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**DESIGN MODEL OF IMMERSIVE VIRTUAL REALITY AID
SYSTEM WITH TAMED CYBERSICKNESS FOR CHILDREN
ROAD SAFETY EDUCATION (IVRAS4CROSE)**



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**DOCTOR OF PHILOSOPHY
UNIVERSITI UTARA MALAYSIA
2023**



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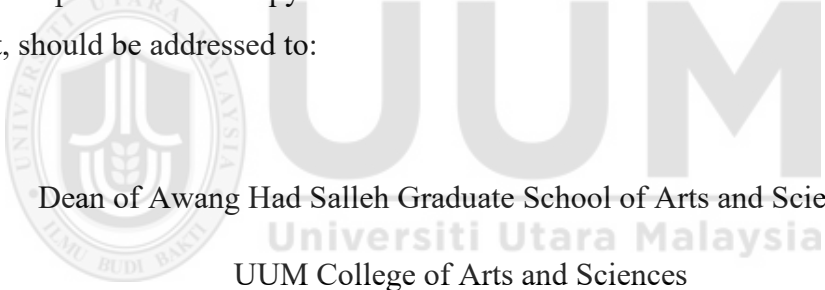
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Abstrak

Kajian ini adalah berfokus kepada pengalaman pengguna dalam menggunakan Realiti Maya (VR) dan Realiti Maya Imersif (IVR) yang direka bentuk untuk kanak-kanak dalam mempelajari keselamatan jalan raya di peringkat sekolah rendah, khususnya dalam meminimumkan kesan *cybersickness*. Penemuan sebelum ini telah mendedahkan bahawa kajian berkaitan kandungan pendidikan melalui IVR sangat kurang terutamanya dalam keperluan khusus dan bukti empirikal dalam mengurangkan kesan *cybersickness* semasa menggunakan aplikasi IVR. Oleh yang demikian, kajian ini mencadangkan sebuah model reka bentuk *Immersive Virtual Reality Aid System with Tamed Cybersickness for Children Road Safety Education* (IVRAS4CROSE). Terdapat empat (4) objektif utama bagi kajian ini: (i) untuk menentukan komponen, elemen dan garis panduan untuk pengurangan *cybersickness* bagi cadangan model reka bentuk IVR untuk pendidikan keselamatan jalan raya kanak-kanak dengan kesan yang minimum terhadap *cybersickness*, (ii) untuk membangunkan model reka bentuk IVRAS4CROSE untuk pendidikan keselamatan jalan raya kanak-kanak dengan keupayaan dalam mengurangkan kesan *cybersickness*, (iii) untuk menilai dan mengesahkan cadangan model reka bentuk IVRAS4CROSE melalui kaedah prototaip dan ulasan daripada pakar dan juga pengguna akhir, dan (iv) untuk menilai prototaip dari segi imersif, interaksi, navigasi, dan tindak balas fizikal terhadap *cybersickness*. Selain itu, kesemua objektif telah berjaya dicapai melalui pelbagai aktiviti saintifik dan langkah penyelidikan melalui Metodologi Penyelidikan Sains Reka Bentuk. Hasilnya, kajian ini telah mencadangkan 19 sub-komponen yang telah dipecahkan kepada lima komponen utama didalam IVRAS4CROSE. Model reka bentuk cadangan ini juga telah ditentusahkan melalui kaedah ulasan pakar dan prototaip. Telah didapati bahawa model reka bentuk yang dicadangkan ini telah diterima secara positif oleh pakar tempatan dan antarabangsa dan sekaligus berguna kepada pembangun IVR melalui proses prototaip. Dapatan daripada ujian pengalaman pengguna juga menunjukan IVRAS4CROSE – Bijak Melintas adalah berupaya menyokong kanak-kanak dalam mempelajari Pendidikan Keselamatan Jalan Raya (PKJR) dan pada masa yang sama telah berjaya mengurangkan kesan *cybersickness* terhadap aplikasi IVR. Kesimpulannya, kajian ini menambah baik pengetahuan yang sedia ada melalui IVRAS4CROSE, di mana ia menyediakan elemen dan prinsip yang membantu dalam mengurangkan kesan *cybersickness* dan secara tidak langsung memupuk penglibatan kanak-kanak dalam mempelajari PKJR. Dari segi sumbangan praktikal, kajian ini menghasilkan IVRAS4CROSE – Bijak Melintas sebagai aplikasi pendidikan alternatif untuk komuniti didalam PKJR.

Kata kunci: Realiti maya, Realiti maya imersif, Reka bentuk, Pendidikan keselamatan jalan raya kanak-kanak, *Cybersickness*

Abstract

This study focuses on User Experience in Virtual Reality (VR) and Immersive Virtual Reality (IVR) assisted learning concept that is designed for children in learning road safety, particularly in minimizing the effect of cybersickness. Previous findings have revealed that studies related to educational content via IVR are highly lacking especially in specific requirements and empirical evidence in reducing the cybersickness effect of IVR applications. Hence, this study proposes a Design Model of Immersive Virtual Reality Aid System with Tamed Cybersickness for Children Road Safety Education (IVRAS4CROSE). There are four (4) main objectives of this study: (i) to determine the main components, elements, and cybersickness reduction guidelines of the proposed Design Model of IVRAS4CROSE with minimal impact of cybersickness effects, (ii) to develop the Design Model of IVRAS4CROSE with capability in minimizing cybersickness effect, (iii) to evaluate and validate the proposed design model of IVR through prototype and reviews from experts and end-user, and (iv) to evaluate the prototype in term of immersion, interaction, navigation, and physical response toward cybersickness aspect. All objectives have been achieved through various scientific activities and research steps through The Design Science Research Methodology. As a result, this study proposes 19 sub-components that break down five main components of the IVRAS4CROSE. The proposed model has been validated through expert review and prototype. It was found that the proposed model has been positively accepted by local and international experts and is also useful for IVR developers through prototype. The findings of user experience evaluation also indicate that the application of IVRAS4CROSE – *Bijak Melintas* is capable to support children in learning RSE and at the same time has successful in minimizing the effect of the cybersickness toward IVR application. In conclusion, this study improves the existing knowledge through IVRAS4CROSE, as it provides the design elements and principles that help reduce the cybersickness effect and indirectly cultivates children engagement in learning children RSE. For practical contribution, this study produces the IVRAS4CROSE – *Bijak Melintas* as an alternative educational application for communities in learning children RSE.

Keywords: Virtual reality, Immersive virtual reality, Design model, Children road safety education, Cybersickness

Acknowledgement

“Allahumma salli `ala sayyidina muhammadin wa `ala ali sayyidina Muhammad Wa la hawla wa la quwwata illa billah”. Alhamdulillah, my foremost heartfelt gratitude and thanks to Almighty Allah S.W.T for giving me the opportunity and strength to complete my Ph.D. journey. My sincere gratitude of appreciation goes to my respected supervisor Associate Prof. Ts. Dr. Ariffin bin Abdul Mutalib and Associate Prof. Ts. Dr. Sobihatun Nur binti Abdul Salam for their continuous support, immense knowledge, experience, guidance, motivation, and enthusiasm in assisting me throughout this journey, thank you so much and I appreciate that. May Allah S.W.T repay everything and shower countless blessing on both you and your families. Not forgetting, the Ministry of Higher Education (MOHE), Universiti Utara Malaysia (UUM), and the School of Multimedia Technology and Communication (SMMTC) for supporting this study. My sincere gratitude also goes to the experts for spending time providing constructive and insightful comments and suggestions for my study. Also, special thanks to all my colleagues for the morale and continuous support especially in sharing their Ph.D. experience and proper writing and citing tools.

Most importantly, my special acknowledgment goes to my lovely wife, Hanis Salwani binti Othman, thank you so much for your understanding and support even though both of us need to finish our Ph.D. studies on time. It is tough for us especially with three little kids Qhalish Nur Elman, Qaisara Nur Erina, and Qaish Nur Eshan to allocate and manage time so that both of us can complete the Ph.D. together. Last but not least, my deepest thanks to my parents Yahaya bin Ahmad, Faridah Md Khir, and also parent-in-law Othman bin Khamis and Zamariah binti Bilal Said for the countless support and understanding all the time. I appreciate all of you very much and I pray to Allah S.W.T that all of you will have a special place in the hereafter, once again, I love all of you very much

Nur Sauri Yahaya
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March 2023

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List of Abbreviations

VR	Virtual Reality
AR	Augmented Reality
MR	Mixed Reality
VE	Virtual Environment
IVR	Immersive Virtual Reality
VRP	Virtual Reality Panoramic
SDK	Software Development Toolkits
FOV	Field of View
FOR	Field of Regard
3D	Three Dimensional
2D	Two Dimensional
VRML	Virtual Reality Modelling Language
HTML	Hypertext Mark-up Language
WHO	World Health Organization
RS	Road Safety
ID	Instructional Design
RSE	Road Safety Education
HMD	Head Mounted Display Device
MOE	Ministry of Education
MIROS	Malaysian Institute of Road Safety Research
OECD	Organization for Economic Cooperation and Development
PKJR	Pendidikan Keselamatan Jalan Raya
DSRM	Design Science Research Methodology
ITM	Iterative Triangulation Methodology
VRDM	Virtual Reality Design Model
IVRDM	Immersive Virtual Reality Design Model
RSDM	Road Safety Design Model
RLM	Reality Learning Media
UCD	User Centered Design
SMMTC	School of Multimedia Technology and Communication

List of Publications and Awards

Journal:

- **Yahaya, N. S., Mutalib, A. A., & Salam, S. N. A. (2022).** A Comparative Analysis on Cybersickness Reduction Guidelines in VR and IVR Applications for Children Road Safety Education. *International Journal of Interactive Mobile Technologies*, 16(5).

Conference Proceeding:

- **Yahaya, N. S., Mutalib, A. A., & Salam, S. N. A. (2020).** A Comparative Analysis of Design Components in VR and IVR Application in Children Road Safety Education. *Proceeding of Creative Humanities International Conference (CHiC'20)*, 32-39.
- **Yahaya, N. S., Mutalib, A. A., & Salam, S. N. A. (2020).** A Comparative Analysis on Cybersickness Reduction Guidelines in VR and IVR Applications for Children Road Safety Education. *Proceeding of Creative Industries International Conference (CIIC'20)*.

