

Virtual Reality: An Efficient Tool for Promoting Social & Psychological Considerations in Designing for Disables

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ABSTRACT: The experimental study aimed to identify the ability of virtual reality technology to promote the psychological and social considerations for the physically disabled in schools. The study sample consisted of 10 students of North Sinai schools in Egypt. The researcher has created a 3D model for a school to be presented by an immersive environment (VR) for the physically disabled to achieve the aim of the study.

He also extracted a checklist to evaluate the school according to the design criteria that take into account the needs of the physically disabled in the school, the evaluation of the school was by professors in the field of interior design. The researcher also prepared a questionnaire for students based on the use of Likert scale that consists of seven steps to measure the responses of sample members to the questionnaire that is related to the psychological and emotional aspects.

The results of the study found that there are no statistical differences between the average of the students' responses and the evaluation of the professors. This confirms the validity of the virtual reality as an efficient tool for evaluating and promoting the psychological and social aspects of the physically disabled in the schools.

KEYWORDS: Virtual reality, psychological, social, physically disabled.

I. INTRODUCTION

The design of Educational buildings plays an important role in improving the level of education. The physically disabled face problems of a different nature than those of their colleagues. The physically disabled and their families suffer greatly in access to schools as well as a difficulty of movement and use the school facilities, which is considered a psychological and physical obstacle for the disabled.

However, it was realized that there is a failure by educational institutions, at all levels, to play their role towards the physically disabled in creating the appropriate physical and social environment for integrating them in schools and taking their opinions and involve them in the process of designing the educational spaces and choose what suits them.

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The technological revolution has produced modern technologies that enable the disabled to participate in the design process and evaluate it through virtual reality technology that gives the disabled the ability to navigate freely within the Virtual Environments.

Therefore, this research simulates a model of Blenheim High School, which has a physically disabled student. The model was presented to the students by the virtual reality using Head-mounted displays (HMD) to evaluate the model and determine the ability of the virtual reality to convey the psychological aspects.

II. RELATED WORK

The emotional dimension of architectural design depends on the characteristics of space that convey both emotional and physical meanings to characterize perceived architectural space dimensions. These adjectives relate to size, openings, temperature, color brightness, style, form, and structural details of architectural spaces.

(G. Franz, 2005) conducted a comparison of effective appraisals and distance estimates in real and corresponding virtual spaces. They were asked to rate the experiential qualities along with nine principal categories of architectural experience (interestingness, comfort, beauty, calm, simplicity, spaciousness, enclosure, brightness, and clarity) using the semantic differential scaling technique et al. [1]. The results of the VR condition were generally very similar to the ratings of the corresponding real rooms.

(Asma Naz & al., 2017) pointed that the emotional response of a person in a living space is predominantly affected by light, color, and texture as space-making elements. She verified whether this phenomenon could be replicated in a simulated environment, color and texture in order to evaluate to which extent the emotional response in a simulated environment is affected by the same parameters affecting real environments.

Data from the experiments confirmed the hypothesis that perceivable emotional aspects of real-world spaces could be successfully generated through simulation of design attributes in the virtual space. The subjective response to the virtual space was consistent with corresponding responses from real-world color and brightness emotional perception. Our data could serve the virtual reality (VR) community in its attempt to conceive of further applications of virtual spaces for well-defined activities et al. [2].

In another study (Dias, M., Eloy, 2014) especially interested in evaluating the usability and impact of architecture space on its inhabitants, by studying their perception, emotional state, empathy, and engagement while experiencing the space.

He conducted a pilot user study whose main goal was to classify the users' response to environmental visual stimuli, by means of biometric sensory data analysis that basic user sensations of "comfortable/positive" and "uncomfortable/negative" architectural spaces can be derived through

he was found that we can discriminate arousal responses related to negative emotions from the neutral condition, when users are confronted with architectural spaces in VR designed especially to provoke those negative emotions, like vertigo or claustrophobia et al. [3].

Moreover, (Franz, G., et al., 2005) tested the Geometric properties from a component-based description of rectangular rooms on their suitability as predictor variables for experiential qualities. In a virtual-reality-based perceptual experiment.

A preference for ratios near to the golden section could be observed for spatial proportions, which are not directly perceivable. Altogether, a set of five widely independent factors (openness, two-room proportions, room area, and balustrade height) turned out to be most effective for describing the observed variance in the attributed experiential qualities. The combination of realistic virtual reality simulations and psychophysical data raising methods proved to be an effective means for basic architectural research. Several quantitative relations between physical properties and the emotional experience of architectural space could be demonstrated et al. [4].

