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A Bilingual Immersive Environment for Kids Learning

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Abstract - Virtual Worlds (VWs) provide an improved learning experience as they have an increased level of user participation and technological involvement. They avoid content duplication and following a set of predefined rules to overcome the issues in game environments. VWs are coherent, persistent and collaborative social places that believe in realism through immersion. Client viewer software is used for user immersion in the form of avatars and in-world content creation in these environments. This work presents a simple bi-lingual environment developed for kids' learning in English and Urdu using the well-known VW development framework called OpenSimulator (OpSim). It used Firestorm viewer for in-world content development and Linden Scripting Language for making the content dynamic and interactive. This work used Blender, Adobe Photoshop and Illustrator for developing images of different objects and adding their related dynamics before integrating them within the OpSim. It developed some basic activities for learning about colours, national personalities of Pakistan, Urdu alphabets, geometrical shapes and fruits. Bots were used to populate the content for making it more appealing. The proposed environment provides an arbitrary number of tries to perform each activity and guides kids through a real time positive feedback towards an improved learning. This work conducted initial validation tests of the proposed presence on standalone mode of OpSim framework with the help of domain experts, which confirmed the effectiveness of the proposed mechanism. However, it was suggested to conduct further validation on grid mode of OpSim framework. The developed environment shall be compared with other methods for learning purposes. It could incorporate more languages, activities and lessons. 3D working models of the alphabets, fruits and vegetables, and customized avatars capable of interacting with kids would offer more positive impact on learning. Similarly, the simple tasks could be extended to multiplayer collaborative games.

Keywords— Virtual Worlds, Metaverse, Second Life, OpenSimulator, Linden Scripting Language

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I. INTRODUCTION

Education has been provided, traditionally, through multiple methods. These methods are broadly categorized into physical and virtual in nature [1-2]. The most conventional method of physical learning has been using physical classroom environments. Teaching and learning in these traditional classrooms are hard and boring. Developing students' interest in them is a difficult task [3-4]. The concept of smart classrooms extended the traditional classrooms to overcome these limitations. It uses modern gadgets such as projectors, smart boards, tablets, desktop computers and smart phones to facilitate improved teaching and learning experiences [2]. Conventional and smart classrooms allow students to participate in collaborative tasks and social interaction. Team based activities and practice has a positive impact on learning, however, in developing countries, the time constraint and lack of passion among teachers make them difficult and boring. The scarcity of physical classrooms, and the time and cost needed for studies in person has always encouraged exploring new methods of leaning to help accommodate those individuals who are, otherwise,

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unable to proceed with their studies [5-6]. Distance learning, physical in nature, is an economical alternative to physical schooling system [5]. However, it believes in isolated studies and, thus, provides limited innovation and creativity.

Internet technologies greatly transformed traditional ways of teaching and learning. Online learning not only overcame the scarcity of physical resources but it also saves cost and time [7-8]. However, they are usually criticized for lacking classroom experience [1]. Technology greatly improved physical and online teaching and learning practices [2, 9]. However, it is observed that gadgets such as mobile phone, tablets and laptops, and applications such as Facebook, TikTok and YouTube have caused students' distraction. Thus, teaching and learning need to incorporate the latest technological trends into the learning process for an improved experience.

Gamification in learning was introduced to cope with the above mentioned issues [10-11]. It improves learning experience as it increases user participation, reduces technological distraction and overcomes the boredom of humans in repetitive tasks [12]. Games are interactive, cooperative, collaborative, immersive, and entertaining in nature [7]. It is the immersive experience that creates the illusion of reality for users [13]. Traditional games such as Ultima Online [14] have introduced more advanced features such as persistence. They are highly scalable, however, they use content duplication to achieve this goal. They lack coherence and use a set of predefined rules [15-16]. They are, therefore, less creative in nature. To overcome these issues, games are equipped with additional features such as coherence and being sociable for an improved user experience. These collaborative, coherent, persistent and social immersive spaces are called Virtual Worlds (VWs) or alternatively the Metaverse. VWs do not follow a strict set of predefined rules and they are, thus, more creative than games [17].

