recognized outcome of using AR technology (Iordache, Pribeanu, & Balog, 2016). Perceived usefulness is in terms of improvement of knowledge, usefulness for testing of knowledge and support for learning (Lee et al., 2010). **Perceived Hedonic Quality** has two facets: cognitive absorption and perceived enjoyment. Cognitive absorption is the state of total engagement when the attention is focused on the interaction with the application (Zhang, Li, & Sun, 2006). Perceived enjoyment refers to the enjoyable experience with the application (Heijden, 2004).
This instrument for VR/AR learning effectiveness and modified Differential Emotions Scale (mDES) was administrated on students (March and April 2022) in order to empirically validate the model. Total 348 students in the age group of 12–16 years responded to the survey. Out of which 22% were boys and 78% were girls. All the samples were collected from the School of Kherva Village in the Mehsana District who were using the Katcchuwa VR products. The response of the students was recorded in groups of 10 to 15, accompanied by a teacher after completing their learning through the VR device. The Cronbach Alpha was more than 0.7 for all the constructs studied (Table 1).

The objective of the study is to identify does the emotions affects the learning effectiveness.
The emotions for the study are classified as Positive and Negative and the learning effectiveness is defined in terms of Egronomic, d Learning Quality. "
H_{01} There is a no significant impact of Positive Emotions on Egronomic Quality of Learning.
H_{02} There is a no significant impact of Positive Emotions on Learning Quality of Learning.
H_{03} There is a no significant impact of Positive Emotions on Hedonic Quality of Learning.
H_{04} There is a no significant impact of Negative Emotions on Egronomic Quality of Learning.
H_{05} There is a no significant impact of Negative Emotions on Learning Quality of Learning.
H_{06} There is a no significant impact of Negative Emotions on Hedonic Quality of Learning.

Table 1 Reliability Statistics	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items	CR	AVE
Positive Emotions	.763	.767	10	0.711	0.268
Negative Emotions	.789	.795	10	0.785	0.309
Ergonomic Quality	.818	.891	6	0.872	0.776
Learning Quality	.833	.859	5	0.961	0.926
Hedonic Quality	.769	.759	6	0.991	0.983

Assessment of reliability and validity
The reliability values were above .70 indicating acceptable reliability. Table 2 for convergent validity and was found significant for the parameters and in the amount of variance explained by Anderson & Gerbing, 1988. The **composite reliability (CR)** of each factor is above the minimum level of **0.70, ranging from 0.71 to 0.99**. This suggests that the items are sufficiently representative on their respective construct. The **average variance extracted (AVE)** is above the minimum recommended level of **0.50,** for constructs, **Learning Quality, Hedonic Quality and Ergonomic Quality. Hedonic Quality** had the highest value of 0.983, indicating that **98.3%** of the variance in the specified indicators was **accounted for by the construct**. If AVE is less than 0.5, but composite reliability is higher than 0.6, **convergent validity of the construct is acceptable**. Hence for the Positive and Negative Emotions, AVE is less than 0.5 but composite reliability is higher than 0.6, the convergent validity of the construct is still adequate (Fornell & Larcker, 1981).

Table 2	CR	AVE	MSV	MaxR(H)	Hedonic Quality	Positive Emotions	Negative Emotions	Egronomic Quality	Learning Quality
Hedonic Quality	0.991	0.983	0.876	1.075	**0.991**				
Positive Emotions	0.711	0.268	0.163	0.972	0.344	**0.517**			
Negative Emotions	0.785	0.309	0.120	0.823	-0.347	-0.073	**0.556**		
Egronomic Quality	0.872	0.776	0.623	0.956	0.654	0.404	-0.138	**0.881**	
Learning Quality	0.961	0.926	0.876	0.973	0.936	0.391	-0.250	0.789	**0.962**

VALIDITY CONCERNS

Convergent Validity: the AVE for Positive_Emotions is less than 0.50.
Convergent Validity: the AVE for Negitive_Emotions is less than 0.50.