It is clear from the previous studies that, the efficiency of the virtual reality to transfer the emotional dimensions of the space and access the user to feel his presence within the space. This allows us to experience architectural spaces in terms of its characteristics such as color, light, texture, the proportion of spaces, and the extent of the impact of spaces on the psychological state.

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III. TEXT INPAINTING

1. Meet the different needs of physically disabled students.

1.1. Social needs of the disabled.

The physically disabled suffers from a weakness of his social relations; he stays away from the groups and fails to form friendships between his peers. In order to let disabled feel that he is a member of a group, he needs to know his/her activities and interests, and he also needs additional spaces inside the school to meet their preferences as follows:

1. The need for success in social roles and Strengthening social relations:
These needs can be addressed by taking into account the following:
 - The availability of one room or more than specialized for training for social skills.
 - The availability of small group rooms. [5]
 - Users of Small size and height low educational spaces are more actively involved in the various group educational activities et al. [6].
2. Facilitate access within work: - Facilitate access within work.
3. Sense of belonging: The availability of a space attached to the basic educational space.
4. Deprivation of well-being: -
 - The availability of space dedicated to social and Entertainment activities for wheelchair users.
 - The availability of Sensory studios.

1.2. Psychological needs of the disabled.

The psychological needs of the physically disabled can be met as follows:

1. Need to security sense: - The sense of security is represented in containing the space for its users, Therefore the ceiling can be treated in dark colors to give a sense of low elevation and thus the psychological containment of the space.
2. The need to feel with its value among his friends and within groups: - This is done by giving attention to the following:
 - The availability of a space that attached to the basic educational space 12:20 m2 to allow the exercise of collective work and the presentation of free views.
 - Use violet color in spaces where they share their views to feel with respect and self-esteem.
3. The need to feel with calm: - Calm can be also provided to the physically disabled by the following:
 - It is possible to reduce the psychological press by providing Calming rooms.
 - Using Cold colors instead of vivid colors because they are considered to be calming et al. [7].
 - The Openness of the educational space to the external environment helps to calm.
4. The need to feel joyful. This was achieved through the following:
 - Provide entertainment spaces to share their friends play.
 - The availability of Sensory studios.
5. The need to not feel with guilty: - It is preferred to provide accessible spaces and bathrooms that he can use.

After studying the psychosocial and social needs of the physically disabled, design criteria were identified that could meet these needs in each educational space. And the following model illustrates this:

psychosocial and social aspects	Space design criteria
calm	Using Cold colors.
	Calming rooms
	Connection with surrounding
Comfortable	Can use the furniture (height of the work surface – deep under the table)
Safety	Enclosure (height - Length -Width)
Reachable	Access
interest	Support facilities

Table. 1. Explain the psychosocial and social aspects and the Corresponding design criteria of Spaces

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Search tools

1. Model of a School:

A three-dimensional model of a school which has a physically disabled students was created by plans, sections, and images of internal spaces using SketchUp software with its actual dimensions. The building was covered with the same materials of space.

2. Checklist

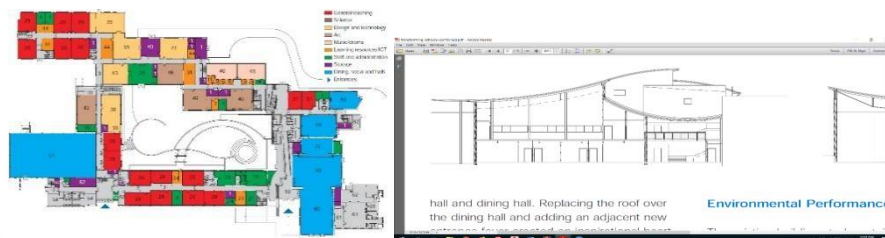
The researcher had reviewed many former studies that were related to the psychosocial, social, and mobility needs of the physically disabled. Then a set of design criteria were derived, taking into account the needs of the physically disabled in the schools.

