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Identifying Learners' Needs and Design Features in Augmented Reality Application for Learning Mandarin Vocabulary: A Pilot Study

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Abstract

Global communication has become narrower and simpler and resulted to the increased demand of foreign language learning. Due to this, more effort has been taken up especially in tertiary level to further improve learning experience in line with the increasing demand and needs of learners in learning. More suitable digital materials are needed and Augmented Reality (AR) is seen able to be utilized. However, AR uses and how it complies to certain principles of language teaching and learning have become a concern. Therefore, this paper attempts to identify the needs of learners in AR learning environment as well as identifying the features required in the content and design of AR application for Mandarin vocabulary learning. This quantitative research involves 320 purposely selected respondents and utilizes a set of survey questionnaire comprises of three parts. The findings, based on descriptive analysis, show that high majority of learners are very positive about the statements in the questionnaire especially in the design aspects with some exceptions in the perceived ease of use, usefulness and intention of use categories. These findings are useful in providing clearer needs of the learners and design requirements in learning Mandarin vocabulary using AR.

Keyword: Mandarin Vocabulary, Augmented Reality Application, Virtual Learning Environment, Innovative Instructional Design, Technology Acceptance Model (TAM)

Introduction

As we embark into the world of globalisation, the modes of communication across the globe become narrower and simpler. More learners are learning foreign languages such as Mandarin since it assists them not only in their career advancement but also enable them to reach out into different horizons especially in social networking throughout their whole life (See & Ching, 2013; Vareckova & Pavelkova, 2018). Furthermore, learners see extra added value if they are able to communicate with people from other countries. As a matter of fact, many are noticing foreign languages not only as modes of communication, but as tools to open their minds to the world around them. As a result, learning foreign language has become a must in most of the higher learning institutions **(**Malaysia Education Blueprint 2015-2025 report, produced by the (Ministry of Education, 2015). At Universiti Teknologi MARA, all the degree students are required to learn a foreign language as their third language beside Malay language and English language. Mandarin is among the most popular third language chosen by students. The Mandarin course is structured in three level; Introductory Mandarin I, Introductory Mandarin II, and Introductory Mandarin III. These three levels of Mandarin learning are spread across three semesters after students registered themselves with Akademi Pengajian Bahasa.

There is a great potential for integrating Augmented Reality (AR) to be further developed for learning purposes, especially in foreign language learning. Since the outbreak of COVID-19 pandemic occurred in 2020, we have to tailor our mode of delivery for teaching and learning in education to more on virtual based and online. Therefore, more digital materials are needed to assist learners to obtain and gain knowledge, whereas, educators have to prepare suitable and conducive digital materials during online distance learning (ODL) or remote learning (Nelson et al., 2021).

Problem Statement

In line with the world of globalisation, comes the era of technology whereby it cuts through time and space to transmit the information. Younger learners are quick to learn these new technologies and have access without limitations. With this changing situation, learners are fast to possess various hi-tech devices including mobile devices. Numerous studies in using augmented reality in foreign language learning such as Mandarin have been conducted and have shown huge potentials in this area especially in increasing interest in language learning and improving students' memorising dimension of learning achievement (Chin & Wang, 2021). Many researchers in other countries have realized the significance and the promising future of AR in language learning and have already started to embark into this area via various research. However, this area has yet to be fully explored in Malaysia.

Likewise, one of the most significant problems in the design of foreign language AR applications is related to aspects that include e-pedagogy, instructional design and how those applications comply to HSK Test standard, a standard that is similar to CEFR. Adhering to the right approach in the design of AR-based vocabulary learning application for the use in foreign language learning is crucial as it will determine the success of the learning process and the extend to where the application can support the learning process. Roubides (2018) and Nelson et al.(2021) stated that, Instructional design approaches and practices need to keep up with advances in technologies and human-machine interaction capabilities that instruction can be effectively deliver when using newer technologies. Therefore, the design of AR-based

learning applications for Mandarin, in this case, must be grounded on a number of relevant learning and language theories and approaches and at the same time comply to the needs of the learners.