Awards:

- **Gold Medal** at International University Carnival on E-Learning 2022 (IUCEL 2020), UPM, Selangor.
 - **Project Title:** (IVRASCROSE) – *Bijak Melintas*, Immersive VR with Tamed Cybersickness
 - **Project Member:** Nur Sauri Yahaya, Ariffin Abdul Mutalib, Sobihatun Nur Abd Salam and Hanis Salwani Othman
- **Gold Medal** at International Conference and Exposition on Inventions by Institution of Higher Learning (PECIPTA 2022), UMK, Kelantan.
 - **Project Title:** (IVRASCROSE) – *Bijak Melintas*, Immersive VR with Tamed Cybersickness
 - **Project Member:** Nur Sauri Yahaya, Ariffin Abdul Mutalib, Sobihatun Nur Abd Salam and Hanis Salwani Othman

CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter explains the details of the proposed research. It comprises nine important components. It begins with a discussion on the background of the study. It is followed by a problem statement, research gaps, research question, and research objective. Next, the discussion focuses on the scope of the study, the expected contribution of the study, and the theoretical model of the study. Lastly, this chapter maps the whole content in an organization of the thesis.

1.2 Research Background

Multimedia is a new form of content representation that is different from traditional media that only uses basic computer displays such as a text-only or traditional printed form in conveying information to the users. Multimedia uses a combination of different media elements such as text, audio, graphic, animation, video, and interactive content where it can be transmitted, processed, and digitally stored. It also enables users to navigate, interact, create and communicate in the digital environment (Roussou et al., 2006). Now, the media elements are enriched with virtual reality and augmented reality (Ludlow, 2015).

Multimedia applications have been absorbed into various areas and contexts including advertisement (Cheng et al., 2012), entertainment (Tan et al., 2015), medical (Mccoy et al., 2016), engineering and architecture (Rafi et al., 2010), and education (Christou, 2010). For example, multimedia has become an effective tool that successfully solves the problem in

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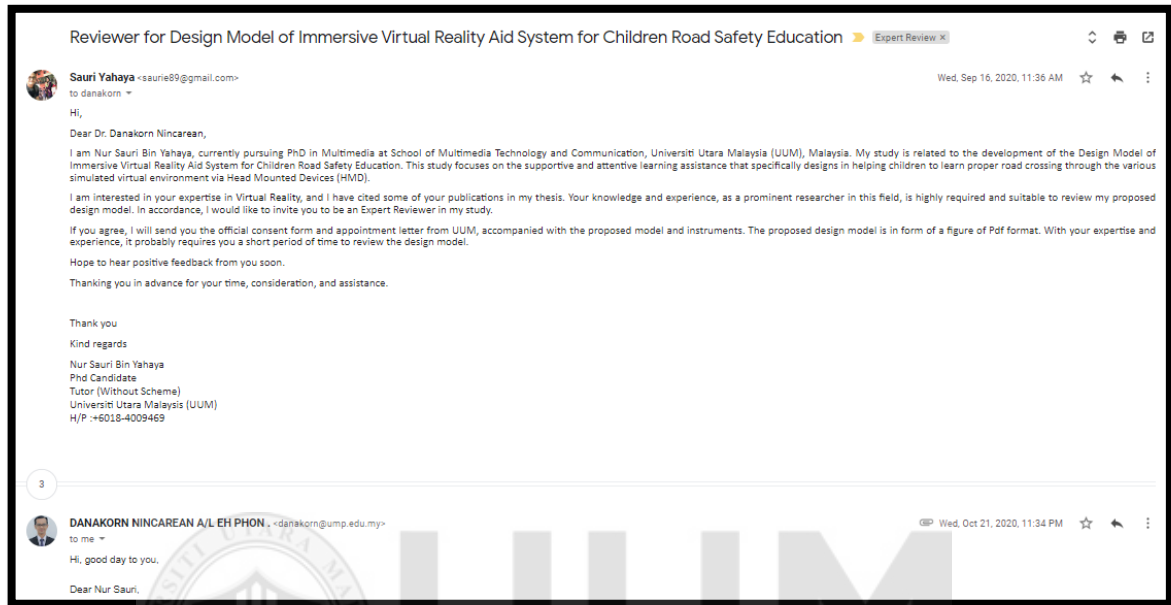
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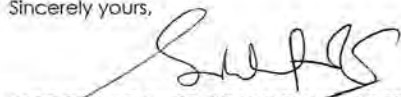
Appendix A

Sample of Invitation Email for Experts



Appendix B

Sample of Appointment Letter

	PUSAT PENGAJIAN TEKNOLOGI MULTIMEDIA DAN KOMUNIKASI SCHOOL OF MULTIMEDIA TECHNOLOGY AND COMMUNICATION Universiti Utara Malaysia 06010 UUM SINTOK KEDAH DARUL AMAN MALAYSIA	 Tel: 604-928 5801 Faks (Fax): 604-928 5804 Laman Web (Web): http://www.smmtc.uum.edu.my
		UUM/CAS/SMMTC/P-48 22nd September 2020
Dr Lisa Dethridge Senior Lecturer Department of Writing and Publishing College of Media and Communication RMIT University, 124 La Trobe Street Melbourne VIC 3000 Australia		
Dr.		
APPOINTMENT AS EXPERT REVIEWER FOR DESIGN MODEL OF IMMERSIVE VIRTUAL REALITY AID SYSTEM FOR CHILDREN ROAD SAFETY EDUCATION (IVRAS4CROSE)		
Thank you for agreeing to involve as an expert in the PhD study with the details below, particularly for reviewing and evaluating a design model:		
Student Name Matric No School Research Title Supervisor	: Nur Sauri bin Yahaya : 903144 : School of Multimedia Technology and Communication, UUM : Immersive Virtual Reality Aid System for Children Road Safety Educations (IVRAS4CROSE) : Assoc. Prof. Ts. Dr Ariffin bin Abdul Mutalib	
For your information, the student will use the design model for his research. Therefore, he needs your expertise, knowledge and experience to review the proposed design model in a few dimensions as stated in the reviewing form.		
Your cooperation, time, and assistance are greatly appreciated.		
Thank you.		
"ILMU BUDI BAKTI"		
Sincerely yours,		
		
ASSOC. PROF. Ts. DR. SOBIHATUN NUR ABDUL SALAM Dean School of Multimedia Technology and Communication		
Tel. : 04-9285800 HP : 019-5597417	Fax : 04-9285804 Emel : sobihatun@uum.edu.my	
Universiti Pengurusan Terkemuka The Eminent Management University		

Appendix C

Sample of Consent Form for Experts



**CONSENT FORM of Expert Review for Design Model of Immersive
Virtual Reality Aid System for Children Road Safety Education
(IVRAS4CROSE)**

School of Multimedia Technology and Communication
College of Arts and Science
Universiti Utara Malaysia (UUM)

1. I have accepted the official appointment letter from UUM. With the expertise and the existing knowledge that I have, I volunteer to be an expert reviewer for "Design Model of Immersive Virtual Reality Aid System for Children Road Safety Education (IVRAS4CROSE)" proposed by Nur Sauri bin Yahaya under supervision of Assoc. Prof. Ts. Dr. Ariffin bin Abdul Mutalib.
2. I understand that the expert review process is designed to gather information and feedbacks in improving the proposed model.
3. I understand that no part of the proposed model may be reproduced, stored in retrieved system, or transmitted in any form or by any means, electronic, mechanical photocopying, recording, or otherwise, without prior permission from the researchers and his supervisor.
4. I understand that the researchers will not identify me by name in any report using information obtained from the instrument, and that my confidentiality as a participant in this study will remain secure. Subsequent uses of records and data will be subject to standard data use policies which protect the anonymity of individuals and institutions.
5. I understand that this study has been reviewed and approved by School of Multimedia Technology and Communication, College of Arts and Sciences, UUM.
6. I have read and understood the explanation provided to me. I have had all my questions answered to my satisfaction, and voluntarily agree to participate in this study.
7. I am given a copy of this consent form.

Reviewer Signature

Date

Reviewer Official Stamp

Researcher Signature

Appendix D

Sample of Instrument for Experts Review

INSTRUMENT FOR EXPERT REVIEW

DESIGN MODEL OF IMMERSIVE VIRTUAL REALITY AID SYSTEM FOR CHILDREN ROAD SAFETY EDUCATION (IVRAS4CROSE)

Dear Prof/Assoc. Prof/ Dr./ Sir/ Madam

EXPERT REVIEW OF DESIGN MODEL OF IVRAS4CROSE

I am Nur Sauri Yahaya and currently pursuing PhD study at Universiti Utara Malaysia. I am delighted to inform that you have been selected to participate in this study based in the following criteria:

- Have academic qualification (Master/PhD) in related field either Multimedia (VR, AR, MR), Educational Technology, Creative Industry, Visual Design, User Experience, and/or
- Have involved in researching/developing/studying and practicing VR or IVR or MR or Mobile or Educational Technology or Computer Science or Creative Industry or Visual Design or User Experience field for at least 5 years of experience.

This study proposes the Design Model of IVRAS4CROSE, which is specifically designed for children to learn road safety. In this study, road safety education has been selected prior to the raising issues and concern relating children in understanding and implementing road safety in their daily basis. The main objective of this study is to propose a design model of immersive virtual reality via head mounted display (HMD) which is capable to promote positive learning interaction and new learning experience for children to learn road safety education. It is proposed that this model consists of comprehensive components and elements with proper attention in creating better learning environment concept that will cultivate the children learning experience.

One part of the research is to evaluate the proposed model in a few dimensions. The review questions are designed to evaluate: i) relevancies of the proposed components and elements of IVRAS4CROSE, ii) the extracted design elements and principles, and iii) readability and understandability of the model. Additionally, based on your expertise, experience, knowledge and interest, I would like to humbly solicit your comments and suggestion in improving the proposed design model.