VWs imitate the real world for content provision and users' immersion in them to answer the criticism on traditional online methods [18-19]. For this purpose, they use a software module called client viewer [6, 20]. They provide social interaction, which is needed for establishing social and ethical norms among the users [1]. Users are represented in the form of digital characters called avatars, which are not only capable of walking and running but also flying and teleporting [8, 21]. There are a large number of environments available to develop VW presences, however, Second Life (SL) [22], OpSim [21] and Activeworlds (AcWds) [23] are the most wellknown VW development platforms [24]. OpSim is preferred over SL and AcWds as it is not only open source and flexible but also more scalable and available free of cost. Further detail on the comparison of these environments is provided in Table 1.

Table 1. The Comparison Of 3 Well-Known Virtual World Development Platforms.

Parameter Name	Virtual World Platforms		
	Activeworlds	OpenSimulator	Second Life
Open Source	No	Yes	No
Charges	Yes	No	Yes
Server Infrastructure	Client-Server	Grid	Grid
Development Language	C/C++	C#	C++
Scripting Language	Renderware 2	LSL	LSL
User Representation	Avatar	Avatar	Avatar
3D Virtual Objects	Yes	Yes	Yes
Configurable Scenarios	No	Yes	No
Educational Abilities	Yes	Yes	Yes
Flying/Teleporting	Not functional	Yes	Yes
Offline Scenarios	No	Yes	No
Bot Characters	Yes	Yes	Yes
Support for 3rd party clients	No	Yes	No
Persistent	Yes	Yes	Yes
Collaborative	Yes	Yes	Yes
Coherent	No	Yes	Yes
Scalable	No	No	No

Pakistan is one of the few countries in the world, where kids have to learn multiple languages. Learning languages is a laborious job and it requires continuous practice which is boring for teachers. Thus, VW environments could overcome these issues. However, according to our knowledge, such a multi-lingual environment does not exist to help

kids learn various activities in different languages. This work is a step towards producing such an environment using OpSim framework. The Purpose of this research was to develop an attractive VW environment for an improved learning experience of kids. The proposed environment is currently providing some basic activities for learning in Urdu and English languages. It used the Firestorm viewer based on inspiration from the study presented in [20]. It used Linden Scripting Language (LSL) for developing dynamic interactive content. It also used Blender, Adobe Photoshop and Illustrator while developing the proposed content. It presents a few basic learning activities regarding colours, famous personalities of Pakistan, Urdu alphabets, geometrical shapes and fruits. The system provides an arbitrary number of tries to perform these activities in English and Urdu, and guides kids through a real time positive feedback towards an improved learning. Non Player Characters (NPCs) called Bots were used to populate the content for making the learning environment more interesting and entertaining. This work evaluated the effectiveness of the developed environment using standalone mode of OpSim framework with the help of a few domain experts and its response was promising. However, detailed analysis using grid mode of OpSim would be carried out in future. This work would be extended to incorporate the suggestions of domain experts identified as future work in this paper.

This paper is structured as follows. Section I introduces the research domain and the platform used for the development of proposed mechanism. Relevant literature is explored and critically analyzed in section II along with the motivation, goals and objectives of the proposed environment. Section III presents the proposed environment along with the tools and frameworks used for developing this environment. Validation results of some initial tests along with limitations and suggestions of experts for further improvement are presented in section IV while the conclusion and future work is given in section V.

II. LITERATURE REVIEW AND MOTIVATION

This section critically analyzes relevant literature and presents the motivation along with objectives of this work.

A. Relevant Literature

Technology was integrated into Education in order to overcome technological distraction and achieve an increased level of interactivity. This led towards developing the concept of smart classrooms. In [2], it was learnt through an experiment that students' engagement in smart classrooms was significantly improved over traditional classrooms. However, physical setup made of traditional and smart classrooms are limited due to restricted timings and higher cost incurred on them. Similarly, there might be cases such as Coronavirus Disease (COVID 2019) outbreak where physical activities might remain closed. Thus, online methods are preferred in these circumstances as they are capable of guiding students without schools [7]. However, there is always a concern about sole reliance on online learning.