Research Objectives

The main objective of this study is to investigate students' perception on using augmented reality for Learning Mandarin vocabulary for Non-native speakers.

Specifically, the study is aimed:

1. To identify the needs of Mandarin language learners in augmented reality learning environment.
2. To identify the features required in the content and design of augmented reality application for Mandarin vocabulary learning.

Methodology

The pilot study seeks to identify the needs of Mandarin language learners in learning the laguage in AR learning environment. Besides, the study will also identify features that are required in the presentation of the learning content as well as the design elements preferred by learning Mandarin vocabulary via an AR application. The fundamental in any initiative as stated by Mckillip (1987) is that need analysis is to be carried out to gather information to identify and determine the solution for a targeted audience. Therefore, this need analysis survey is conducted prior to the development of an AR application for learning Mandarin vocabulary. A well designed AR application that prioritizes the needs of the learners will effectively provide condusive learning environment as well as able to promote ubiquitous learning and immersive learning (cybergogy) environment. Consequently, it will offer great flexibility of instructional materials, thus, promote learner's motivation to learn foreign language and embrace lifelong learning.

The study was carried out in Universiti Teknologi MARA, a public university in Malaysia. The purposive sampling consist of undergraduate volunteers of non-native speakers of Chinese language who enrolled in a mandarin language course *Introductory Mandarin 1* at UiTM. The student population included male and female students from different faculties. The subjects comprised 320 students from three faculties at UiTM satellite Seremban campus; Faculty of Computer and Mathematical Sciences (FSKM), Faculty of Sports science & Recreation (FSK) and Faculty of Administrative Science & Policy Studies (FSPPP).

The instrument used was an online survey questionnaire comprising four parts, namely Part A (demographics), Part B (readiness), and Part C (perceptions of using AR application in learning Mandarin vocabulary) and Part D (. The questionnaire employed a five-point Likert's scale ranging from 1 to 5 (1=Strongly Disagree (SD), 2=Disagree (D), 3= not sure(NS), 4=Agree (A), and 5=Strongly Agree (SA). The feedback of the online questionnaire is used in the study.

Results and Discussions

A. Demographic Information

The distribution of respondents' demography is described in Table 1 covers gender, faculty and age.

Table 1
Demographics of Respondents

Item	Category	Frequency	Percentage (%)
Gender	Male	55	17.2
	Female	265	82.8
Faculty	FSKM	199	62.2
	FSPPP	102	31.9
	FSR	19	5.90
Age	19	1	0.31
	20	55	17.19
	21	215	67.19
	22	24	7.5
	23	22	6.88
	24	3	0.93

The results in Table 1 show that the distribution of students by gender is male 55 (17.2%) and female 265 (82.8%). The respondents are from a satellite campus of UiTM, Seremban. They are from FSKM, FSPPP and FSR. Majority of the respondents are from FSKM with 199 (62.2%) students, followed by FSPPP with 102 students (31.9%) and the smallest number of respondents are from FSR with 19 (5.90%) students. This distribution of respondents by faculty is a true reflection of the student composition in the UiTM Seremban campus.

In terms of age, 67.19% or 215 are 21 years old, 55 (17.19%) are 20 years old, 24 (7.5%) are 22 years old and 22 or (6.88%) are 23 years old. Three students (0.93%) are 24 years old and the remaining (0.31%) is 19 years old.

B. Factors that influence students' readiness towards AR application in learning Mandarin
Table 2 indicates the factors that influence students' readiness towards implementing AR application / technology in learning Mandarin. It provides information about respondents' knowledge about AR, their interest in using AR application and the choice of tools used in AR application in learning Mandarin.