Your cooperation and input in completing the review question is highly appreciated and I would be really honored if you can do the evaluation accordingly.

The information supplied will be treated as confidential and will be used for the research purposes, which maybe reported anonymously in academic publications.

Please feel free to contact me by email (saurie89@gmail.com) in regards to any queries or my supervisor Assoc. Prof. Ts. Dr Ariffin Abdul Mutalib.

Thank you for your time and assistance.

Instruction:

The review instruments are attached with the figures of:

- i) The basic model (Figure 1)
- ii) The detail design model (Figure 2)

Please read and go through the figure of the Design Model of IVRAS4CROSE carefully. Once this is done, with the expertise and experience you possess, please complete the questions in the provided spaces.

PART I: EXPERT /REVIEWER DETAILS (*required to fill-in)

Name* : _____

Age : _____

Gender : ☐ Male ☐ Female

Highest Education Level : _____

Experience* : _____ years

Area of Expertise : _____

PART II: ITEM TO REVIEW

Based on the proposed design model (as illustrated in Appendix A – Figure 2), please tick (✓) an appropriate option

No	The proposed components and sub-component in the following section are relevant		Some are definitely NOT relevant	Some may be NOT relevant	All are relevant	Comment
1	Design Component	General Design				
		Multimedia Design				
		Navigation Design				
		Immersion Design				
		Interaction Design				
		Cybersickness Reduction Guidelines				
	Content Component	Virtual Environment				
		Content Structure and Presentation				
		Development Process				

	ID Model				
Learning Component	Learning Theories				
	Learning Approaches				
	Learning Technique				
User Component	Developer				
	Audience				
	Character Assist				
Technology Component	IVR Devices				
	Platform				
	Hardware and Software				

No	The proposed design elements and principles for IVRAS4CROSE in each design components are understood		Need very detail explanation	Need some explanation	Easy to understand	Comments
2	General	Themes				
		3D Modeling Scale and Proportion				
		Typography				
		Color				
		Virtual Environment Interface Layout				
	Multimedia	Text				
		Graphic				
		Audio				
		Video				
		Animation				
	Navigation	Navigation Instruction				
		Navigation Aids/Tools				
		User Control				
		Navigation Structure				
	Immersion	Sound				
		Level of Detail of 3D Object				
		Avatar/3D Movement				

		Transition				
		3D Object Placement				
		Haptic Simulation				
		Screen Size and Resolution				
	Interaction	Action Intuitive				
		Feedback Message				
		Cue/Tooltips				
		Point and Click				
		Information Resources				
		Environment Setting				
		Natural/Physical Interaction				
	Cybersickness Reduction Guidelines	Duration of Use				
		Experiences				
		Physical Setting				
		Acceleration Speed				
		Movement Speed				
		Field of View				
		Degree of Control				
		Camera				
		Sound Effect				
		Head Tracking Viewpoint				

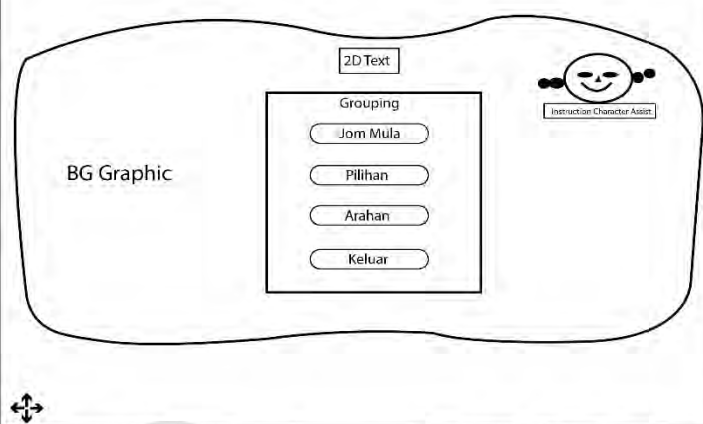
Appendix E

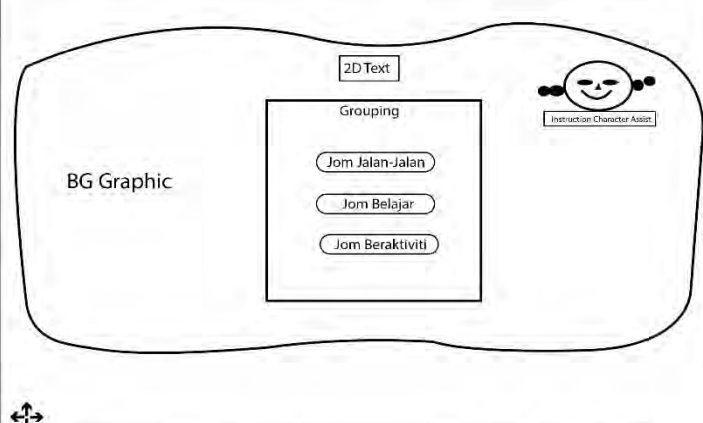
Sample of MOE PKJR Syllabus

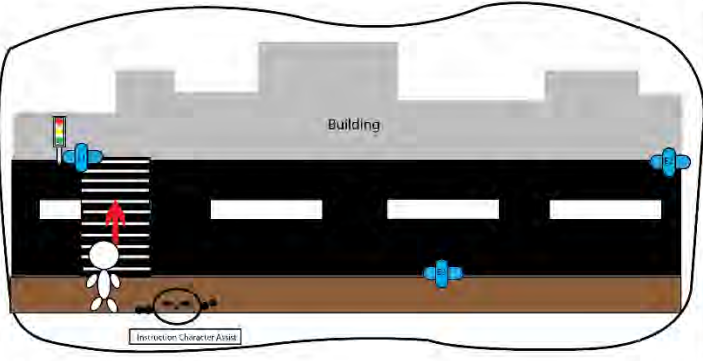


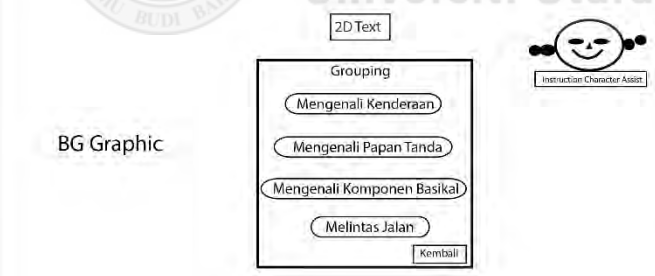
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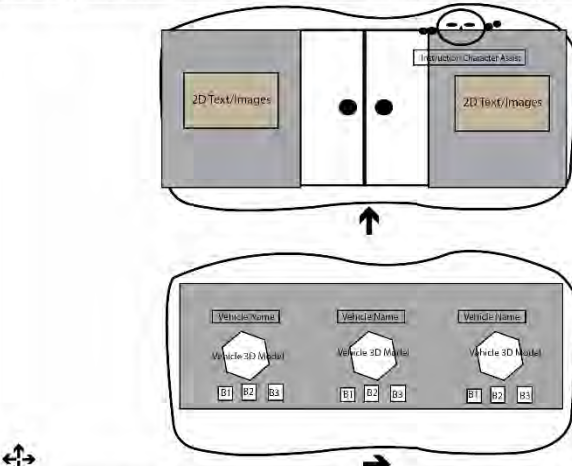
Sample of Storyboard of IVRAS4CROSE – Bijak Melintas

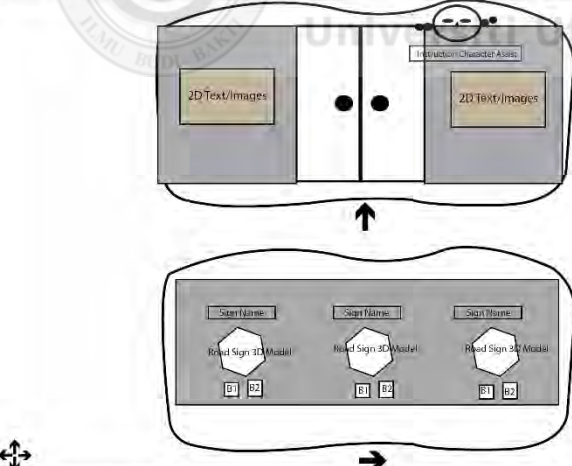
Scene : Welcome	Content Structure : Opening (Section)	Graphic/Text
		BG Graphic : Road Safety 2D Graphic BG Color : None (Replace by 2d Graphic) 2D Text : "Selamat Datang ke Aplikasi Bijak Melintas" (Follow Text DP) 3D Text : None Grouping : Designed Graphic (Box/Traffic Light, Signage Graphic) Light Colour (Follow Graphic and Color DP) 3D/2D/TextOnly - Button : 4 Button B1 - "Jom Mula" - Link to "Menu Utama" B2 - "Pilihan" - Link to "Pilihan" B3 - "Arahan Permainan" - Link to "Arahan" B4 - "Keluar" - Link to "Keluar dari permainan"
		Sound BG Sound : Inspiring Music (Ashamkew/Hygen) Instruction Narration : Welcome Script Explanation Narration : Welcome Script (Follow Audio DP)
		Character/3D Model/Object 1. "Jom Mula" Button 2. "Pilihan" Button 3. "Arahan" Button 4. "Keluar" Button 5. Instruction Character assist - "Ocobot concept"
Presentation Flow/Concept	Design Element and Principle Involved	Content : Strategies & Instruction Features
The scene begin with the entrance of the BG music (Minimum Volume). Followed by the introduction of the name of the application and the explanation about available selection of function (4 Button). This introduction process is carried out by instruction character assist name "Ocobot" that responsible in delivering all the in-game instruction to the user through out the learning process inside VE.	Graphic - 1. Use clear & attractive graphic 2. Use meaningful graphic 3. Limit no of graphic used Text - 1. Use necessary and understandable text 2. Place text in right location 3. Limit no of text 4. Use proper text size Audio - 1. Use familiar voice 2. Provide clear pronunciation 3. Use friendly and cheerful voice Color - 1. Limit the number of color used 2. Differentiate between BG and foreground color 3. Use right choices of color Typography - 1. Use suitable font color 2. Use consistent font size 3. Use consistent font style Navigation Instruction - 1. Clear instruction 2. Avoid redundant instruction	Opening Section - Contain element of Welcome, Title, Starting and Navigation Instruction Pedagogical Strategies - Instruction Based Supportive Strategies - Separator and Positive Instruction Features