Structural Equation Modelling (SEM) is the technique that is used to analyze structural relationships. This technique is the combination of factor analysis and multiple regression analysis. This method is preferred as it estimates the multiple and interrelated dependence in a single analysis. In this analysis, two types of variables - endogenous and exogenous variables are used. Endogenous variables are equivalent to dependent variables and Exogenous are equal to the independent variable. The determination of appropriate sample size is a critical issue in SEM. According to Wolf,

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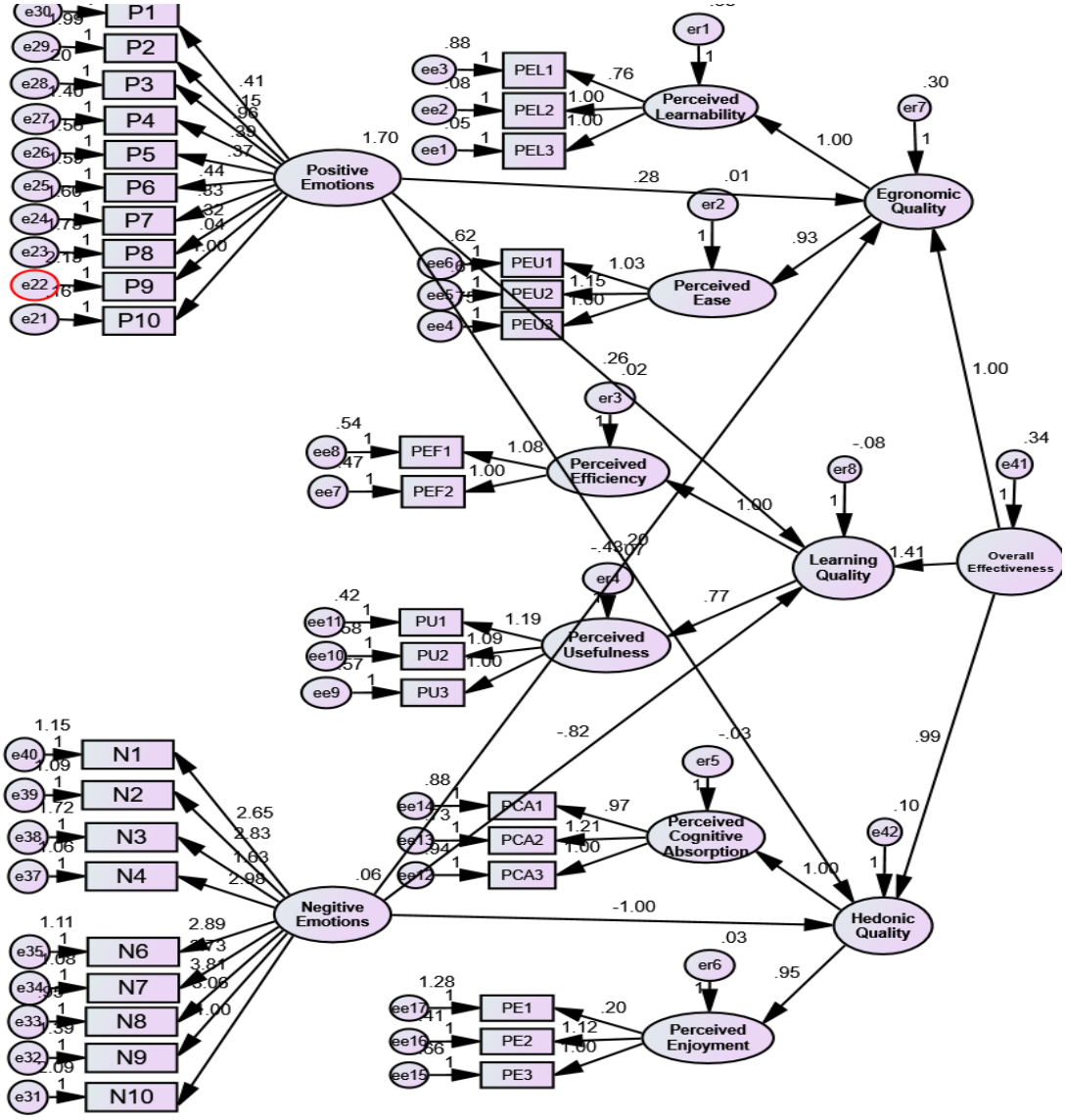
Harrington, Clarkand Miller (2013) suggested a range of sample size from thirty to four hundred and sixty. However sample size more is not always better. Kline (2010) suggested a larger sample size, N = 200 for SEM. To validate the conceptual model, AMOS 23.0.0 was used to analyze. The goodness-of-fit (GOF) indices are represented in Table 3. The structural model showed **good model fit**. The chi-square remained significant (1414.864, df 579). The ratio of $\chi 2$ /df was .244 AGFI was .774, GFI was .803, TLI was .842, CFI was .855, RMSEA was .064.