In [7], the authors conducted a study examining whether basic learning needs could be achieved using traditional online mode of study. It was learnt through a detailed analysis that learning needs were partially achieved. It was also learnt that adequate positive feedback and arousal improves effective online learning. Teaching and learning must be aligned with technological development for making these activities more efficient and effective. Towards this, the concept of gamification was recently used in education to innovate it. In [25], the authors conducted applied research and used gamification tool to study various activities in a project management course. They used Quizizz as an assessment tool and claimed a positive impact. 66% respondents preferred using Quizizz as an assessment tools compared with quizzes taken on paper or Google forms. The impact of screen cast videos in learning was explored in [26] while an online learning platform with agent based assistance was presented in [27]. Traditional online methods, however, are generally criticized for lack of classroom experience.

To overcome these limitations, Virtual Reality (VR) systems are used, which are primarily developed for entertainment purposes. They have proven highly potential tool for businesses, knowledge dissemination and learning. Thus, education institutions have started introducing VR supported teaching. In [28], the authors investigated the possibilities of using VR in vocational trainings. They analyzed the usability and suitability of selected VR systems and relevant cameras that are used in industrial practices for developing VR software products, which are used in vocational apprenticeships. In [10], the authors also explored the role of VR in learning and found that it has an improved affect on students' mastery about different material. They also identified the role of VR gadgets such as glasses and helmets for an immersive experience. However, hardware based VR solutions are costly. To encounter this, software based 3D alternatives are encouraged to develop. Software based VR systems include most of the existing 2D/3D games environments. The majority of them including Ultima Online [14] have advanced characteristics such as immersion, collaboration and persistence. However, they are not coherent and follow a strict

set of rules. These environments are not social in nature. Further, they lack coherence and use content duplication for scaling purposes.

To encounter the above mentioned issues, Virtual World (VW) environments are developed as the most advanced form of 3D virtual spaces. These environments have been used in various domains including education, content visualization and preserving cultural heritage [19]. In [13], the authors developed a 3D virtual physics laboratory for improving cognitive skills of students with learning disabilities. According to them, VWs are capable of creating highly complex interactive simulation. The authors developed a customized 3D set-up for students with learning disabilities against a specially designed criterion and studied its effectiveness. This study suggested that the learning experience was improved. The authors in [18] also suggested the use of 3D online VWs for practicing collaborative activities as these environments have opened new horizons of student centered pedagogies. They believe that these environments are capable of facilitating in-depth and durable learning of complex theoretical concepts without advanced skills and specialized resources. Tlili et al. [29] conducted a systematic literature review for summarizing the literature related to the use of Metaverse in education. They investigated the literature, which revealed that there is potential gap in lifelogging applications. It was learnt that the design of Metaverse has changed over time and the most recent generation is targeting AI technologies.

SL has emerged as one of the most promising and stable VW development framework since its beginning [30, 22]. They offer virtual classrooms, meeting rooms and laboratories where regular sessions are conducted. There is a large number of learning environments developed using SL, whose detail is listed in [31]. In particular, it includes virtual presences of different Universities worldwide including the University of Texas at San Antonio (TejanoTech - UTSA Virtual Campus), University of Shieffield UK (Infolit iSchool) and Standford University (virtual library) [32]. Similarly, there are many museums developed virtually in SL [33]. VWs have an increased interest in cultural heritage as they not only offer support for visual presentation but they can also be used for educational purposes. It is believed that VW presences for cultural heritage in the form of a 3D game have emerged as a promising method of learning for users of all ages. In [34], the authors explored the potential of SL for cultural heritage. This study found promising aspects of knowledge dissemination about heritage. Since, SL is commercial and closed environment, the content developed through it is mostly proprietary and, thus, it is not available for common use. To support Research and Development communities, OpSim framework provides a valuable alternative to SL. OpSim is not only more flexible, scalable and available free of cost but its complete source code is also available for further improvements. The majority of user developed content is available for use and experimentation in the form of specialized archive files. Introduction of some well known presences developed in OpSim and available in the form of archive files are available at [35].