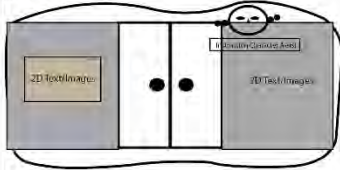
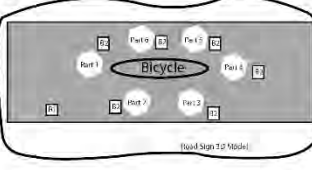
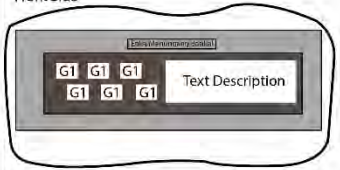
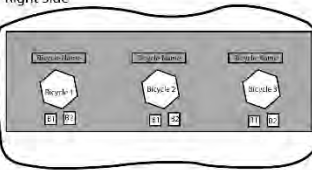
Scene : Quick Start Main Menu	Content Structure : Content Section Separator	Graphic/Text
		BG Graphic : Road Safety 2D Graphic BG Color : None (Replace by 2d Graphic) 2D Text : "Menu Utama" (Follow Text DP) 3D Text : None Grouping : Designed Graphic (Box/Traffic Light, Signage Graphic) Light Colour (Follow Graphic and Color DP) 3D/2D/TextOnly - Button : 4 Button B1 - "Jom Jalan Jalan" - Link to scene "Jom Jalan Jalan" B2 - "Jom Belajar" - Link to scene "Belajar" menu B3 - "Jom Beraktiviti" - Link to scene "Aktiviti" menu
		Sound BG Sound : Inspiring Music (Ashamkew/Hygen) Instruction Narration : Main Menu Script Explanation Narration : Main Menu Script (Follow Audio DP)
		Character/3D Model/Object 1. "Jom Jalan Jalan" Button 2. "Jom Belajar" Button 3. "Jom Beraktiviti" Button 5. Instruction Character assist - "Ocobot concept"
Presentation Flow/Concept	Design Element and Principle Involved	Content : Strategies & Instruction Features
The scene is triggered when user choose "Jom Mula" button in this scene there are 3 menu button that will allow user to use 3 different interactivity in the application. First "Jom Jalan Jalan" button will bring user to free roaming scene where user have ability to freely navigate inside the virtual environment and interact with the learning event. Second button "Jom Belajar" will bring user to learning scene where there are 4 main learning module that user can choose. Third button "Jom Beraktiviti" allow user to perform 3 different exercise that related to learning road safety education. The character assist will still available in every menu scene in order to provide basic instruction.	Graphic - 1. Use clear & attractive graphic 2. Use meaningful graphic 3. Limit no of graphic used Text - 1. Use necessary and understandable text 2. Place text in right location 3. Limit no of text 4. Use proper text size Audio - 1. Use familiar voice 2. Provide clear pronunciation 3. Use friendly and cheerful voice Color - 1. Limit the number of color used 2. Differentiate between BG and foreground color 3. Use right choices of color Typography - 1. Use suitable font color 2. Use consistent font size 3. Use consistent font style Navigation Instruction - 1. Clear instruction 2. Avoid redundant instruction	Content Section - Contain element of Section Separator, Menu and Navigation Instruction Pedagogical Strategies - Instruction Based Supportive Strategies - Separator and Positive Instruction Features

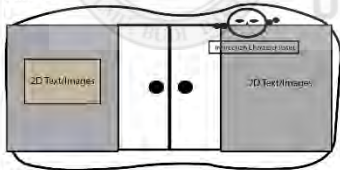
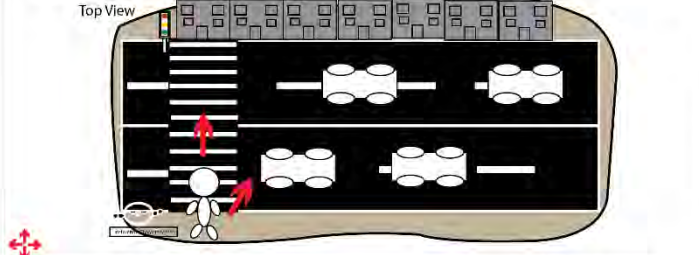
Scene : Free Roaming		Content Structure : Learning Content 5	Graphic/Text
			2D Graphic : Infographic : 1. Traffic light Learning 2. Crossing bridge 3D/2D/TextOnly - Button : 3 Button Will available on selected event 1. E1 "Bridge" - will show the infographic on selected event 2. E2 "Traffic Light" - will trigger the event for that location 3. E3 "SideWalk" - will trigger the event for that location
			Sound BG Sound : Town Sound Effect (Ahsanulhakeem/Musri) Instruction Narration: Instruction Script Explanation Narration: Based on event infographic (Follow Audio DP)
			Character/3D Model/Object 1. City/Town Prefab - UNITY PREFAB 2. Learning Prefab 1 - Trafficlight E1 2 - Crossing Bridge E2 3 - SideWalk E3 3. Instruction Character assist : "Oobot concept" will explain the detail of all the instruction through voice over and images.
Presentation Flow/Concept	Design Element and Principle Involved		Content : Strategies & Instruction Features
1. This is the Scene for Free Roaming Learning Session where user can learn freely about road safety in VE. The VE is simulated like the a town that have activities surround its such as car moving and people walking. So user can walk around inside the VE while looking for a provided learning event which has been assigned in the specific location. 2. User can move via touchpad or TELEPORT to move around in VE. 3. Character assist still available when user enter the VE and will available again when user have interact with the learning content in VE. 4. There are 5 learning event that related to road safety available in VE. User need to explore the VE in order to interact with it. 5. User have ability to pause the session or exit by selecting provided button. 6. It will have assistance or warning sign in order to assist user in VE.	Graphic - 1. Use clear & attractive graphic 2. Use meaningful graphic 3. Limit no of graphic used Text - 1. Use necessary and understandable text 2. Place text in right location 3. Limit no of text 4. Use proper text size Audio - 1. Use familiar voice 2. Provide clear pronunciation 3. Use friendly and cheerful voice Color - 1. Limit the number of color used 2. Differentiate between BG and foreground color 3. Use right choices of color Navigation Instruction - 1. Clear instruction 2. Avoid redundant instruction Video - 1. Specific Video Content 2. Minimized the length of video duration Avatar - 1. FPC 2. used human average speed on avatar Transition - Avoid fast movement, single viewing direction Object Placement - Place the 3D object properly and right location Navigation Aid tool - Teleportation User Control - Enter and Exit function Feedback Messages- Positive response WILL ADD MORE BASED ON DESIGN PRINCIPLE		Content Section - Contain Menu Pedagogical Strategies - Instruction Based and Infographic Supportive Strategies - Separator and Positive Instruction Features Content Specification - Introduction, Lesson Content and Closing

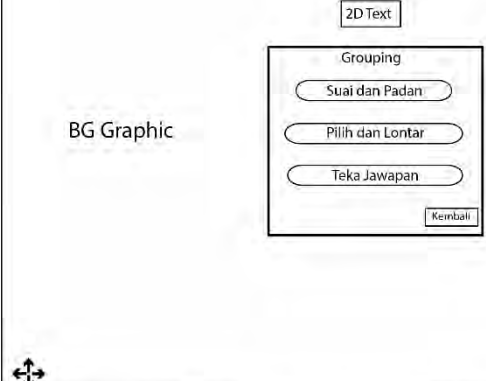
Scene : Jom Belajar		Content Structure : Content Section Separator	Graphic/Text
			BG Graphic : Road Safety 2D Graphic BG Color : None (Replaced by 2d Graphic) 2D Text : "Menu Jom Belajar" (Follow Text DP) 3D Text : None Grouping : Designed Graphic (Box/Traffic Light, Signage Graphic) Light Colour (Follow Graphic and Color DP) 3D/2D/TextOnly - Button : 4 Button B1 - "Mengenal Kenderaan" - Link to scene "Mengenal Kenderaan" B2 - "Mengenal Papan Tanda" - Link to scene "Mengenal Papan Tanda" B3 - "Mengenal" - Link to scene "Mengenal" B4 - "Ism Berakiviti" - Link to scene "Aktiviti" B5 - "Kembali" - Return to Main Menu Scene
			Sound BG Sound : Learning Music (Ahsanulhakeem/Musri) Instruction Narration: Jom Belajar Script Explanation Narration: Jom Belajar Script (Follow Audio DP)
			Character/3D Model/Object 1. "Mengenal Kenderaan" Button 2. "Mengenal Papan Tanda" Button 3. "Mengenal Komponen Basikal" Button 4. "Melintas Jalan" Button 5. Instruction Character assist : "Oobot concept"
Presentation Flow/Concept	Design Element and Principle Involved		Content : Strategies & Instruction Features
The scene is triggered when user choose "Jom Belajar" button. In this scene there are 4 menu button that will allow user to ave 4 different learning modules. First "Mengenal Kenderaan" button will allow user to learn about different type of vehicle. Second Button "Mengenal Papan Tanda" will allow user to learn about road related and relevant road signage. Third Button "Mengenal Komponen Basikal" allow user to learn about different type of bicycle. Last button is "Melintas Jalr" that allow user to learn properly about road crossing. The character assist will still available in every menu scene since it need to provide the basic instruction about the function of the button.	Graphic - 1. Use clear & attractive graphic 2. Use meaningful graphic 3. Limit no of graphic used Text - 1. Use necessary and understandable text 2. Place text in right location 3. Limit no of text 4. Use proper text size Audio - 1. Use familiar voice 2. Provide clear pronunciation 3. Use friendly and cheerful voice Color - 1. Limit the number of color used 2. Differentiate between BG and foreground color 3. Use right choices of color Typography - 1. Use suitable font color 2. Use consistent font size 3. Use consistent font style Navigation Instruction - 1. Clear instruction 2. Avoid redundant instruction Navigation Aid tool - Teleportation User Control - Back function Feedback Messages- Positive and encourage message to user		Content Section - Contain element of Section Separator, Menu and Navigation Instruction Pedagogical Strategies - Instruction Based Supportive Strategies - Separator and Positive Instruction Features