Table 2

Readiness

Item	Category	Frequency	Percentage (%)
Do you have any knowledge of using Augmented Reality (AR) application in learning?	Yes	22	6.9
	No	298	93.1

Interest

Item	Category	Frequency	Percentage (%)
Would you be interested in using AR for learning Mandarin?	Yes	301	94.1
	No	19	5.9

Tools

Item	Category	Frequency	Percentage (%)
I have the resources necessary to use Augmented Reality (e.g., smartphone)	Yes	296	92.5
	No	24	7.5
Augmented Reality is compatible with other technology I use.	Yes	283	88.4
	No	37	11.6
I can get help from others if I have difficulties using Augmented Reality	Yes	292	91.3
	No	28	8.8

Referring to Table 2, the results show that majority of students or 301 (94.1%) of them do not have any knowledge of using Augmented Reality (AR) application in learning and only 19 students (5.95%) do. In other words, even though AR applications have been used or commonly utilized in learning recently, majority of students do not have the opportunity to use it in their learning. Fortunately, when asked whether they would be interested in using AR in learning Mandarin, majority of them responded positively with 301 (92.5%) interested and 19 (5.9%) are not. This might be caused by their poor understanding of the technology, minimum exposure to AR application or merely having little knowledge about AR application. All these can increase their anxiety level in exploring AR technology in learning.

Morover, responding to whether they have resources to own necessary technology tools such as mobile device, laptop etc., in order to use AR application in learning Mandarin, 296 students (92.5%) believe that they do and only minority of them 24 (7.5%) do not have such resources. Besides this, majority (283) of the respondents believe that AR is compatible with the other technology that they use. Most of them 292 (91.3%) also believe that they can get help if they have difficulties using AR application in learning. Only 37 students (11.6%) think that Augmented Reality is not compatible with the other technology they use and 28 students (8.8%) admit that they can't get help from others if they face difficulties in using AR technology. Furthermore, owning the right tools compatible to AR among some of the students is hindered by their financial restrictions.

C: Perceptions in using AR application in learning Mandarin vocabulary

The researchers assessed students' perceptions in using AR application in four aspects; (i) the application's design of contents and presentation, (ii) respondents' perceived ease of use, (iii) respondents' perceived usefulness and (iv) respondents' intention to use Mandarin AR app in learning Mandarin vocabulary. Additionally, the researchers used Likert's scales of 1-5 to categorise the score: 1=strongly disagree, 2= disagree, 3 = not sure and 4=agree, 5 = strongly agree. The descriptive analysis was carried out using SPSS software version 27. Scores related to frequency, percentage, mean and standard deviation (SD) were analyzed and tabulated. The detailed results of the participants' perceptions toward the design of contents and presentation of Mandarin AR vocabulary application are shown in Table 3 below.

I. Design of content and presentation of Mandarin AR vocabulary Application

Table 3

Design of content and presentation of Mandarin AR vocabulary Application

No	Item	SD	D	NS	A	SA	M	SD	Interpretation
16	The size and type of font used in the app should be suitable	0 (0.0)	1 (0.3)	34 (10.6)	165 (51.6)	120 (37.5)	4.26	.653	High
17	The virtual graphics / images used in the apps should be suitable.	0 (0.0)	1 (0.3)	30 (9.4)	154 (48.1)	135 (42.2)	4.32	.653	High
18	Informative virtual graphics or images are necessary to make me understand the lesson better.	0 (0.0)	0 (0.0)	27 (8.4)	147 (45.9)	146 (45.6)	4.37	.635	High
19	Sample sentences should be provided to illustrate the use of each vocabulary item in the lesson will help to increase my vocabulary.	0 (0.0)	0 (0.0)	27 (8.4)	135 (42.2)	158 (49.4)	4.41	.642	High
20	The audio quality of the app should be good.	0 (0.0)	1 (0.3)	25 (7.8)	109 (34.1)	185 (57.8)	4.49	.653	High