Pakistan is one of the few countries in the world where its citizens need to learn multiple languages. Each person is required to learn at least three languages: Urdu as the national language, English as the official language and a mother language, which is usually one of the local languages such as Punjabi, Pashto, Sindhi and Balochi. Similarly, it has diverse cultural heritage. However, the Metaverse for learning and cultural heritage is merely used in Pakistan. Therefore, there is a need to utilize this exciting platform for education and cultural heritage to get global audience. In [1], the authors used OpSim framework and Blender for developing an educational and cultural heritage presence for the University of Science and Technology Bannu - Pakistan. It constructed the present (academic setup) and reconstructed the past (the British rail System) of this institution, which is mostly demolished. This work provided interactive maps and signboards to support advanced navigation through teleporting. It not only imparts online education and help youngsters to know about the past but also facilitate prospective students by offering them virtual tour of the campus. It was learnt that the users liked navigation through flying and teleporting while exploring the spaces. These authors further analyzed the impact of carefully designed VW presences in learning using the same environment. They conducted experiments with the help of users and quantitatively analyzed this presence whose results are summarized in [19]. It revealed that the properties such as realism, friendliness, advanced navigation, and being detailed and social in nature greatly attracted user attention in learning. The learning was fast compared with traditional methods, however, it was a little hard for naive users to start exploring the content. Pre and post learning responses of users revealed that their knowledge level was significantly increased. Though, this environment took a local scenario, however, it only offers the content in English language. It is generally suitable for learning advanced concepts and higher grade students. On the other hand, the aim of this work was to develop a multi-lingual VW presence for kids to start learning 4 different languages with the help of a diverse set of activities.

B. Motivation, Goal and Objectives

The unique and exciting features of VWs and the nonexistence of a multi-lingual VW environment for kids' learning in Pakistani context motivated us towards developing such an environment. The primary goal of this system was to offer effective guidance to kids for improved learning. This work has the following objectives:

1) It aims to develop a coherent, consistent, cooperative and social immersive environment for an improved learning in Urdu and English languages.
2) It aimed fostering creativity among the kids through increased user participation and reduced technological distraction while avoiding using a set of predefined rules.
3) It further aims to cope with the limitation of humans' boredom for repetitive tasks.

III. THE PROPOSED PRESENCE

This work used the concept of gamification to develop a bi-lingual immersive learning environment, which provides a platform for kids to learn various academic activities in Urdu and English. It facilitates learning in individual and group capacities in real time. It is developed using OpSim, where users are represented in the form of avatars, which are either teachers or students. The students are taught not only to learn a few simple concepts of colors, fruits, languages and mathematics but also the ethics and social norms in the form of supervised learning through mentors or system itself. The kids can learn distinguishing different colors, fruits, personalities, Urdu alphabets and geometry with the help of various activities with carefully designed feedback mechanism to enhance their learning experience. It allows unlimited practice for overcoming the boredom of repetitive tasks and producing a more detailed statistics on learning outcomes. Objects related to these activities are carefully designed that resembles the actual objects. Scripts are added to these objects, which are executed when they are touched by the avatars of the users. These scripts provide response and positive feedback in the form of text as well as associated voice. Gamification of the activities and positive feedback towards learning were expected to increase users' interest towards learning. It was also expected to reduce technological distraction by making it part of learning. This work created an OpSim region using Firestorm viewer in standalone mode and, then, added various objects needed for the selected activities. Some of the objects were created from scratch using various tools while the others which were available for use were obtained from other sources. The researchers added different pictures, textures and scripts to make these objects attractive for kids. Well designed interfaces are provided for user interaction with these activities and objects. In case a user response is correct, it acknowledges the responses in the form of text as well as voice. In case of a wrong response, it not only acknowledges the response but also provide a positive feedback to help kid learn the concepts. This work added bots to make the proposed environment more interesting and real for kids.

