香港教育大學
The Education University of Hong Kong

A Project entitled

***Investigate the acceptance and usage frequency of teachers on using virtual reality(VR) and augmented reality(AR) in primary Mathematics education.***

Submitted by

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submitted to the Education University of Hong Kong for the degree of ***Bachelor of Education (Honours) (Primary) – Mathematics Major***

in *April 2019*

# Outline

# Declaration

I, *Lam Chung Tak* , declare that this research report represents my own work under the supervision of Dr. FOK Ping Kwan, *Associate Head of Department of Curriculum and Instruction (C&I)*, and that it has not been submitted previously for examination to any tertiary institution.

Signed _ _

*Lam Chung Tak*

*25.04.2019*

# Abstract

The purpose of this study was to *investigate the acceptance and usage frequency of teachers on using virtual reality(VR) and augmented reality(AR) in primary Mathematics education.* Educators always seek new techniques, innovative tools and technologies in order to enhance students' learning. Especially in Science, Technology, Engineering and Mathematics (STEM) education which was recently raised by Hong Kong Education Bureau, educators are encouraged to teach in innovative way. Virtual reality(VR) and augmented reality(AR) were kinds of those innovative tools could facilitate teachers teaching. This investigation could help Hong Kong Education Bureau realizes the actual usage and acceptance of VR and AR among teachers in order to regulate the current educational policy on STEM education. The research questions were set as follow,

1. How teachers understand VR and AR?
2. What is teachers' acceptability on using VR and AR in teaching primary Mathematics?
3. How frequency are teachers on using VR and AR in teaching primary Mathematics?

Questionnaire was designed to collect both quantitative and qualitative result. Three main dimensions were set for collecting point of views of teachers towards

understanding, reception and frequency in VR and AR in teaching primary Mathematics. 3 major findings were listed, first, teachers knew VR and AR in theoretical, however, they were not able to use VR and AR in practical teaching. Second, teachers quite accepted using VR and AR, more of them believed it was able to enhance students learning. Third, teachers use VR and AR very less in frequency, mainly between 0 to 2 times annually.

Keywords: virtual reality, augmented reality, primary Mathematics, teachers, acceptance, usage frequency, STEM education

# Research Topic

Investigate the acceptance and usage frequency of teachers on using virtual reality(VR) and augmented reality(AR) in primary Mathematics education.

# A. Research Background and Significance

Educators always seek new techniques, innovative tools and technologies in order to enhance students' learning. Especially in Science, Technology, Engineering and Mathematics (STEM) education which was recently raised by Hong Kong Education Bureau, educators are encouraged to teach in innovative way. Virtual reality(VR) and augmented reality(AR) were kinds of those innovative tools could facilitate teachers teaching. This investigation could help Hong Kong Education Bureau realizes the actual usage and acceptance of VR and AR among teachers, by studying the relationship among teachers' understanding, acceptance and usage frequency in order to regulate the current educational policy on STEM education. For instant, the less teachers accepted and used VR and AR, the more promotion could be established.

# B. Literature Review

## 1. Nature of VR and AR in Education

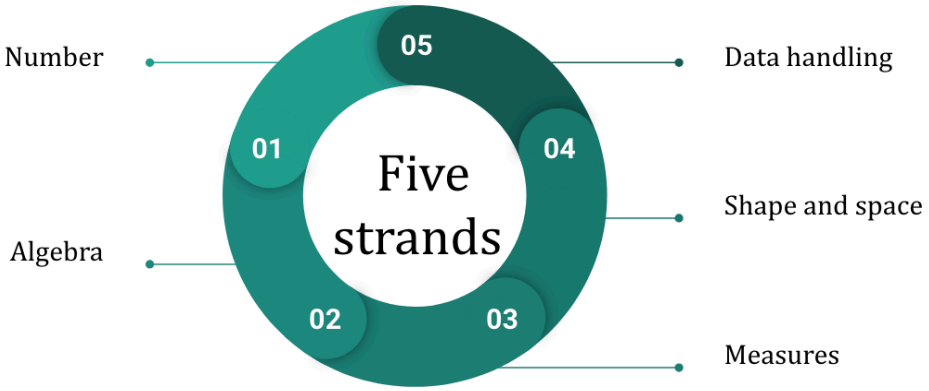
Both VR and AR gave students simultaneous expression of physical and virtual elements. While VR was intent to locate at virtual side, AR was at between virtual and physical which was also known as mixed reality. VR enhanced student mainly visual sensation towards reality. They might explore the virtual world in

simultaneously with body movement, such as head turning and walking. Those sensations helped students immerse into the virtual sensation, as experiencing realistic environment, while AR was a merged image which included real-time environment and virtual image combined together onto the screen. AR and VR could be applied at the same time. When user was viewing a VR image, AR could be added to boost the image with additional information showing on monitor, known as mixed reality(MR). To conclude, AR better suited in a student's physical learning environment, while VR better suited in his/her virtual learning environment.