21	The layout and interface design should be systematic.	0 (0.0)	0 (0.0)	30 (9.4)	132 (41.3)	158 (49.4)	4.40	.655	High
22	The layout and interface design should be user friendly.	0 (0.0)	0 (0.0)	27 (8.4)	117 (36.6)	176 (55.0)	4.47	.647	High
23	Navigation of Mandarin AR should be user friendly.	0 (0.0)	0 (0.0)	26 (8.1)	121 (37.8)	173 (54.1)	4.46	.642	High
24	Instruction of using Mandarin AR should be easy to understand	0 (0.0)	0 (0.0)	27 (8.4)	109 (34.1)	184 (57.5)	4.49	.648	High
25	Distribution of vocabulary items into different themes will made learning process easy.	0 (0.0)	0 (0.0)	31 (9.7)	133 (41.6)	156 (48.8)	4.39	.658	High
	Overall						**4.41**	**.649**	**High**

N=320 M=Mean SD=Standard Deviation

SD: Strongly Disagree **D**: Disagree **NS**: no sure **A**: Agree **SA**: Strongly agree

Questions 16 to 25 are used to extract students' preference regarding the design of content and presentation elements that are used in a Mandarin AR application. Respondents were asked to state their agreement on the suitability of the AR application (app) in aspects such as multimedia elements and design, content presentation, as well as the role of the design elements in learning Mandarin. Here, multimedia elements refer to text, font size, virtual graphics/images and audio. Based on the survey, more than 90 % of the respondents agree that multimedia elements used should be suitable especially the good audio quality of the AR endorsed by 91.9% of the respondents. Regarding the layout/interface design, 90.7% agree that it should be systematic and user friendly (91.6%). Navigation is one of the most important design and presentation element in developing an AR app. and in the survey, 91.6% think that the instruction provided how to use AR app should be easy to understand. In the aspect of the content, 86.5% agree that each vocabulary item is to be attached with sample sentences. This will help users to master the vocabulary items that they learn via the application. Besides that, the respondents (90.4%) agree that the distribution of vocabulary items into different themes will help in making the learning process much easier. However, a few respondents (7.8%-10.6%) are indecisive or 'not sure' whether the design and content of Mandarin AR app is suitable, systematic and user friendly. This is supported by Solak and Cakir (2016); Demetriou (2020); Fan et al (2020); Zuo et al (2022) who mentioned that well-designed AR app in combination of multimedia elements could enhance the presentation of information and attract learners' attention to learn. Gavilanes Lopez et al (2019) reported

that learning contents used in AR app are easy to be digested and useful to learners. Ultimately, such advantages have granted improvement in learning.

Based on table 3, the data analysis shows that the aspect of design of content and presentation of Mandarin AR vocabulary Application represented by the statements in the survey were positively endorsed or agreed. Overall, the mean value of those items is 4.41 and recorded a standard deviation of 0.649. This indicates that respondents agree that multimedia elements as crucial elements in the design of AR app. One of the items with the highest mean scores is related to the audio quality of the app (M = 4.49, SD = .653) and instructions for using Mandarin AR should be easy to understand (M = 4.49, SD = .648). This is followed by the layout and interface design that should be user friendly (M = 4.47, SD = .647). All items recorded mean values at a high level. The standard deviation (SD) for all measures range from 0.635 to 0.655, suggesting that there was little variation among the students' view for each measure.

II. Perceived Ease-Of-Use

Questions number 26 to 29 in Table 4 represent respondents' perceived ease of use of the application. In the following table, Table 5, the focus will be on the usefulness of using AR app in learning Mandarin vocabulary.