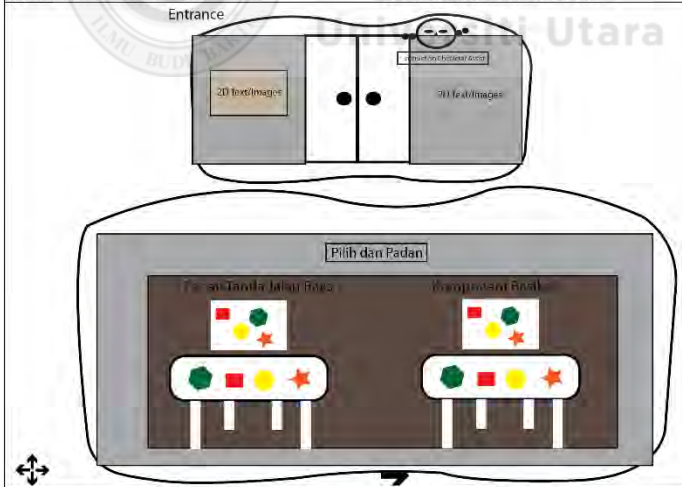
Scene : Mengenali Kendaraan		Content Structure : Learning Content 1	Graphic/Text
			3D Text : Selamat Datang ke Modul 1 "Jom Belajar" 1. All 8 vehicle name. 2D Text : Instruction before entering the learning module. 2D Graphic : Example of 9 vehicle images, Road safety images. 3D/2D/TextOnly - Button : 3 Button 1. B1 "Gambar" - will show the real images of the vehicle 2. B2 "Suara Penerangan" - will trigger VO on selected vehicle 3. B3 "Bunyi" - will trigger the sound effect of the vehicle
			Sound BG Sound : Inspiring Music (Ashamake/muse) Instruction Narration: Instruction Script Explanation Narration: Based on vehicle infographic Vehicle Sound Effect (Follow Audio DP)
			Character/3D Model/Object 1. Class Room Setting - UNITY PREFAB 2. Lorry, Bus, Car, Bicycle, Motorcycle, Train, Bulldozer, Taxi and Minivan 3. Instruction Character assist "Ocosbot concept" will explain the details of all the instruction through voice over and images.
Presentation Flow/Concept	Design Element and Principle Involved	Content : Strategies & Instruction Features	
1. This is the Scene for Module 1 where user can learn different type of the vehicle. The VF is simulated like the class room where user can walk around inside the room while looking at 9 type of available vehicle that categorise into Public Transport, Heavy and Personal. User can use TELEPORT to move around in classroom 2. Character assist still available at the entrance of the classroom and disappear when user enter the classroom 3. Each vehicle will be equipped with explanation by using 3D simulation of the vehicle, real images, some simple text and VO explanation. 4. User can come closer to the vehicle and see in detail (Not Low Poly) 4. User need to exit from the classroom through main entrance if they want to exit the learning session	Graphic - 1. Use clear & attractive graphic 2. Use meaningful graphic 3. Limit no of graphic used Text - 1. Use necessary and understandable text 2. Place text in right location 3. Limit no of text 4. Use proper text size Audio - 1. Use familiar voice 2. Provide clear pronunciation 3. Use friendly and cheerful voice Color - 1. Limit the number of color used 2. Differentiate between BG and foreground color 3. Use right choices of color Navigation Instruction - 1. Clear instruction 2. Avoid redundant instruction Video - 1. Specific Video Content 2. Minimized the length of video duration Avatar - 1. FPC 2. used human average speed on avatar Transition - Avoid fast movement, single viewing direction Object Placement - Place the 3D object properly and right location Navigation Aid tool - Teleportation User Control - Enter and Exit function Feedback Messages - Positive response WILL ADD MORE BASED ON DESIGN PRINCIPLE	Content Section - Contain Menu Pedagogical Strategies - Instruction Based and Video Demonstration Supportive Strategies - Separator and Positive Instruction Features Content Specification - Introduction, Lesson Content and Closing	

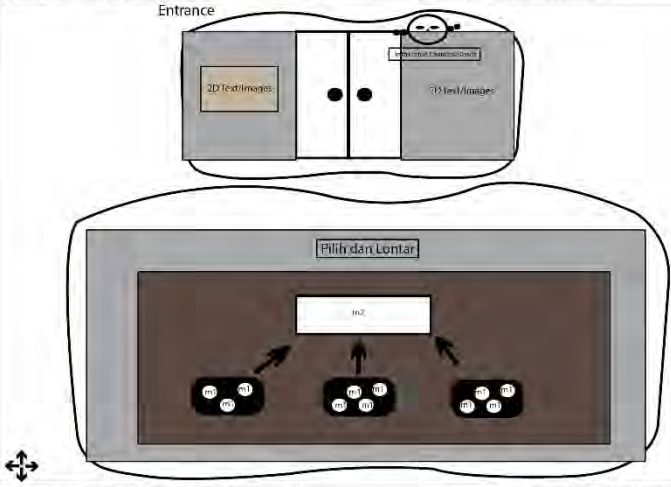
Scene : Mengenali Papan Tanda		Content Structure : Learning Content 2	Graphic/Text
			3D Text : Selamat Datang ke Modul 2 "Jom Belajar" 1. All 15 road sign name. 2D Text : Instruction before entering the learning module. 2D Graphic : Example of 15 road sign image, Road safety images 3D/2D/TextOnly - Button : 3 Button 1. B1 "Gambar" - will show the real images of the vehicle 2. B2 "Suara Penerangan" - will trigger VO on selected vehicle
			Sound BG Sound : Inspiring Music (Ashamake/muse) Instruction Narration: Instruction Script Explanation Narration: Based on road signage infographic (Follow Audio DP)
			Character/3D Model/Object 1. Class Room Setting - UNITY PREFAB 2. Berhenti, Kawasan laluan melintas, hentian bus, laluan trotoar, laluan basikal, laluan tempat parking, kawasan pemaluan, dilawar masuk, dilawar pusing U, Simpang 4, Bongkol, laluan melintas, Had Juju 3. Instruction Character assist "Ocosbot concept" will explain the details of all the instruction through voice over and images. 4. The position the signage like museum where all the item spread through out the area. We can add other activities later on.
Presentation Flow/Concept	Design Element and Principle Involved	Content : Strategies & Instruction Features	
1. This is the Scene for Module 2 where user can learn different type of the road signage. The VF is simulated like the class room that have two level floor and user can walk around inside the room while looking at 15 type of available road signage. 2. In this classroom user can move via teleportation. 3. Character assist still available at the entrance of the classroom and disappear when user enter the classroom. 4. Each road signage will be equipped with explanation by using 3D simulation of the rotating road signage, real images, some simple text and VO explanation. 5. User can come closer to the road sign and see in detail (Not Low Poly) 4. User need to exit from the classroom through main entrance if they want to exit the learning session	Graphic - 1. Use clear & attractive graphic 2. Use meaningful graphic 3. Limit no of graphic used Text - 1. Use necessary and understandable text 2. Place text in right location 3. Limit no of text 4. Use proper text size Audio - 1. Use familiar voice 2. Provide clear pronunciation 3. Use friendly and cheerful voice Color - 1. Limit the number of color used 2. Differentiate between BG and foreground color 3. Use right choices of color Navigation Instruction - 1. Clear instruction 2. Avoid redundant instruction Video - 1. Specific Video Content 2. Minimized the length of video duration Avatar - 1. FPC 2. used human average speed on avatar Transition - Avoid fast movement, single viewing direction Object Placement - Place the 3D object properly and right location Navigation Aid tool - Teleportation User Control - Enter and Exit function Feedback Messages - Positive response WILL ADD MORE BASED ON DESIGN PRINCIPLE	Content Section - Contain Menu Pedagogical Strategies - Instruction Based and Video Demonstration Supportive Strategies - Separator and Positive Instruction Features Content Specification - Introduction, Lesson Content and Closing	