This list was presented with plans and sections of the school that illustrate the different dimensions and heights of the space. Captured shots of the internal spaces that illustrate the colors and brushes of the different spaces were presented to the experts to evaluate these spaces. Fig 1

The following table shows the design criteria of a classroom space that takes into account the psychological and social needs of the physically disabled:

Design criteria	Yes	No
Dominant used colors like green for chairs, blue and yellow for wall		
The area of the window openings shall not be less than (20%) for the surface of the separation		
The height of the desk/table can be adjusted		
The height of the work surface of the desk/table is between 0.71m and 0.86 m above the floor		
A clear space is at least 0.68 m from the floor to the underside of the desk/table		
Clear space under the table is at least 0.48 m deep		
There is a space of not less than 0.9 m wide and 1.52 m long to permit a wheelchair to enter from a side approach or 1.22 m long to permit a wheelchair to enter from the front or rear of the space		
The bottom edge of the chalkboard is no greater than 0.61 m above the floor		
A height of at least 3 m		
A width of at least 6.6m		
A length of at least 7.9m		
The floor level is flat, and there are no different levels		
Clear floor space is at least 1.52 m in front of the teacher's desk and chalkboard.		
The width of the corridors between tables is at least 0.9m.		
The Widths of the doors is at least 0.9 m		
Small group room 12-20 m ²		

Table. 2. The checklist of the classroom evaluation



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Fig. 1. sample attached for evaluation (a) The new entrance (b) Master plan (c) section

3. The Questionnaire

The researcher prepared a questionnaire for the students to measure their psychological and emotional state. The questionnaire consists of a pair of oppositional adjectives, as shown in the following table, in order to evaluate these adjectives by using Likert scale that consists of seven steps to measure the responses of sample members to the questionnaire that related to the questionnaire that is related to the psychological and emotional aspects.

Adjectives	Oppositional adjectives
Calm	Angry
Comfortable	Uncomfortable
Safety	Fear
Reachable	unreachable
Interest	Boring

Table. 3. The oppositional adjectives used in the questionnaire

Method:

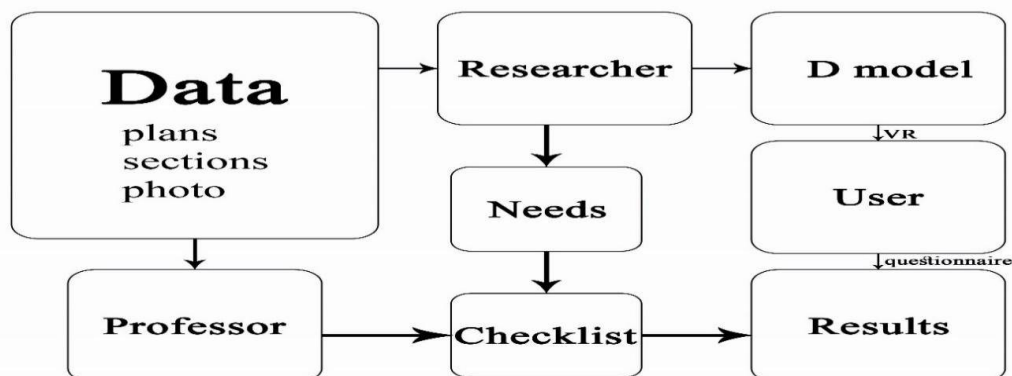


Fig. 2. Methodology of research

1. Plans and sections of the model school that illustrate the different dimensions and heights of the space and pictures of the internal spaces that illustrate the colors and brushes of the different spaces were also presented to a group of the professors to evaluate these spaces through the checklist attached with them.

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2. Ten students with physically disabled were selected from different schools ranging in age from 15-18 years, and the participation was voluntary.
3. Participants were requested to fill in the acceptance questionnaire for the experiment: where students with mental disabilities (cerebral palsy) and students who use medications that affect their psychological state, or who are psychologically treated have been excluded.
4. Before the test session, the semantics or contextual meaning of each psychophysiological terms used in the questionnaire were explained to the Participants to ensure that these terms were properly understood without priming. The psychological terms were explained in terms of pairs of oppositional or bipolar adjectives.
5. Participants were asked to wear the head-mounted displays (HMD) type (HTC-Vive) to display the school model through the immersive virtual reality environment (VR). They were also asked to wander in the various spaces of the school, starting from the arrival areas (parking) to the internal courtyard.
6. During the wandering of the students in each space, they were asked orally in the questionnaire so that the students evaluate each space on a scale of 1:7 and the most positive score is (7), and the most negative score is (1).
7. The evaluation results of the professors for the design criteria of the different school spaces were derived, then the researcher classified these criteria according to the psychological aspects of the questionnaire.
8. The previous results were compared statistically with the results of the student's evaluation on the psychological aspects mentioned in the questionnaire.

The following is an example of the psychological aspects mentioned in the questionnaire and the corresponding design criteria in the educational spaces.