Table 3 : The goodness of fit index	**Cut off values**	**Result**
Cmin/df	<=2	2.44
p-value	>=.05	.000
AGFI	>=.90	.774
GFI	>=.90	.803
CFI	>=.90	.855
TLI	>=.90	.842
RMSEA	<=.08	.064



Regression Weights:

			Estimate	**S.E.**	**C.R.**	**P**	**Hypothesis**
Egronomic_Quality	<---	Overall_Effectiveness	1.000				

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			Estimate	S.E.	C.R.	P	Hypothesis
Learning_Quality	<---	Overall_Effectiveness	1.409	.147	9.571	***	
Hedonic_Quality	<---	Overall_Effectiveness	.992	.115	8.596	***	
Egronomic_Quality	<---	Positive_Emotions	.282	.040	7.001	***	H_{01} not accepted
Learning_Quality	<---	Positive_Emotions	.257	.038	6.808	***	H_{02} not accepted
Hedonic_Quality	<---	Positive_Emotions	.200	.034	5.827	***	H_{03} not accepted
Egronomic_Quality	<---	Negitive_Emotions	-.429	.261	-1.645	.100	H_{04} accepted
Learning_Quality	<---	Negitive_Emotions	-.824	.352	-2.339	.019	H_{05} not accepted
Hedonic_Quality	<---	Negitive_Emotions	-.999	.393	-2.540	.011	H_{06} not accepted
Perceived_Learnability	<---	Egronomic_Quality	1.000				
Perceived_Ease	<---	Egronomic_Quality	.934	.082	11.397	***	
Perceived_Efficiency	<---	Learning_Quality	1.000				
Perceived_Usefulness	<---	Learning_Quality	.775	.062	12.437	***	
Perceived_Cognitive_ Absorption	<---	Hedonic_Quality	1.000				
Perceived_Enjoyment	<---	Hedonic_Quality	.953	.095	10.000	***	
PEL3	<---	Perceived_Learnability	1.000				
PEL2	<---	Perceived_Learnability	1.002	.021	48.883	***	
PEL1	<---	Perceived_Learnability	.758	.045	16.899	***	
PEU3	<---	Perceived_Ease	1.000				
PEU2	<---	Perceived_Ease	1.150	.090	12.749	***	
PEU1	<---	Perceived_Ease	1.030	.084	12.211	***	
PEF2	<---	Perceived_Efficiency	1.000				

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			Estimate	S.E.	C.R.	P	Hypothesis
PEF1	<---	Perceived_Efficiency	1.077	.068	15.869	***	
PU3	<---	Perceived_Usefulness	1.000				
PU2	<---	Perceived_Usefulness	1.094	.090	12.136	***	
PU1	<---	Perceived_Usefulness	1.186	.090	13.237	***	
PCA3	<---	Perceived_Cognitive_ Absorption	1.000				
PCA2	<---	Perceived_Cognitive_ Absorption	1.212	.111	10.911	***	
PCA1	<---	Perceived_Cognitive_ Absorption	.974	.102	9.593	***	
PE3	<---	Perceived_Enjoyment	1.000				
PE2	<---	Perceived_Enjoyment	1.124	.089	12.624	***	
PE1	<---	Perceived_Enjoyment	.200	.088	2.262	.024	
P7	<---	Positive_Emotions	.328	.053	6.178	***	
P6	<---	Positive_Emotions	.443	.053	8.298	***	
P5	<---	Positive_Emotions	.366	.053	6.963	***	
P4	<---	Positive_Emotions	.386	.050	7.722	***	
P3	<---	Positive_Emotions	.961	.032	29.594	***	
N8	<---	Negitive_Emotions	3.806	1.334	2.854	.004	
N7	<---	Negitive_Emotions	3.726	1.309	2.846	.004	
N6	<---	Negitive_Emotions	2.886	1.027	2.812	.005	
N4	<---	Negitive_Emotions	2.976	1.055	2.820	.005	
N3	<---	Negitive_Emotions	1.630	.643	2.536	.011	
N1	<---	Negitive_Emotions	2.651	.949	2.793	.005	
N2	<---	Negitive_Emotions	2.825	1.006	2.809	.005	