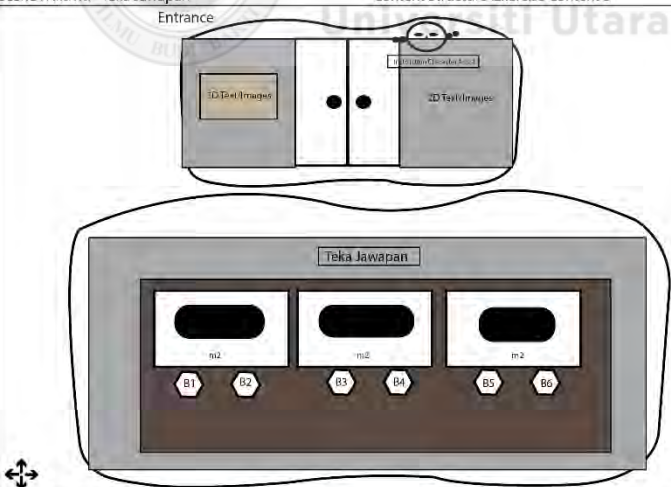
Scene : Mengenali Komponen Basikal		Content Structure : Learning Content 3	Graphic/Text
Entrance  Left Side  Front Side  Right Side 			3D Text : Selamat Datang ke Modul 2 'Jalan Belajar' 1. #1 '15 road sign name. 2D Text - Instruction before entering the learning module "Etika Menunggang Basikal" Explanation 2D Graphic : G1- Example of bicycle ethic G2- Type of bicycle 3D/2D/TextOnly - Button : 3 Button 1. B1 "Gambar" - will show the real images of the vehicle 2. B2 "Suara Penerangan" - will trigger VO on selected vehicle User have can interact with the bicycle component such as holding the item and get closer to the item
Presentation Flow/Concept 1. This is the Scene for Module 3 where user can learn basic part of bicycle, riding ethic and the type of the bicycle. The VE is simulated like the classroom that have one level floor and user can walk around inside the room (left front and right) while looking at 3D model of Bicycle and its part, different type of bike, and riding ethic infographic. 2. In this classroom user can move via teleportation. 3. Character assist still available at the entrance of the classroom and disappear when user enter the classroom. 4. Each part of bicycle will be equipped with explanation by using 3D real images and some simple text and VO explanation. 5. User can come closer to the 3D model and see in detail (Not Low Poly). 6. User need to exit from the classroom through (main) entrance if they want to exit the learning session.		Design Element and Principle Involved Graphic - 1. Use clear & attractive graphic 2. Use meaningful graphic 3. Limit no of graphic used Text - 1. Use necessary and understandable text 2. Place text in right location 3. Limit no of text 4. Use proper text size Audio - 1. Use familiar voice 2. Provide clear pronunciation 3. Use friendly and cheerful voice Color - 1. Limit the number of color used 2. Differentiate between BG and foreground color 3. Use right choices of color Navigation Instruction - 1. Clear instruction 2. Avoid redundant instruction Video - 1. Specific Video Content 2. Minimized the length of video duration Avatar - 1. FPC 2. used human average speed on avatar Transition - Avoid fast movement, single viewing direction Object Placement - Place the 3D object properly and right location Navigation Aid tool - Teleportation User Control - Enter and Exit function Feedback Messages - Positive response WILL ADD MORE BASED ON DESIGN PRINCIPLE	Sound BG Sound : Inspiring Music (AshmaluevMusic) Instruction Narration: Instruction Script Explanation Narration : Based on road Etika Menunggang basikal infographic and jenis jenis basikal (Follow Audio DP) Character/3D Model/Object 1. Class Room Setting - UNITY PREFAB 2. Right Side - Mountain Bike, Road Bike, Kid Bike Bicycle, Folding Bike 3. Left Side - Bicycle with 6 example of parts Part 1: Bolek Part 2: Wheel Part 3: Handle Part 4: Gear Parts 5: Seat Part 6: Pedal 3. Instruction Character assist: "Ocobot concept" will explain the detail of all the instruction through voice over and images.
Content : Strategies & Instruction Features Content Section - Contain Menu. Pedagogical Strategies - Instruction Based and Video Demonstration Supportive Strategies - Separator and Positive Instruction Features Content Specification - Introduction, Lesson Content and Closing			

Scene : Melintas Jalan		Content Structure : Learning Content 4	Graphic/Text
Entrance  Choosing Difficulties  Top View 			3D Text : Selamat Datang ke Modul 4 'Jalan Melintas' 2D Text - Instruction before entering the learning module "Silalah Tahap Kesukaran Melintas" 3D/2D/TextOnly - Button : 3 Button 1. B1 "Mudah" - to "Mudah" scene 2. B2 "Sederhana" - to "Sederhana" scene 2. B3 "Sukar" - to "Sukar" scene Mudah Scene - Less Traffic, Good Weather Sederhana Scene - Medium Traffic, Good Weather Sukar - Heavy Traffic and Bad Weather Traffic will response when user cross the road while the system producing warning note in order to alert the user.
Presentation Flow/Concept 1. This is the Scene for Module 4 where user can learn how to cross road safely. Before start learning, user need to choose difficulties of road traffic such as easy, medium and hard. The difficulties is based on an dangerous and difficult situations such as heavy traffic, and busy road. The first VE is simulated like the class room and user can walk around inside the room while choosing the difficulties. After choosing, they will be directed to selected scene to perform learning activities. 2. In this classroom user can move via teleportation. 3. In the learning scene, user are placed beside the road and will listen to the character assist guidance before crossing the road. There are a system response based on user actions. 4. Character assist still available at the entrance of the classroom and disappear when user enter the classroom and appear again inside learning scene to guide user to perform learning session.		Design Element and Principle Involved Graphic - 1. Use clear & attractive graphic 2. Use meaningful graphic 3. Limit no of graphic used Text - 1. Use necessary and understandable text 2. Place text in right location 3. Limit no of text 4. Use proper text size Audio - 1. Use familiar voice 2. Provide clear pronunciation 3. Use friendly and cheerful voice Color - 1. Limit the number of color used 2. Differentiate between BG and foreground color 3. Use right choices of color Navigation Instruction - 1. Clear instruction 2. Avoid redundant instruction Video - 1. Specific Video Content 2. Minimized the length of video duration Avatar - 1. FPC 2. used human average speed on avatar Transition - Avoid fast movement, single viewing direction Object Placement - Place the 3D object properly and right location Navigation Aid tool - Teleportation User Control - Enter and Exit function Feedback Messages - Positive response WILL ADD MORE BASED ON DESIGN PRINCIPLE	Sound BG Sound : Town, Traffic, and others natural sound Instruction Narration: Instruction Script Explanation Narration : Melintas Jalan Script (Mudah, Sederhana, Sukar) (Follow Audio DP) Character/3D Model/Object 1. Class Room Setting - UNITY PREFAB 2. Town Setting and Road Crossing - UNITY PREFAB 3. Instruction Character assist: "Ocobot concept" will explain the detail of all the instruction through voice over and images.
Content : Strategies & Instruction Features Content Section - Contain Menu. Pedagogical Strategies - Instruction Based and Video Demonstration Supportive Strategies - Separator and Positive Instruction Features Content Specification - Introduction, Lesson Content and Closing			

Scene : Jom Belajar		Content Structure : Content Section Separator	Graphic/Text
			BG Graphic : Road Safety 2D Graphic BG Color : None (Replace by 2d Graphic) 2D Text : "Menu Jom Belajar" (Follow Text DP) 3D Text : None Grouping : Designed Graphic (Box/InFr Light , Signage Graphic) Light Colour (Follow Graphic and Color DP) 3D/2D/TextOnly - Button : 4 Button B1 - "Suai dan Paden" - Link to scene "Suai dan Paden" B2 - "Pilih dan Lontar" - Link to scene "Pilih dan Lontar" B3 - "Tekan Jawapan" - Link to scene "Tekan Jawapan" B4 - "Kembali" - Return to Main Menu Scene
			Sound BG Sound : Inspiring Music (AShamaluevMusic) Instruction Narration : Exercise Menu Script Explanation Narration : JExercise Menu Script (Follow Audio DP)
			Character/3D Model/Object 1. "Suai dan Paden" Button 2. "Pilih dan Lontar" Button 3. "Tekan Jawapan" Button 4. Instruction Character assist, "Ocobot concept"
Presentation Flow/Concept	Design Element and Principle Involved		Content : Strategies & Instruction Features
This scene is triggered when user choose "Jom Beraktiviti" button. In this scene there are 3 menu button that will allow user to have 3 different exercises. First "Suai dan Paden" button will allow user to perform exercise about mix and match. Second Button "Pilih dan Lontar" will allow user to select the answer and throw it to the correct answer location. Third Button "Tekan Jawapan" allow user to guess the correct answer by choosing from two provided answers. The character assist will still available in every menu scene since is need to provide the basic instruction about the function of the button.	Graphic - 1. Use clear & attractive graphic 2. Use meaningful graphic 3. Limit no of graphic used Text - 1. Use necessary and understandable text 2. Place text in right location 3. Limit no of text 4. Use proper text size Audio - 1. Use familiar voice 2. Provide clear pronunciation 3. Use friendly and cheerful voice Color - 1. Limit the number of color used 2. Differentiate between BG and foreground color 3. Use right choices of color Typography - 1. Use suitable font color 2. Use consistent font size 3. Use consistent font style Navigation Instruction - 1. Clear instruction 2. Avoid redundant instruction User Control - Back function Feedback Messages - Positive and encourage message to user		Content Section : Contain element of Section Separator, Menu and Navigation Instruction Pedagogical Strategies - Instruction Based Supportive Strategies - Separator and Positive Instruction Features

Scene : Aktiviti - Suai Dan Paden		Content Structure : Exercise Content 1	Graphic/Text
			3D Text : Selamat Datang ke Aktiviti Suai dan Paden 2D Text : Instruction before entering the activities "Komponen Basikal" "Papan Tanda Jalan Raya" 2D Graphic : Road safety relevant images on the BG
			Sound BG Sound : Inspiring Music (AShamaluevMusic) Instruction Narration : Instruction Script Explanation Narration : Will have encourage and appreciation voice (Follow Audio DP)
			Character/3D Model/Object 1. Class Room Setting - UNITY PREFAB 2. 5 Bicycle Component 3. 5 Road Signage 4. Instruction Character assist "Ocobot concept" will explain the detail of all the instruction through voice over and images.
Presentation Flow/Concept	Design Element and Principle Involved		Content : Strategies & Instruction Features
1. This is the Scene for Activities 1 where user can learn road safety through activities such as Match and Matching. The VE is simulated like the class room and it has two type of match matching activities and user may choose either one. 2. In this classroom user can move via teleportation. 3. Character assist will available at the entrance of the classroom and disappear when user enter the classroom. 4. First Match and Matching activities is for signage module and second activities for Bicycle component module. 5. User need to pickup the 3D model and place it at the right location on the table. 4. User need to exit from the classroom through main entrance if they want to exit the learning session.	Graphic - 1. Use clear & attractive graphic 2. Use meaningful graphic 3. Limit no of graphic used Text - 1. Use necessary and understandable text 2. Place text in right location 3. Limit no of text 4. Use proper text size Audio - 1. Use familiar voice 2. Provide clear pronunciation 3. Use friendly and cheerful voice Color - 1. Limit the number of color used 2. Differentiate between BG and foreground color 3. Use right choices of color Navigation Instruction - 1. Clear instruction 2. Avoid redundant instruction Video - 1. Specific Video Content 2. Minimized the length of video duration Avatar - 1. FPC 2. used human average speed on avatar Transition - Avoid fast movement, single viewing direction Object Placement - Place the 3D object properly and right location Navigation Aid tool - Teleportation User Control - Enter and Exit function Feedback Messages - Positive response WILL ADD MORE BASED ON DESIGN PRINCIPLE		Content Section - Contain Menu Pedagogical Strategies - Instruction Based and Video Demonstration Supportive Strategies - Separator and Positive Instruction Features Content Specification - Introduction, Lesson Content and Closing