Psychological aspects	Design criteria
Calm	Dominant used colors like green for chairs, blue and yellow for wall
	The area of the window openings shall not be less than (20%)
Comfortable	The height of the desk/table can be adjusted
	The height of the work surface of the desk is between 0.71m and 0.86 m above the floor
	A clear space is at least 0.68 m from the floor to the underside of the desk/table
	Clear space under the table is at least 0.48 m deep
	There is a space of not less than 0.9 m wide
	The bottom edge of the chalkboard is no greater than 0.61 m above the floor
Safety	A height of at least 3 m
	A width of at least 6.6m
	A length of at least 7.9m
Reachable	The floor level is flat, and there are no different levels
	Clear floor space is at least 1.52 m in front of the teacher's desk and chalkboard.
	The width of the corridors between tables is at least 0.9m.
	The Widths of the doors is at least 0.9 m
Interest	Small group room 12-20 m ²

Table. 4. An example of psychological aspects and corresponding design criteria

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IV. EXPERIMENTAL RESULTS

Quantitative results were studied using the Mann -Whitney test using a program (SPSS, 24.0). The results of the test showed that, there were no statistically significant differences between the mean rank of the students' responses to the aspects that were mentioned in the questionnaire: (Calm- Comfortable- Safety- Reachable- Interest) and the mean rank of the evaluation of the professors for the design criteria of school spaces for school spaces. The value p is 0.072, which is more than 0.05. The mean rank of student responses was 18.33 and the mean rank of professors evaluation was 12.67. The following chart shows the percentages of students' responses and the professors' evaluation.

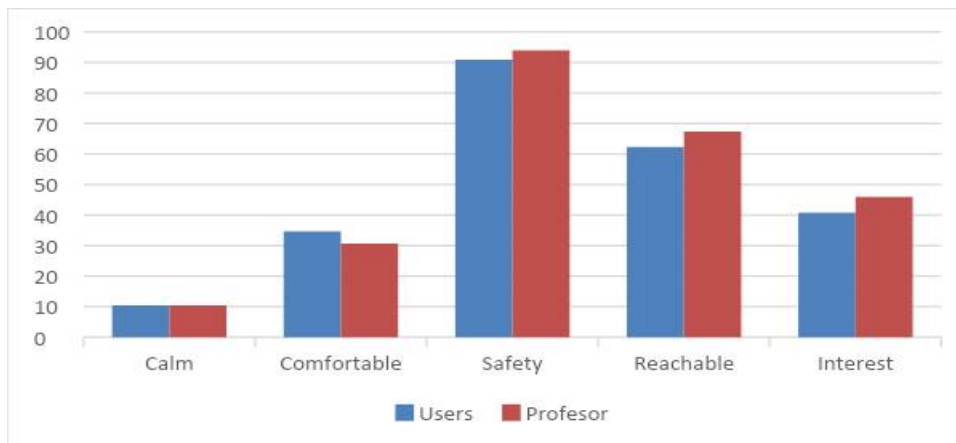
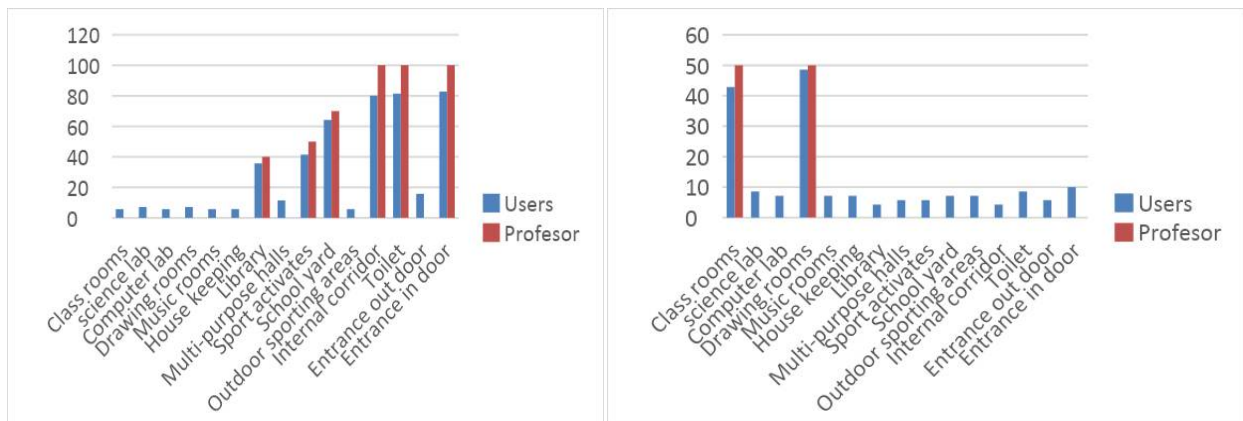


Fig. 2. A chart compares professor's evaluation and student response in school

The results of the study also showed that there were no statistically significant differences between the mean rank of students' responses to each aspect that was mentioned in the questionnaire and the mean rank of professors' evaluation for the corresponding design criteria in the different school spaces ;Where the calm ($p = 0.48, p > 0.05$), the comfortable ($p = 0.114, p > 0.05$),the safety ($p = 0.105, p > 0.05$),the reachable ($p = 0.466, p > 0.05$),the interest ($p = 0.082, p > 0.05$) and the following charts shows percentages of students' responses and the professors' evaluation in the different school spaces.