A. Tools Used

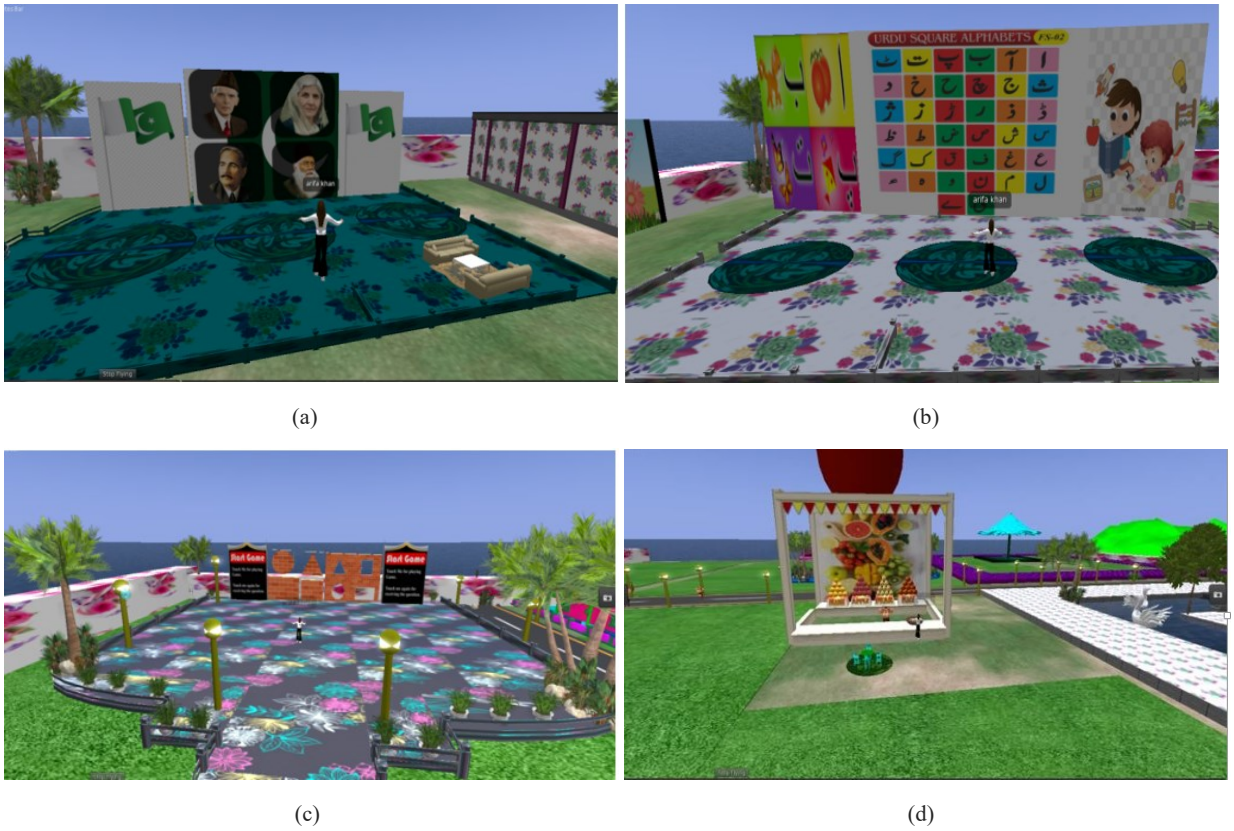
This work used a number of tools for developing various aspects of the proposed presence and integrating them all for an exciting learning experience. It was developed over Windows operating system. It used OpSim Framework [21] and Firestorm viewer for the development of content and integrating various aspects into the presence. LSL was used for adding dynamism to the content. Most of the basic and builtin functionalities of OpSim were used including the avatar appearance and advanced navigation through flying and teleporting. This work used Adobe Photoshop [36] for designing various images used in the developed space, which has become an industry standard for digital art and raster graphics. It used Adobe Illustrator [37] for developing Urdu characters, which has demonstrated an improved creativity among the students for developing vector graphics. Blender [38] was used to add animations to the mesh models before integrating them into the developed content. Since, the proposed mechanism used both textual and voice based learning material and feedback, voice maker [39] was used for creating different voices of the text used in various activities and converting audio into mono form before integrating them into the developed presence. Google Chrome was used for searching material about different topics and activities covered in this work.