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			Estimate	S.E.	C.R.	P	Hypothesis
N10	<---	Negitive_Emotions	1.000				
N9	<---	Negitive_Emotions	3.059	1.092	2.802	.005	
P10	<---	Positive_Emotions	1.000				
P8	<---	Positive_Emotions	.315	.055	5.716	***	
P9	<---	Positive_Emotions	.036	.061	.589	.556	
P1	<---	Positive_Emotions	.411	.056	7.369	***	
P2	<---	Positive_Emotions	.155	.059	2.636	.008	

Discussion and Conclusion:

The results of the study support the objective that the emotions affect learning using the VR technologies. The results revealed that the positive emotions affect the Ergonomic, Learning, Hedonic and overall learning. According to Goetz et al. (2003) emotions influence individuals desire to learn, based on their eagerness and inquisitiveness, as well as motivation, that will result in getting good results. Emotions make use of learning practices easier. Additionally, emotions can influence self-control techniques. Joy, hope, and pride are positive emotions that motivates for flexible learning strategies and self-regulation (Dewaele &Alfawzan 2018). Negative emotions such as hopelessness and boredom, on the other hand, are known to lower motivation and facilitate information processing, implying a negative impact on performance.
There is inconclusive evidence about the role of positive emotions in students' learning, with some research demonstrating how positive emotions or any well-being dimension relate to longitudinal increases in positive academic outcomes (Denovan et al.,2020). Affective phenomena in psychology can be conceptually approached from three attributes, commonly used interchangeably: affect, mood and emotion (Batson et al., 1992). Positive feelings like joy, hope, and pride are thought to support self-control, encourage the adoption of adaptable learning strategies, and contribute to both internal and external motivation (Tyng et al., 2017). As a result, they have a favourable effect on academic performance circumstances. Researchers discovered that pupils with greater emotional intelligence scores typically achieved better results on achievement tests and received higher marks. Even after adjusting for intelligence and personality traits, this conclusion remained valid.

Some academicians there is a strong link between emotional state and learning ability, according to this study. Academic emotions, according to Goetz et al. (2003), are feelings that occur in the context of education. He claims that such feelings might arise in five different academic situations: during class, during evaluations, while preparing or doing homework independently, while studying in a group, and in other circumstances. Academic circumstances such as one-on-one tutorials with the teacher to discuss a task or obtain oral feedback can be found in the last group. Other sensations are connected to social interactions or personal feelings.

Despite the fact that VR/AR use high-end technology and sophisticated tools, these technologies are unimportant to educational academics. What's more essential is how technology aids and facilitates meaningful learning. Educators, researchers, and designers would be more productive if they approached VR/AR as a concept rather than a specific type of technology. Employed technology to offer courses in a 3D format, allowing students to virtually manipulate a range of learning items and interact with the data in a novel and dynamic way. VR surroundings help people learn new skills. According to Klopfer (2008), VR mobile games allowed learners to organise, search, and assess data and information, allowing them to improve their skills in traversing primary and secondary material.
VR can provide a natural approach of presenting contextual and location-specific information to the user by integrating the real environment to information browsing and delivery (Alakärppä et al. 2017). It can also give a setting in which youngsters can engage with concepts that are difficult to grasp in real life. By mixing real-time evidence from the natural world with virtual information, VR allows these difficult concepts to be taught and learners to solve complicated issues (Tobar-Muoz et al. 2017). Recent studies justified that the content learned through VR technologies can improve students'

long-term memory, problem-solving skills, enthusiasm, motivation, and collaborative abilities, as well as improve learning performance (Wei et al. 2015), interaction, and learning satisfaction (Huang et al. 2016). The student's learning preparation, attitude, and learning style—used to customise the VR environments—have an impact on how effectively and successfully a virtual learning environments VLE are used (Jena 2016; Kurilovas 2016).