Table 4
Perceived Ease-Of-Use

No	Item	SD	D	NS	A	SA	M	SD	Interpretation
26	I think AR Mandarin can be used for learning Mandarin.	0 (0.0)	1 (0.3)	77 (24.1)	154 (48.1)	88 (27.5)	4.03	.727	High
27	I think AR Mandarin is easy to use for learning Mandarin.	0 (0.0)	3 (0.9)	110 (34.4)	128 (40.0)	79 (24.7)	3.88	.785	Medium
28	I think learning to use/ operate AR Mandarin is easy for me.	0 (0.0)	5 (1.6)	120 (37.5)	130 (40.6)	65 (20.3)	3.80	.775	Medium
29	I think students are more skilful at using AR Mandarin.	0 (0.0)	4 (1.3)	111 (34.7)	137 (42.8)	68 (21.3)	3.84	.765	Medium
	Overall						**3.89**	**.763**	**Medium**

N=40 M=Mean SD=Standard Deviation

SD: Strongly Disagree **D**: Disagree **NS**: not sure **A**: Agree **SA**: Strongly Agree

Table 4 above shows the interpretation of data on the respondents' perceived ease of use of the application. As far as easy of use of AR app in learning Mandarin is concerned, 60 %-75.6% respondents perceived AR app is easy to use and 24.1%-37.5% students are indecisive or not sure. This is due to majority of students (93.1%) who do not have any experience in using AR app in learning. Since they are not familiar with AR app, they might not be able to anticipate the advantage of AR in learning Mandarin.

Besides, in terms of mean measure, the overall score is 3.89 and a standard deviation of .763. All items have a mean average score at a medium level, except for one item at the high level, the "I *think AR Mandarin can be used for learning Mandarin"* with a mean value of 4.03 and a standard deviation of .727. The item with the lowest mean score was the *"I think learning to use/operate AR Mandarin is easy for me"*, which recorded 3.88 with a standard deviation of .775. Therefore, it can be concluded that the respondents are positive in using AR in the future as they believe in the ease of use of such technology.

III. Usefulness of using Mandarin AR in learning Mandarin vocabulary

Table 5

Usefulness of using Mandarin AR in learning Mandarin vocabulary

No	Item	SD	D	U	A	SA	Mean	SD	Interpretation
30	Using AR in learning Mandarin can be fun, enjoyable, and exciting.	0 (0.0)	1 (0.3)	66 (20.6)	164 (51.2)	89 (27.8)	4.07	.703	High
31	AR Mandarin can make interaction more flexible.	0 (0.0)	2 (0.6)	74 (23.1)	165 (51.6)	79 (24.7)	4.00	.710	High
32	I think I can be in control when dealing with AR experience	1 (0.3)	1 (0.3)	115 (35.9)	145 (45.3)	58 (18.1)	3.81	.739	Medium
33	I think/ believe that using AR Mandarin helps to make information	0 (0.0)	0 (0.0)	83 (25.9)	164 (51.2)	73 (22.8)	3.97	.699	Medium

	easier to understand								
34	Using Augmented Reality in learning Mandarin can make learning more focused and faster	0 (0.0)	2 (0.6)	91 (28.4)	158 (49.4)	69 (21.6)	3.92	.721	Medium
35	AR Mandarin will increase my productivity in learning Mandarin	0 (0.0)	3 (0.9)	78 (24.4)	165 (51.6)	74 (23.1)	3.97	.716	Medium
36	Using AR in learning Mandarin can motivate me to learn Mandarin	0 (0.0)	0 (0.0)	75 (23.4)	166 (51.9)	79 (24.7)	4.01	.695	High
37	Distribution of vocabulary into themes via Augmented Reality can help student to memorize the vocabulary	0 (0.0)	1 (0.3)	83 (25.9)	161 (50.3)	75 (23.4)	3.97	.712	Medium
	Overall						**3.97**	**.712**	**Medium**

N=40 M=Mean SD=Standard Deviation

SD: Strongly Disagree **D**: Disagree **U**: Uncertainty **A**: Agree **SA**: Strongly Agree