B. Activities and Related Scripts

This work developed a number of activities for learning regarding colors, famous personalities, Urdu alphabets, geometry and fruits. In particular, it distinguishes between different colors, National personalities, Urdu alphabets, geometrical concepts and Fruits. Figure 1(a)-(d) shows four different portion of the presence where the activities considered in this work do run when they are initiated by the avatars.

To help kids learn various colors, this work provided a simple activity in which chairs were given different colours. When this activity is initiated, the kid is asked to sit on a randomly selected and announced chair. The kid, then, acts accordingly and selects the chair and sit on it. If the colour of the selected chair matches with the asked one, it tells the kid in written as well as verbal form that "The selection was correct". Otherwise, it produces a message "Oh! It was a different one, try again". The system gives a hint to the kid what the color looks a-like or by highlighting the chair with the asked color.

To help kids learn about famous personalities, this work developed a gallery and provided the images of four famous personalities. It includes the details about the Founder of Pakistan Quaide-Azam Muhammad Ali Jinnah, his sister Madar-e-Millat Muhtarama Fatima Jinnah, Shayer-e-Mashriq Allama Muhammad Iqbal and Sir Syed Ahmad Khan. Scripts to their pictures are added in both text and voice form. When a kid clicks on an image, it displays a brief introduction of the selected personality in textual form with an option to say the text in verbal form. It not only offers the introduction in both Urdu and English but also help learn the vocabulary in both languages using the voice over text. The system has also an activity where it asks the kids to select the personality against a given query. It provides the details about a personality if the kid selects a correct image in response of a query. Otherwise, the detail is not displayed if the wrong image is clicked. The queries for this task consider different information about each personality on the basis of provided information. Figure 1(a) presents the virtual gallery implementing the activities and their interfaces for initiating them.



(a) (b)

(c) (d)

Figure 1. Random Glimpses from The Developed Environment. Interfaces For the Activities Regarding: A). National Personalities, B). Urdu Alphabets, C). Basic Geometrical Shapes And D). Fruits Kept in A Virtual Fruit Shop.

Learning alphabet set as the foundation for a language is advantageous for kid as it help them learn how the letters and words are pronounced and spelt. Keeping this in mind, this work provides an opportunity for kids to learn the sequence and pronunciation of Urdu alphabets. It presents an interactive interface towards these alphabets, which is equipped with attractive images of alphabets. The kids can get lessons by clicking on the alphabets. It tests kids' ability to select the correct option against a randomly chosen alphabet by the system. It pronounces the alphabet if the correct option is selected. Otherwise, it is guided towards the correct alphabet. The gallery of Urdu alphabets and interfaces for their related learning activities are presented in Figure 1(b).

To help learn basic geometry shapes, the developed environment provides a lesson about the basic shapes including the square, rectangle, circle and triangle. It also includes a simple game of missing parts in the form of basic geometry shapes, which the kids are asked to fix with the correct missing parts. It provides a well defined interface for not only learning about the shapes but also for playing the game. In case of using a wrong shape, the system provides a positive feedback by highlighting the shape needed to complete the pattern. Figure 1(c) provides the gallery managing these activities about basic geometrical concepts.

This work utilised existing 3D mesh models of different fruits to help kids learn about them. It used a bot to serve as shop keeper. A user's avatar can pick and put the fruits in basket. The system provides a lesson on a few common fruits in English and Urdu. It provides activities that allow kids to differentiate fruits based on their names or colors. When a correct option is selected, it pronounces its name. In case a wrong option is selected, the system highlights the correct response for kids' attention. Blender was used for giving motions to the mesh models before incorporating them into the developed presence. The fruit shop used for different learning activities and their interfaces is presented in Figure 1(d).

Besides the above mentioned avatar centered activities, the authors decided to populate the region with Non Player Characters (NPCs) called Bots. They, therefore, downloaded Monkey's mesh model and given it a script for random walking using Blender. Several bots of the same model were added to make the space more interesting and fascinating. Figure 1 also highlights various aspects such as road infrastructure and user as well as bot characters.