Scene : Aktiviti - Pilih dan Lontar		Content Structure :Exercise Content 2	Graphic/Text
Entrance 		3D Text : Selamat Datang ke Aktiviti Pilih dan Lontar 2D Text : Instruction before entering the activities 2D Graphic : Road safety relevant images on the BG No button interaction since it involved user physical interaction in choosing correct vehicle to the target area	Sound BG Sound : Inspiring Music (AshamaluevMusic) Instruction Narrations Instruction Script Explanation Narration : Sound Effect - Cheering (Follow Audio DP)
Presentation Flow/Concept 1. This is the Scene for Activities 2 where user can learn road safety through activities such as Select and Throw. The VE is simulated like the class room and it has two type of Select and Throw activities and user may choose either one. 2. In this classroom user can move via teleportation. 3. Character assist still available at the entrance of the classroom and disappear when user enter the classroom 4. First Select and Throw activities is for signage module and second activities for vehicle selection module. 5. User need to pickup the 3D model and throw it at the right location or provided box. 6. User need to exit from the classroom through main entrance if they want to exit the learning session		Design Element and Principle Involved Graphic - 1. Use clear & attractive graphic 2. Use meaningful graphic 3. Limit no of graphic used Text - 1. Use necessary and understandable text 2. Place text in right location 3. Limit no of text 4. Use proper text size Audio - 1. Use familiar voice 2. Provide clear pronunciation 3. Use friendly and cheerful voice Color - 1. Limit the number of color used 2. Differentiate between BG and foreground color 3. Use right choices of color Navigation Instruction - 1. Clear instruction 2. Avoid redundant instruction Video - 1. Specific Video Content 2. Minimized the length of video duration Avatar - 1. FPC 2. used human average speed on avatar Transition - Avoid fast movement, single viewing direction Object Placement - Place the 3D object properly and right location Navigation Aid tool - Teleportation User Control - Enter and Exit function Feedback Messages - Positive response - WILL ADD MORE BASED ON DESIGN PRINCIPLE	Content : Strategies & Instruction Features Content Section - Contain Menu Pedagogical Strategies - Instruction Based and Video Demonstration Supportive Strategies - Separator and Positive Instruction Features Content Specification - Introduction, Lesson Content and Closing

Scene : Aktiviti - Teka Jawapan		Content Structure :Exercise Content 3	Graphic/Text
Entrance 		3D Text : Selamat Datang ke Aktiviti Teka Jawapan 2D Text : Instruction before entering the activities m2 - Three set of question related to road safety and user need to choose by pointing the controller to the correct answer. 2D Graphic : Infographic question Button Answer : Answer Button B1 - Question 1 Answer B2 - Question 1 Answer B3 - Question 2 Answer B4 - Question 2 Answer B5 - Question 3 Answer B6 - Question 3 Answer	Sound BG Sound : Inspiring Music (AshamaluevMusic) Instruction Narrations Instruction Script Explanation Narration : 3 Set of question Sound Effect - Cheering if correct/Sadd if wrong (Follow Audio DP)
Presentation Flow/Concept 1. This is the Scene for Activities 3 where user can learn road safety through activities such as Select and Throw. The VE is simulated like the class room and it has three set of question that user can choose. 2. Each question will have 2 choices answer and user need to use controller to point to the correct answer. The system will response to based on the user selection. 3. In this classroom user can move via teleportation. 4. Character assist still available at the entrance of the classroom and disappear when user enter the classroom 5. User need to exit from the classroom through main entrance if they want to exit the learning session		Design Element and Principle Involved Graphic - 1. Use clear & attractive graphic 2. Use meaningful graphic 3. Limit no of graphic used Text - 1. Use necessary and understandable text 2. Place text in right location 3. Limit no of text 4. Use proper text size Audio - 1. Use familiar voice 2. Provide clear pronunciation 3. Use friendly and cheerful voice Color - 1. Limit the number of color used 2. Differentiate between BG and foreground color 3. Use right choices of color Navigation Instruction - 1. Clear instruction 2. Avoid redundant instruction Video - 1. Specific Video Content 2. Minimized the length of video duration Avatar - 1. FPC 2. used human average speed on avatar Transition - Avoid fast movement, single viewing direction Object Placement - Place the 3D object properly and right location Navigation Aid tool - Teleportation User Control - Enter and Exit function Feedback Messages - Positive response - WILL ADD MORE BASED ON DESIGN PRINCIPLE	Content : Strategies & Instruction Features Content Section - Contain Menu Pedagogical Strategies - Instruction Based and Video Demonstration Supportive Strategies - Separator and Positive Instruction Features Content Specification - Introduction, Lesson Content and Closing

Appendix G

Sample of Voice Over Scripting

Mengenali Kenderaan Voice Over Script

Instruction Character Assist VO:

Selamat datang ke Modul 1 iaitu Mengenali Kenderaan. Dalam paparan ini, adik boleh belajar mengenali pelbagai jenis kenderaan seperti basikal, motosikal, bas sekolah, ambulans dan banyak lagi. Adik boleh berinteraksi dengan memegang model kenderaan dan penerangan lanjut akan diaktifkan.

Selain itu, di bahagian dinding belakang setiap kenderaan, ada beberapa contoh gambar dan penerangan yang lebih jelas.

Jom kita teroka bersama-sama!

BASIKAL

Basikal merupakan kenderaan dua roda yang ditunggang dengan mengayuh pedalnya dengan menggunakan kaki ataupun menggunakan tenaga elektrik untuk bergerak.

Terdapat beberapa jenis basikal yang telah disesuaikan dengan situasi yang tertentu. Sebagai contoh, basikal gunung yang digunakan untuk aktiviti lasak, basikal lipat untuk aktiviti riadah dan basikal roda tiga yang digunakan untuk membawa penumpang ataupun barangan.

MOTOSIKAL

Motosikal merupakan kenderaan dua roda yang menggunakan enjin atau tenaga elektrik untuk bergerak dan ianya perlu ditunggang seperti kenderaan dua roda yang lain seperti basikal.

Untuk pengetahuan adik, terdapat beberapa jenis motosikal seperti "Super Bike" - motosikal berkelajuan tinggi, "Skuter" - motosikal yang menggunakan transmisi automatic dan Kapcai - motosikal yang ringkas dan mudah untuk ditunggang.

BAS

Bas merupakan pengangkutan awam yang digunakan untuk membawa penumpang ke satu destinasi yang ingin dituju.

Untuk pengetahuan adik terdapat 4 jenis bas di Malaysia seperti :

1 Bas Henti Henti – Bas yang berulang alik mengikut laluan yang telah ditetapkan

2 Bas Sekolah – Bas yang digunakan secara eksklusif untuk membawa murid atau kakitangan Pendidikan ke sekolah

3 Bas Pekerja – Bas yang digunakan untuk membawa pekerja ke mana mana tempat perindustrian.

4. Bas Ekspres – Bas yang digunakan untuk membawa penumpang ke destinasi yang jauh.

KERETA API

Kereta Api merupakan pengangkutan awam yang boleh digunakan untuk membawa penumpang dan juga barangan cargo. Terdapat beberapa jenis kereta api seperti kereta api wap, kereta api elektrik dan kereta api diesel.

Untuk pengetahuan adik, kereta api penumpang terbahagi kepada dua iaitu kereta api elektrik yang kebanyakannya beroperasi di pusat-pusat bandar yang menghubungkan destinasi yang terdekat. Manakala kereta api diesel digunakan untuk membawa penumpang ke destinasi yang jauh.

Selain itu, terdapat juga kereta api kargo, yang menyediakan perkhidmatan membawa kargo yang biasanya sangat mudah untuk diakses untuk membawa barangan dengan kuantiti yang banyak.

TRAK PEMADAM KEBAKARAN

Trak Pemadam Kebakaran merupakan kenderaan yang diguna pakai oleh Agensi Keselamatan dan Penyelamat seperti BOMBA bagi tujuan memadam kebakaran. Kenderaan ini dilengkapi dengan pelbagai peralatan untuk menyelamatkan dan juga memadam api.

AMBULANS

Ambulans merupakan kenderaan yang digunakan oleh pihak hospital ataupun mana mana agensi penyelamat di negara kita bagi tujuan membawa pesakit ke hospital bagi mendapatkan rawatan.

Sebagai orang awam yang prihatin, kita haruslah memberikan laluan dengan segera sekiranya kita berhadapan dengan ambulans di jalan raya seperti bergerak ke kiri atau kekanan bahu jalan bagi memberi laluan kepada ambulans untuk segera tiba ke hospital.

KERETA

Kereta merupakan kenderaan beroda yang menggunakan petrol/diesel atau tenaga elektrik untuk bergerak. Kenderaan boleh digunakan sebagai kenderaan persendirian atau pun untuk pengangkutan awam.

Appendix H

Sample of Observation Checklist

USER EXPERIENCE TESTING [OBSERVATION CHECKLIST]				
DESIGN MODEL OF IMMERSIVE VIRTUAL REALITY AID SYSTEM FOR CHILDREN ROAD SAFETY EDUCATION (IVRAS4CROSE)				
SECTION A: RESPONDENT DETAILS				
Name	: _____	Age	: _____	years
Gender	: Male / Female	Computers Experience	: YES / NO	
School	: _____	Standard	: _____	
Race	: _____	ID	: _____	
SECTION B: RESPONDENT ACTION / BEHAVIOUR / RESPONSES				
The instrument is used to evaluate the experiences and responses from the respondents (student) while using the IVRAS4ROSE – <i>Bijak Melintas</i>. Indicator Code: 1. Relax / Comfortable 2. Cheerful / Smile 3. Happy 4. Enjoy 5. Excited 6. Positive Voice Reaction				
No	Observed Respondent Behaviors / Actions	Indicator	IVRAS4ROSE Scene	Remark

**SECTION C: CHILDREN ENGAGEMENT AND INTERACTION WITH IVRAS4ROSE
– BILAK MELINTAS**

The checklist instrument is used to investigate the respondent's engagement and interaction.