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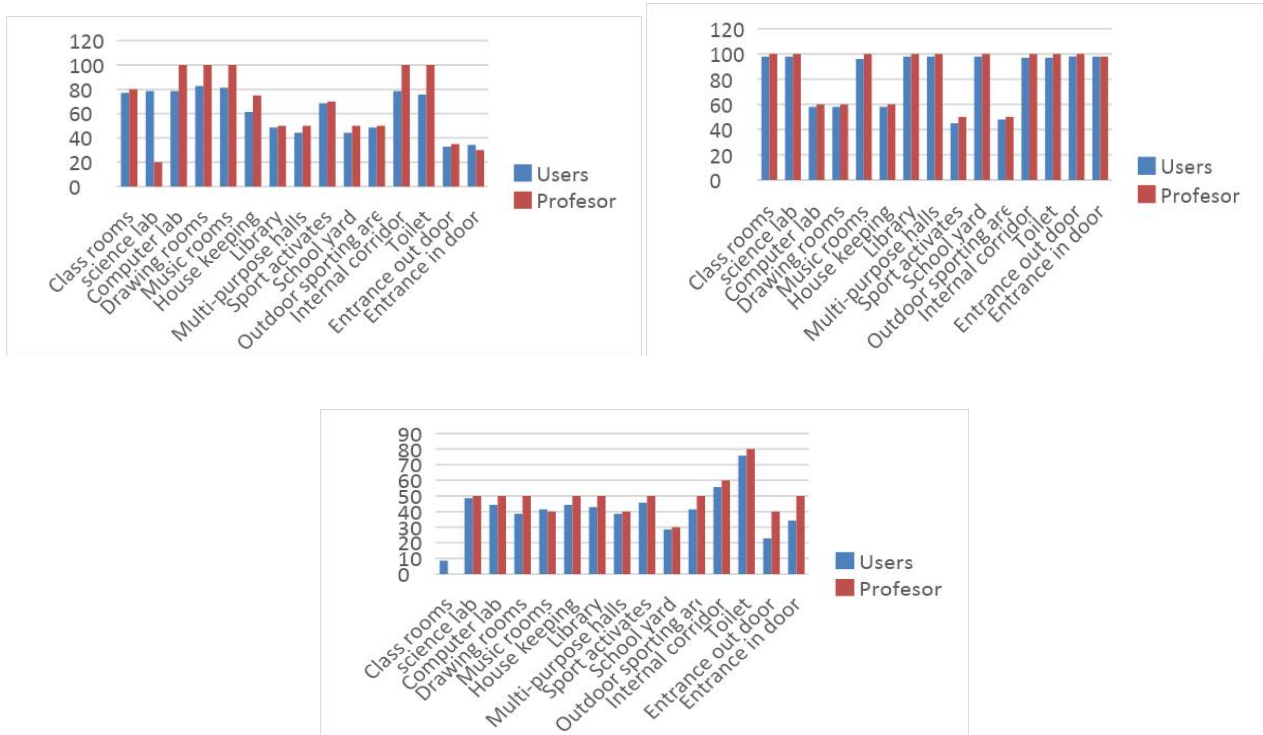


Fig. 2. (a) Aspect calm (b) Aspect comfortable (c) Aspect safety (d) Aspect reachable (e) Aspect interest

V. CONCLUSION

In this study, the psychosocial and social needs of the physically disabled were discussed, the spatial characteristics of the space have psychological considerations associated with them, and the aspects of the psychological experience are achievable experimentally where virtual reality technology can be used to evaluate the psychological considerations of space. The results of the study showed -after applying Mann whitny test and using a program of SPSS.24- that there were no statistically significant differences between students' responses to aspects that were mentioned in the questionnaire: (Calm- Comfortable- Safety- Reachable- Interest) and the evaluation of professors for the design criteria of the different school spaces in the checklist. The values of $p > 0.05$, which confirms the validity of the virtual reality as an effective tool to evaluate and promote the psychological and social dimensions of the disabled in schools.

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BIOGRAPHY



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