## 2. AR and VR Usage in Primary Mathematics Education

### i. Primary Mathematics Teaching Curriculum

In primary Mathematics context, there were totally five strands including, number strand, algebra strand, measures strand, shape and space strand and data handling strand (The Education Bureau, 2017, p. 16). For example, Aurasma could be applied in measure strand and shape and space strand.




The Education Bureau, 2017, p. 16

Figure 1. Five Strands in Primary Mathematics Teaching Curriculum

### ii. AR and VR Usage in Primary Mathematics Education

VR could be applied in discussion or flipped classroom. Although students and teachers were in different location, they could construct a common virtual learning area populated by virtual objects and required materials for learning. (Kaufmann, 2013) For example an educational app, ENGAGE, it allowed at most 35 students appeared in one virtual room at the same time. Each student could create their own virtual character to attempt discussion in classroom or flipped classroom outside classroom. This technology helped student immerse into the learning environment without physically appeared in classroom.

AR usually complemented with a standard curriculum rather than teaching via AR only. Student could view a real-time scenario with augmented information such as text, graphics, video and audio. That additional information could be triggered by embedded label on teaching materials (CARRIE, 2011 ; Stewart-Smith, 2015). For example, an AR app, Aurasma, allowed students to visualize 2-D figure in 3-D way. Its image recognition technology required a smartphone's or tablet's camera to recognize authentic images. Afterward, media as animations, videos, 3D models and web pages would overlay on top of it.

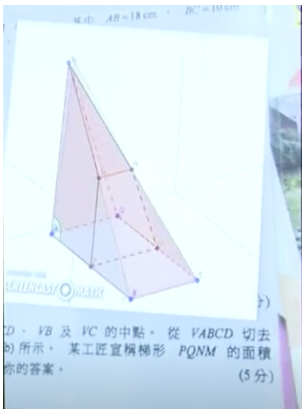


Figure 2. Screen Capture of Aurasma App.

Teaching materials could freely tailor-made for students. Although there were only a few AR and VR applications, such as ENGAGE and Aurasma mentioned above, there was an educational scheme for producing VR and AR teaching materials for Hong Kong teachers teaching them how to produce own learning materials for students. In its sharing conference, the chief system designer showed audiences how teachers worked on their application. Creating new VR or AR materials could only cost 30 minutes. All subjects' teachers could use it to construct their own teaching materials. It showed that VR and AR materials can be tailor-made to student by most of the local teacher in different subject including Mathematics.

### iii. AR and VR Usage in Other Learning Subjects

AR boosted the authenticity of the teaching content. Triggered by specific labels, related information could be popped out. For example, an English textbook in Japan complements with AR element. There would be animation and

sound showing characters who were chatting in English standing above textbook. It made the teaching content more authentic.

Instead of learning passively, students could be active learners, following their own steps. For example, in Letters alive 2.0, it allowed students to learn English letters actively by interacting with 3-D animals. Once students put the letter card under the scanner. Animal representing the letter would pop out on screen with animation and sound. Furthermore, letter combined to form a vocabulary, students could choose any letter they want to combines in order to construct a new vocabulary by their own (Carrie, 2011).

Literatures showed us that AR helps providing a more tailor-made and convenient learning. It shortened the distance between what was taught at school and the authentic world. Students would become more engaged in their learning (Augment, 2016). Those applications showed the possibility of VR and AR. They could be further modified and adapted to Mathematics education.

## 3. Acceptance of VR and AR towards STEM Related-subject Teachers

According to an investigation on acceptance of VR and augmented technology towarded STEM related-subject prospective teachers, although the majority had heard VR and augmented technology, they were not familiar with those. There were only 5.3% of them knowing very much about those. 49.8% and 30.5% of them were

having seen some samples and having heard of but without personal experience respectively. 12.7% of them never heard of any VR and augmented technology.