Score	Description
0	Did not complete the content at all
1	Engaged the content but partially completed
2	Engaged the content and fully completed

No	Module / Sub Module	Score	Remark
1	Start Time		
2	Learning Module i. <i>Mengenal Kenderaan</i> ii. <i>Mengenal Papan Tanda</i> iii. <i>Mengenal Komponen Basikal</i> iv. <i>Belajar Melintas Jalan</i>		
3	Learning Activities i. <i>Suai dan Padan</i> ii. <i>Pilih dan Lontar</i> iii. <i>Teka Jawapan</i>		
4	Free-Roaming (Exploration)		

(Adapted from Zulaiha, (2017))

SECTION D: EFFECT OF CYBERSICKNESS (PHYSICAL RESPONSE)

Indicator Code:

1. Sweating
2. Dizziness
3. Eye Strain
4. A Lingering Sense of Movement
5. Nausea
6. Disorientation
7. Vertigo

Time Frame (Minutes)	Observed Respondent Physical Responses towards Cybersickness	Scene	Indicator	Remarks
1 - 5				
6 - 10				
11 - 15				
16 - 20				
21 - 25				
26 - 30				

(Adapted from Davis et al., (2014), Freiwald et al., (2020), Henrie et al., (2015), Scherer, (2016), Schwind et al., (2019), Sevinc and Berkman (2020) and Tcha-Tokey et al., 2016)

Observer Name :

Date and Time :

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- Zulaiha, S. (2017). *A Conceptual Model of Interactive Computer Assisted Learning for Low Achieving Primary School Student*. Universiti Utara Malaysia.



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Universiti Utara Malaysia

Appendix I

Sample of Interview Checklist

USER EXPERIENCE TESTING [INTERVIEW CHECKLIST]		
DESIGN MODEL OF IMMERSIVE VIRTUAL REALITY AID SYSTEM FOR CHILDREN ROAD SAFETY EDUCATION (IVRAS4CROSE)		
SECTION A: RESPONDENT DETAIL/DEMOGRAPHIC		
Name*	:	
Age	:	
Gender	:	<input style="width: 40%;" type="checkbox"/> Male <input style="width: 40%;" type="checkbox"/> Female
Race	:	
School	:	
School Standard Level	:	
Respondent ID	:	
SECTION B: EXPERIENCE ON USING COMPUTER, HMD AND ANY IVR APPLICATION		
This section collects the respondent feedback in terms of the experience of using the computer, computers the experience in using HMD, and the experience in using any IVR application such as education application or games.		
No	Question	Answer
1	Have you learned to use the computer before?	

2	Where and when did you learn it?	
3	Do you know what is VR and IVR?	
4	Have you ever used a VR or IVR application/game before? If so, what is the title and platform of the application?	
5	What do you think of the VR/IVR application?	
6	Do you know what is HMD and the function of HMD?	
7	What do you think of the use of HMD in IVR applications?	

(Nurulnadian, 2015)

SECTION C: GENERAL EXPERIENCE OF USING IVRAS4CROSE – *Bijak Melintas*

This section collects the respondent feedback in terms of experience when and after they are using the IVRAS4CROSE – *Bijak Melintas*.

No	Question	Answer
1	What do you think of the IVRAS4CROSE- <i>Bijak Melintas</i> ?	
2	Does playing instruction clear and easy to understand?	
3	Does the playing instruction help in assisting you to use the IVRAS4CROSE- <i>Bijak Melintas</i> ?	

4	Do 30 minutes of playing time is enough to explore the IVRAS4CROSE- <i>Bijak Melintas</i> ?	
5	Does the physical setting of is user experience testing is suitable and comfortable?	
6	Which playing position is preferred? (Standing/Sitting)	
7	Does HMD is comfortable to use?	
8	What are the strengths of IVRAS4CROSE- <i>Bijak Melintas</i> ?	
9	What is the weakness of IVRAS4CROSE- <i>Bijak Melintas</i> ?	
10	What have you learned for the IVRAS4CROSE- <i>Bijak Melintas</i> ?	

(Nurulnawati, 2015; Zulaiha, 2017)

SECTION D: ELEMENTS IN IVRAS4CROSE

This section collects the respondent feedback in terms of suitability and applicability of some of the specific features/elements of IVRAS4ROSE – *Bijak Melintas*.

General and Multimedia		
No	Question	Answer
1	What do you think about the text in IVRAS4ROSE – <i>Bijak Melintas</i> ?	
2	What do you think about the graphic and animation used in the IVRAS4ROSE – <i>Bijak Melintas</i> ?	

3	What do you think about the audio and assistive voice narration provided in the IVRAS4ROSE – <i>Bijak Melintas</i> ?	
4	What do you think about the video used in the IVRAS4ROSE – <i>Bijak Melintas</i> ? Does it helpful?	
Immersion		
No	Question	Answer
1	What do you think about the VE in the IVRAS4ROSE – <i>Bijak Melintas</i> ?	
2	Does 3D model look realistic in the IVRAS4ROSE – <i>Bijak Melintas</i> ?	
3	Does the placement of every 3D model are properly placed and suitable for the assigned position?	
4	Does the 3D model use relevance with the learning theme (Children Road Safety Education)?	
5	Do you prefer low-poly modeling or high-poly modeling?	
6	Do you prefer real images or simple color as texture for the 3D model used in IVRAS4ROSE – <i>Bijak Melintas</i> ?	
7	What do you think about the assistive 3D model character inside IVRAS4ROSE – <i>Bijak Melintas</i> ? Does it attractive?	
8	What do you think about the lighting used inside the VE in IVRAS4ROSE – <i>Bijak Melintas</i> ?	
Navigational and Interaction		
No	Question	Answer
1	What do you think is the navigational layout of IVRAS4ROSE – <i>Bijak Melintas</i> ?	

2	What do you think about the transition provided in the IVRAS4ROSE – <i>Bijak Melintas</i> ?	
3	What do you think about the navigational assistive instruction provided in IVRAS4ROSE – <i>Bijak Melintas</i> ?	
4	What do you think about the teleport function used in IVRAS4ROSE – <i>Bijak Melintas</i> ? Do you prefer teleport or joystick movement?	
5	Does the teleport area are easy to find and access?	
6	What do you think about the hand tracking function in IVRAS4ROSE – <i>Bijak Melintas</i> ? Does it helpful in assisting you to interact and manipulate the 3D model?	
7	Does the HMD controller function easy to use?	
8	Do you prefer the free exploration concept or sequential exploration concept?	
9	What do you think about overall interaction in the IVRAS4ROSE – <i>Bijak Melintas</i> ?	

SECTION E: THE EFFECT OF CYBERSICKNESS TO RESPONDENT

This section collects the respondent feedback in terms of the effect of cybersickness after using the IVRAS4ROSE – *Bijak Melintas*.

No	Question	YES/NO	Remark
1	Do you feel any dizziness?		
2	Do you feel any nausea?		
3	Do you sweat?		
4	Do you feel eye strain?		
5	Do you feel disorientation?		
6	Do you have any experience in having vertigo?		
7	Do you have difficulties in terms of sense of movement (standing, sitting, and walking)?		

(Davis et al., 2014; Freiwald et al., 2020; Schwind et al., 2019; Sevinc & Berkman, 2020; Tcha-Tokey et al., 2016)

SECTION F: THE LEARNING EXPERIENCE FROM IVRAS4CROSE

This section collects the respondent feedback in term learning experience after using the IVRAS4ROSE – *Bijak Melintas*.

No	Question	YES/NO	Remark
1	Do you think this concept is a new learning approach/experience?		
2	Do you discover new knowledge about children's road safety education?		

3	Do you feel excited about what you have learned?		
4	Do you get curious about finding out more about the learning content of IVRAS4CROSE- <i>Bijak Melintas</i> ?		
5	Does IVRAS4CROSE help to recall road safety knowledge that you have learned?		
6	Do you feel familiar with the learning content provided in IVRAS4CROSE- <i>Bijak Melintas</i> ?		
7	Will you recommend this IVRAS4CROSE- <i>Bijak Melintas</i> application to your friends?		

(Ibrahim & Ali, 2018)

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Appendix J

Sample of Parent Consent Form

SURAT AKUAN KEBENARAN IBU BAPA / PENJAGA

Adalah saya _____ ibu / bapa / penjaga
kepada murid bernama _____, pembawa kad
pengenal / surat beranak bernombor _____ yang belajar
di Sekolah Kebangsaan _____.

Dengan kerelaan hati saya:

1. Saya bersetuju mengizinkan anak/ jagaan saya menjadi responden kajian bagi penyelidikan yang dijalankan oleh penyelidik Nur Sauri Bin Yahaya.
2. Memberi kebenaran kepada pihak Tuan untuk merakam dan merekod segala reaksi dan percakapan anak/ jagaan saya di dalam bentuk video, audio dan gambar bagi tujuan penyelidikan.
3. Bersetuju TIDAK akan membuat sebarang tuntutan di mahkamah terhadap mana – mana pihak sekiranya kandungan rakaman tersebut digunakan untuk tujuan penerbitan penyelidikan dan disebar kepada pihak umum.

Nota : Kajian ini melibatkan penggunaan aplikasi computer yang bertajuk “ IVRAS4CROSE – Bijak Melintas” untuk diuji dari aspek pengalaman penggunaan tanpa melibatkan bahan-bahan yang berbahaya.

Disaksikan Oleh :

.....
Tandatangan Ibu/ Bapa/ Penjaga

Nama: _____

No. K.P: _____

.....
Tandatangan Penyelidik

Nama Saksi : _____

No. K.P: _____