IV. EVALUATING EFFECTIVENESS

This section validates the effectiveness of the proposed presence with the help of a simple set of experiments targeting the features and functionalities of OpSim framework and client viewer as well as various learning activities developed for kids. It introduces the evaluators and provides experimental setup, experimental tasks, validation results and suggestions of the evaluators for improving the developed environment.

A. Experimental Set-up and Evaluators

This work used an experimental set up comprises a machine running the stable versions of both OpSim instance in standalone mode and a Firestorm viewer. SQLite was used as a back-end database server. The prototype developed was loaded to a region on OpSim instance. This work was validated by three domain experts in whom two were male while the third was a female. The experts were all local and they were given a chance to explore the content in individual capacity. They were thoroughly guided to explore the capabilities of OpSim framework as well as the developed presence.

B. The Experiment and Questionnaire

To validate and evaluate the effectiveness of the proposed presence, this work used a basic but detailed experiment. It covered the characteristics of host platform as well as the effectiveness of the developed content. It also requested the evaluators to produce the limitations of current prototype and recommend improvements. Experts responses were recorded through a questionnaire divided into two parts. Questions regarding the host platform and developed content were added in first part while experts' feedback and future prospects were collected in second part of the questionnaire. This work used a multi-point scale for questions of first part while left second part for suggestions open ended. The first part asked evaluators to produce their experiences regarding the following tasks:

1) use of different interaction methods such as text and voice.
2) in-world immersion.
3) in-world digital representation of users and the way they perform various activities.
4) existence of Bots and their role in making the content attractive.
5) navigation in the form of walking, running, flying and teleporting.
6) retention of concentration and overcoming technological distraction.
7) attractiveness of content and activities.
8) interaction and learning.
9) impact of unlimited practice of tasks on learning.
10) simplicity and ease of use to explore the content.
11) completeness of the content.
12) feedback mechanism and its impact on learning.

13) usefulness.
14) accessibility.
15) overall impression.

C. Validation Results

According to the experts, the developed VW presence is a true multimedia application, which offers multiple means for communication among the users. Similarly, it allows users to interact with various in-world objects using different ways. The evaluators acknowledged that VW presences offer an immersive experience. They agreed that the representation of users in terms of humanoid shaped avatars look like the people in physical world. They, however, suggested developing customized avatars to resemble actual individuals as the current prototype uses the OpSim default structure for the avatars. When the experts were asked about their experiences with NPC Bots while exploring the presence, they agreed that their presence made the content more appealing, lively and attractive for kids. However, they offer very limited interaction with other objects and avatars. They suggested that they might be made tutors and mentors for offering learning support around the clock as the tutors and mentors backed avatars disappear as they go offline. They could be made intelligent, which can learn from actual mentors and tutors and, then, use the gained knowledge to help assist kids in learning. The experts navigated the space by walking, running, flying and teleporting. They believed that exploring the content using conventional walking and running makes it a real time experience but purely virtual in nature. The presence is, however, made more interesting and fascinating by offering navigation through flying and teleporting. These unique and advanced navigation methods would attract the attention of kids. Especially, they believed that teleporting is the most valuable and innovative addition to virtual spaces that is capable of transferring an avatar to an arbitrary location within a few seconds. However, it would require a scalable world based on grid mode of OpSim as the current exposure was limited in scope to a single standalone region. The experts agreed that the VW environments immersively involve the users in different activities and, thus, they greatly help avoid technological distraction. However, the activities must be designed in a manner to retain the attention of users.

In response to a query about the content and activities, the experts believed that they are carefully designed and attractive but most of them are single user. Though, the environment and its generic activities are 3D in nature, however, the learning material is presented in 2D form. They suggested incorporating multi-user collaborative activities. Content shall be made 3D for a better experience. Learning in an interactive and collaborative environment is fun and it makes the environment capable of attracting and retaining kids' attention.