Most prospective STEM related-subject teachers did not have much prior knowledge about VR and 3D technologies. With various implementation difficulties, those technologies were less commonly used in classroom. (Yeung, 2004)

# C. Research Design

## 1. Research Questions

1. How teachers understand VR and AR?
2. What is teachers' acceptability on using VR and AR in teaching primary Mathematics?
3. How frequency are teachers on using VR and AR in teaching primary Mathematics?

## 2. Research Method

Questionnaire was designed to collect both quantitative and qualitative result. Total 22 questions were set in questionnaire, including rating scale and open-ended question, which were type of question in Q1 to Q20 and Q21 to Q22 respectively. Three main dimensions were set, Q1 to Q5, Q6 to Q12 and Q13 to Q18 were set for collecting point of views towards understanding, reception and frequency dimensions in VR and AR in teaching primary Mathematics.

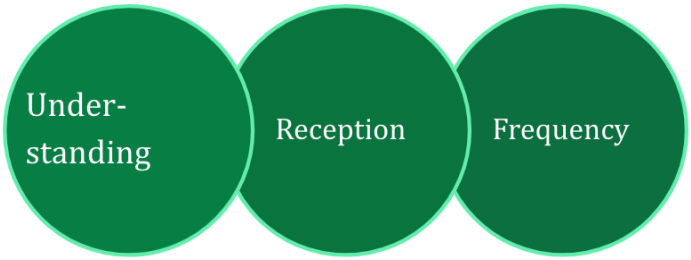



Figure 3. 3 dimensions of Questions in Questionnaire

Q6, Q7 and Q20 were set in reversed scale in order to distinguish the invalid response as respondents were expected to give small degree of difference in answering same dimension of questions. Score 1, 2, 3 and 4 were representing strongly agree, agree, disagree and strongly disagree, the absolute mean (i.e. neutral stand) of each question should be 2.5. Mean below 2.5 meant respondent tend to give positive response to the question; while mean above 2.5 meant respondent tend to give negative response to the question.

Personal information as teaching seniority, gender, major teaching subject, lesson per week, major teaching grade, Mathematics lesson per week, Mathematics teaching grade were collected in order to have a comparison with 22 questions mentioned above. Correlation and significant result was expected to generate after comparison.

## 3. Sampling Method

The population in this research was all teachers who were teaching primary Mathematics in Hong Kong. The sampling framework was same as the population, while convenience sampling method was used to select the sample.

Questionnaire distributed to teachers who were teaching primary Mathematics in Hong Kong. All data was collected in form of online questionnaire. Among the 51 distributed questionnaires, 50 responses were collected (over 98% response rate).

## 4. Reliability Instruments

Reliability test was run to ensure the reliability of question sets. 4 dimensions used to be tested with reliability test, however, a negative Cronbach's Alpha was shown in the fourth dimension, Future View, consisted of Q21 to Q22, indicating that it was not reliable enough. Therefore, the fourth dimension was deleted. Q21 and Q22 were labelled as individual questions without belonging to any dimensions, which were directly compare with other 3 dimensions to generate the result. .555, .829 and .547 were scored as Cronbach's Alpha of understanding, reception and frequency dimensions respectively, indicating reliable statistics were generated in those three dimensions.

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .555 | 5 |

```
RELIABILITY
  /VARIABLES=Q1 Q2 Q3 Q4
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Table 1. Reliability test for understanding dimension

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .829 | 4 |

```
RELIABILITY
  /VARIABLES=Q6R Q7R Q8 Q9 Q10 Q11 Q12
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Table 2. Reliability test for reception dimension

**Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| .547 | 7 |

```
RELIABILITY
  /VARIABLES=Q13 Q14 Q15 Q16 Q17 Q18
  /SCALE('ALL VARIABLES') ALL
  /MODEL=ALPHA.
```

Table 3. Reliability test for frequency dimension

## 5. Data Analysis

All data in questionnaires were inputted into a statistical package for SPSS 25 Network version for Mac in order to analyse the response of questionnaires to see whether there were any generalizable results.

## 6. Limitation

Four limitation were found in this research, first, lacking of local related research on acceptance and using frequency towards VR and AR in Hong Kong primary Mathematics teaching, as development of VR and AR was still in progress, which was known as a brand new technology. Literature showing this dimension was lacking. Second, there were quite amount of respondents not willing to expose their names of school which they were teaching. All of respondents were willing to expose their school districts, therefore, only school districts could be used to do the comparison among group of data, however, it did not give any significant result when it was comparing with 3 dimensions of questions. It would be better when school name was able to collect in order to find out the relationship between 3 dimensions towards school nature, school size and teacher seniority distribution etc. Third, questionnaire sample was not big enough with only 50 responses were collected. Fourth, more qualitative response could be collected in order to have an in-depth analysis of data. Conducting interview was one of the way to collect qualitative response.