Table 5 shows the respondents' feedback regarding the usefulness of using Mandarin AR in learning Mandarin vocabulary. 71%-78% students provided positive feedback on how AR is useful in learning Mandarin vocabulary. 78% students agreed that the use of AR app can be fun, enjoyable and exciting and make interaction more flexible (76.3%). In addition, AR app can make information (learning Mandarin) easy to understand (74%), make learning more

focused and fast (71%) and boost productivity of learning Mandarin. Thematic distribution of vocabulary items will assist learners to memorize those vocabulary items (73.7%). All the usefulness aspects discussed are believe to enable to increase their motivation to learn Mandarin as agreed by (76.6%) of the respondents. These findings are in line with many other research findings (Chang, et al., 2022; Chuang, et, al., 2022; Wang, et al., 2022; Yang et al., 2022) which indicated that AR apps improve academic achievement and motivate students in learning language.

The descriptive analysis, mean and standard deviation were also calculated. Based on Table 5, the data show the usefulness of using AR in learning Mandarin vocabulary with an overall mean score of 3.97 and a standard deviation of .712. This shows that AR Mandarin is useful for learning Mandarin. All items recrded mean average scores of medium and high level. Items with the highest mean values were *"Using AR in learning Mandarin can be fun, enjoyable, and exciting"* with values (M = 4.07, SD = .703) followed by the item with *"Using AR in learning Mandarin can motivate me to learn Mandarin."* with values (M = 4.01, SD = .695). Next item was *"AR Mandarin can make interaction more flexible."* with values (M = 4.00, SP = .71). Thus, it can be concluded that students are positive in integrating or using AR app in learning Mandarin vocabulary. To them, that using AR app in learning Mandarin vocabulary can be fun, enjoyable, exciting as well as making interaction to be flexible. Apart from that, they also strongly believe that they become more motivated to learn with the use of AR application.

IV. Intention to use

Table 6
Intention to use

No	Item	SD	D	U	A	SA	Mean	SD	Interpretation
38	I would like to use Augmented Reality in learning Mandarin as soon as possible	0 (0.0)	3 (0.9)	92 (28.7)	164 (51.2)	61 (19.1)	3.88	.710	Medium
39	I will always try to use Augmented Reality when learning Mandarin	0 (0.0)	5 (1.6)	72 (22.5)	182 (56.9)	61 (19.1)	3.93	.689	Medium
40	I plan to use Augmented Reality application to learn Mandarin in the future	0 (0.0)	3 (0.9)	89 (27.8)	166 (51.9)	62 (19.4)	3.90	.707	Medium
41	I think learner's acceptance of AR in learning Mandarin will be high	0 (0.0)	1 (0.3)	90 (28.1)	165 (51.6)	64 (20.0)	3.91	.698	Medium
	Overall						**3.91**	**.701**	**Medium**

N=40 M=Mean SD=Standard Deviation

SD: Strongly Disagree **D**: Disagree **NS**:not sure **A**: Agree **SA**:Strongly Agree

Table 6 explained the intention of use. Although majority of students do not have experience in using AR app in learning, they would like to use it as soon as possible (70.3%). Furthermore, (76 %) would seize the opportunity of trying out AR in learning given the opportunity. 71.3 % students also mentioned that they plan to use AR app in future and (71.6%) agree that the acceptance of AR in Mandarin vocabulary to be high.

Data from table 6 show that the items scores are at medium level with an overall mean score of 3.91 and a standard deviation of .701. Among the items with highest mean scores are *"I will always try to use Augmented Reality when learning Mandarin* (M = 3.93, SD = .689) followed by *"I think learner acceptance of AR in learning Mandarin will be high"* (M = 3.91, SD = .701). Next items are *"I plan to use Augmented Reality applied to learning Mandarin in the future"* (M = 3.9, SD = .707), and *"I would like to use Augmented Reality in learning Mandarin*

as soon as possible" with values (M = 3.88, SD = .71). Generally, students are interested and have high intention of using AR app in learning Mandarin vocabulary in the future.

Next, based on Table 7, the results show that the Cronbach's Alfa reliability scores of this survey for all four sections are recorded in the range of 0.92 to the highest of 0.972, which according to Gliem & Gliem (2003) is excellent. Hence, the instrument possesses acceptable internal consistency.