Emotions play a crucial role in learning, which is something that educators and students alike must recognise. Emotions range from pleasant to negative and are an embodied reaction to a stimulus (whether actual or perceived, internal or external). Emotions can significantly influence whether learning and teaching are supported or undermined in a learning environment. The cognitive abilities of attention, memory, executive function, decision-making, critical thinking, problem-solving, and regulation—all of which are crucial to learning—are inextricably related to and influenced by emotions. Interest, wonder, curiosity, passion, inventiveness, engagement, and joy are all desirable learning emotions. These improve focus and attention by turning on the brain's reward system, making the experience appealing. Positive emotional states can help pupils widen their horizons, consider alternatives, persevere through difficulties, and react skillfully to failure and criticism. The motivation of the learner is influenced by both positive emotions and the learning states they support. It is possible to think of motivation as the drive and vitality behind learning. Both internal learning objectives (mastery goals) and external motivators like grade recognition can help students learn (performance goals).

By increasing a user's perspective of and interaction with the real environment, Virtual Reality can be used for learning, amusement, or edutainment. Like a genuine object, the user can move around the three-dimensional virtual image and observe it from any angle. Users can execute real-world operations with the information provided by virtual items. Innovative computer interfaces that integrate the virtual and real worlds can be created to improve face-to-face and remote communication.The students in a positive emotion states while they are using the VR technology based learning enhances the overall learning is effectiveness. Their prior exposure to the technology can be credited to put them in positive state of emotions.

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47. **Modified Differential Emotions Scale (mDES) to find the Positive and Negative Emotions,** where measured as 1 = Not at all, 2 = A little bit, 3 = moderately, 4 = Quite a bit, and 5 = Extremely

	Item Name	**Questions**	**Response**
Positive Emotions	PE1	What is the most amused, fun-loving, or silly you felt?	
	PE2	What is the most awe, wonder, or amazement you felt?	
	PE3	What is the most grateful, appreciative, or thankful you felt?	
	PE4	What is the most hopeful, optimistic, or encouraged you felt?	
	PE5	What is the most inspired, uplifted, or elevated you felt?	
	PE6	What is the most interested, alert, or curious you felt?	
	PE7	What is the most joyful, glad, or happy you felt?	
	PE8	What is the most love, closeness, or trust you felt?	
	PE9	What is the most proud, confident, or self-assured you felt?	
	PE10	What is the most serene, content, or peaceful you felt?	
Negative Emotions	E1	What is the most angry, irritated, or annoyed you felt?	
	E2	What is the most ashamed, humiliated, or disgraced you felt?	
	E3	What is the most contemptuous, scornful, or distainful you felt?	
	E4	What is the most disgust, distaste, or revulsion you felt?	
	E5	What is the most embarrassed, self-conscious, or blushing you felt?	
	E6	What is the most guilty, repentant, or blameworthy you felt?	
	E7	What is the most hate, distrust, or suspicion you felt?	
	E8	What is the most sad, downhearted, or unhappy you felt?	
	E9	What is the most scared, fearful, or afraid you felt?	
	E10	What is the most stressed, nervous, or overwhelmed you felt?	

The VR/AR based teaching platform scale used is 5-point Likert scale (1 – strongly disagree, 2 – disagree, 3 – neutral, 4 – agree, and 5 – strongly agree).

			Questions	**Response**
Ergonomic quality	**Perceived learnability (PEL)**	PEL1	Understanding how to use device is easy	
		PEL2	It would be easy to learn how to use device	
		PEL3	It would be easy to remember how to use device	
	Perceived ease of use (PEU)	PEU1	It would be easy to use device for learning subjects	
		PEU2	Interacting with device was easy for me	
		PEU3	Device is easy to us	
Ergonomic quality	**Perceived efficiency (PEF)**	PEF1	Device would help me to understand the lesson faster	
		PEF2	Device would help me to learn more quickly and understand the lesson	
	Perceived usefulness (PU)	PU1	After using device my subject knowledge will improve	
		PU2	Device exercises are useful to test my knowledge	
		PU3	Device helps learning subjects	

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Hedonic quality	**Perceived cognitive absorption (PCA)**	PCA1	Time appeared to go by very quickly when I was using device	
		PCA2	While using device I was able to concentrate on the lesson	
		PCA3	While using device I was absorbed in what I was doing	
	Perceived enjoyment (PE)	PE1	Using device is an enjoyable learning experience	
		PE2	I like learning subjects with device	
		PE3	I enjoyed using device	