The experts believed that unlimited practice helps students' to learn better but with additional timings. However, it does not suffer the students who learn faster. Similarly, it overcomes the issues with real people while performing repetitive tasks. The experts were of the opinion that it would be hard for kids to start with, though, they believed that content is simple. This simplicity makes it easy to explore especially using flying and teleporting. It is, however, believed that most of the kids play online games and it would be an exciting experience for them to learn with the help of VR. The experts believed that the simple activities were enough to achieve their goals, however, more detailed activities were recommended for an improved learning. The experts agreed that the positive feedback given to users during the learning has a positive impact. They believed that the proposed presence is useful. The experts pointed out that the presence was accessed using powerful 7 computers and laptops. They added that smartphones are more common nowadays and, therefore, there is a need to make VW presences accessible on smart handheld devices. The experts had an overall impressive experience. They recommended the use of such systems for learning different concepts as well as ethical and social norms.

V. CONCLUSION

This section concludes the work undertaken in this work It uses experts suggestions to produce limitations of current presence and enlist future directions.

A. Summary of Works

This work explored different physical and virtual methods for learning along with their strength and limitations. It was learnt that Virtual Worlds offer the most effective way of learning and compared three well-known VW development frameworks and selected the OpenSimulator framework for prototype development in this work. Relevant literature was critically analyzed and research gap was identified. This work used Blender, Adobe Photoshop and Illustrator, and Voice Maker to support the development of a simple bi-lingual environment for kids' learning in

OpenSimulator platform. Firestorm viewer was used for in-world content development while Linden Scripting Language was utilized for making the content dynamic. The current prototype provides a few basic activities for learning about colours, famous personalities of Pakistan, Urdu alphabets, geometrical shapes and fruits in Urdu and English. Bots were added to the content for making it more interesting. The system provides an arbitrary number of tries to perform each activity and guides kids through a real time positive feedback towards an improved learning. The effectiveness of the developed mechanism was evaluated by domain experts using a simple but detailed experiment. This evaluation confirmed not only the effectiveness of the proposed mechanism but also provided positive feedback for further improvement in future.

B. Limitations and Future Directions

The experts endorsed that the proposed system is useful and easy to use, however, the current prototype offers limited activities of a few selected concepts. Similarly, the evaluation setup to find out the effectiveness of the OpSim platform and proposed presence was confined to standalone mode. In response, it was unable to experience well-known characteristics and activities linked into more flexible and scalable grid mode of OpSim framework. Based on experts opinion, the following are enlisted as future directions:

1) use grid mode of OpSim framework to host the presence and evaluate the efficiency of the characteristics such as global reach, concurrency, scalability, in-world collaborative activities and social behavior, which are linked to this scalable mode of OpSim framework.
2) need to incorporate collaborative tasks and activities such as multiplayer games. Particularly, extend the chair selection activity into a multi-player musical chair game. Similarly, a competitive multi-player shooting coloured balloons can be an interesting activity. The simple geometrical game may also be easily converted into a multiplayer competitive game.
3) add more 2D shapes and their associated tasks and extend the geometrical tasks towards 3D concepts.
4) add more personalities and it would be interesting to develop their 3D customized characters who can interact with kids for a more improved learning experience as it will increase kids engagement. They may be developed as NPC characters so they can facilitate learning around the clock.
5) English alphabet set shall be added. Rules for developing words and their associated tasks might be an interesting addition.
6) incorporate bi-directional translations of alphabets and words between Urdu and English.
7) add more languages especially Arabic and Chinese languages to the developed presence for facilitating learning the Holy Quran, and interaction and joint ventures with Chinese in corresponding order.
8) bots could be made intelligent and they may be used as tutors and mentors in the developed presence. It would be interesting to add bots for aerial birds.
9) add 3D models of the objects currently in 2D such as alphabets in different languages.
10) extend the fruit shop by adding more fruits. It could include basic vegetables. The setup can be extended to provide capabilities for learning basic arithmetic such as addition, subtraction and multiplication.

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AUTHOR CONTRIBUTIONS

Tufail Ahmad: Literature Review and critical analysis, Conceptualization and Design
Arifa Bibi: Literature Review and critical analysis, Implementation and Writing – Original Draft Preparation.
Umar Farooq: Supervision, Discourse Analysis, Validation and Writing – Review and Final Editing
Ihsan Rabbi: Supervision, validation, Writing – Review and Editing

CONFLICT OF INTERESTS

Authors has no conflict.

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