Constructs and Items

Table 7

Constructs and Items

	Cronbach's Alfa	Number of items
Perceptions towards using AR App in learning Mandarin vocabulary		
• *Design of content and presentation of Mandarin AR vocabulary Application*	.972	10
• Perceived ease of use	.944	4
• Usefulness of using Mandarin AR in learning Mandarin vocabulary	.962	8
• Intention to use	.92	4
OVERALL	**0.94**	**26**

All in all, students welcome AR app in learning Mandarin vocabulary as soon as possible or in the future.

Conclusion

This research investigated the learners' feedback in relation to the usability of the AR app in its contents and design of learning Mandarin vocabulary. For the research finding, the research has confirmed the potential of usability of AR app as a supplementary e-instructional tool in the teaching and learning of Elementary Mandarin 1 for UiTM students. In terms of AR design, majority of the respondents think that integrating multimedia elements (audio, text, animation, and image) in AR app for learning Mandarin vocabulary should be systematic and user friendly. Besides, AR presentation, interface design/layout should also be systematic and use friendly too. Whereas, content presentation and navigation for content should be designed to be easily comprehended by the users. Respondents also require for each vocabulary item that is to be introduced in the lesson should be presented together with sample sentences and distributed into different themes. These is will ease the learning process. These findings also correlate with the findings of other researchers such as Teh et al (2018) who indicated that vocabulary items distributed into different themes had made learning Mandarin easy and increase learners' written test performance and the percentage of them who obtained grade A also increased.

When asked about whether AR application should be easy to use, most students provided positive feedback. Regarding the usefulness of using AR app, majority of them agree that the use of AR app can be fun, enjoyable, exciting and provide opportunity for a more flexible way of interaction. AR also able to make learning Mandarin more focused and fast as well as improving Mandarin learning process. More importantly is that students believe the use of AR app can help to motivate them in learning Mandarin. This finding is in line with several past studies that the AR app can motivate students in learning (Chen, et al., 2019; Garzon, et al., 2019; Chen, et al., 2022; Parmaxi & Demetriou, 2020; Huang et.al., Wang, et al., 2022; Cai, et al., 2022).

As mentioned, this study is based on Technology Acceptance Model (TAM) by (Davis, 1989). Davis et al (1992) that stressed two important factors that affect learners' decision to continue using a technology system (here refers to AR app). They suggested perceived usefulness as an example of extrinsic motivation which reveals the learner's tendency to use the system/an application to help their achievement/enhancement in learning. Whereas, intrinsic motivation, also known as autonomous motivation refers to the "perceived enjoyment" of the learner when using the app/system. Referring to the research finding, most students indicated that AR app can be fun, enjoyable, and exciting, and provide opportunities for a more flexible way of interaction. As such, will coax students' willingness to continuously use the app in the future. More importantly, the incorporation and utilization of such application coupled with the use of AR that fulfills learners' expectations, will help to boost their motivation in learning Mandarin. One of the most significant contributions of this paper is that it highlights the specific aspects that need to be designed in accordance to the learners' needs and expectations. This will ensure a better acceptance of the application that in turn will increase learners' motivation in learning.

Even though most students do not have AR app knowledge in Mandarin learning, they reflected very positively in their intention to use AR app in their Mandarin learning in the future. In addition, current studies have found that more development of AR app in learning Mandarin vocabulary is needed to promote interesting self-learning processes especially in facing an outbreak like the COVID-19, where the education sector has restructured face-to-face learning into online distance learning (ODL). In keeping with the current mode of delivery, developing AR app in learning Mandarin vocabulary can serve as a supplementary online learning material in teaching and learning of Mandarin apart from the various known and unexplored advantages it has to offer to the learners of Mandarin. In addition, findings from the survey that is based on the factors in TAM can serve as a guideline for developing AR app.

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