# D. Findings and Discussion

## 1. General Findings

### i. Background Statistic

All data was collected in form of online questionnaire. Among the 51 distributed questionnaires, 50 responses were collected (over 98% response rate).

In gender, most of the respondents are female. Total 11 males and 39 females responses were collected, which were in 22% and 78% over the population respectively. In teaching seniority, most of the respondents have only 0 to 2 years of teaching seniority. Total 56%, 30% and 14% of respondents were in 0 to 2, 3 to 6, equal or over 10 years of teaching seniority respectively. In teaching lesson per week, which was counted in 5 days as a week. More than a half of the respondents were teaching more than 24 lessons per week. Total 16%, 10%, 4%, 18% and 52% of respondents were teaching less than 15, 15 to 18, 19 to 21, 22 to 24 and more than 24 lessons per weeks respectively. In Mathematics teaching grade, primary 2 was the most being taught grade in Mathematics (in 42%). Total 28%, 42%, 34%, 34%, 22% and 18% of respondents had taught primary 1, 2, 3, 4, 5 and 6 Mathematics respectively.

**Gender**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 男 Male | 11 | 22.0 | 22.0 | 22.0 |
| | 女 Female | 39 | 78.0 | 78.0 | 100.0 |
| | Total | 50 | 100.0 | 100.0 | |

Table 4. Gender of Respondents

**TeachingSeniority**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 0 - 2 | 28 | 56.0 | 56.0 | 56.0 |
| | 3 - 9 | 15 | 30.0 | 30.0 | 86.0 |
| | >= 10 | 7 | 14.0 | 14.0 | 100.0 |
| | Total | 50 | 100.0 | 100.0 | |

Table 5. Teaching Seniority of Respondents

**LessonPerWeek**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | < 15 | 8 | 16.0 | 16.0 | 16.0 |
| | 15 - 18 | 5 | 10.0 | 10.0 | 26.0 |
| | 19 - 21 | 2 | 4.0 | 4.0 | 30.0 |
| | 22 - 24 | 9 | 18.0 | 18.0 | 48.0 |
| | > 24 | 26 | 52.0 | 52.0 | 100.0 |
| | Total | 50 | 100.0 | 100.0 | |

Table 6. Teaching Lesson per Week (in 5 Days)

**MathematicsTeachingGradeP6**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | .00 | 41 | 82.0 | 82.0 | 82.0 |
| | 1.00 | 9 | 18.0 | 18.0 | 100.0 |
| | Total | 50 | 100.0 | 100.0 | |

**MathematicsTeachingGradeP5**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | .00 | 39 | 78.0 | 78.0 | 78.0 |
| | 1.00 | 11 | 22.0 | 22.0 | 100.0 |
| | Total | 50 | 100.0 | 100.0 | |

**MathematicsTeachingGradeP4**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | .00 | 33 | 66.0 | 66.0 | 66.0 |
| | 1.00 | 17 | 34.0 | 34.0 | 100.0 |
| | Total | 50 | 100.0 | 100.0 | |

**MathematicsTeachingGradeP3**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | .00 | 33 | 66.0 | 66.0 | 66.0 |
| | 1.00 | 17 | 34.0 | 34.0 | 100.0 |
| | Total | 50 | 100.0 | 100.0 | |

**MathematicsTeachingGradeP2**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | .00 | 29 | 58.0 | 58.0 | 58.0 |
| | 1.00 | 21 | 42.0 | 42.0 | 100.0 |
| | Total | 50 | 100.0 | 100.0 | |

**MathematicsTeachingGradeP1**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | .00 | 36 | 72.0 | 72.0 | 72.0 |
| | 1.00 | 14 | 28.0 | 28.0 | 100.0 |
| | Total | 50 | 100.0 | 100.0 | |

Table 7. Mathematics Teaching Grade

### ii. Whole Question Set

In mean of whole question set, questions labelled with 'R' meant it was reversed in order of response. As score 1, 2, 3 and 4 were representing strongly agree, agree, disagree and strongly disagree, the absolute mean (i.e. neutral stand) of each question should be 2.5. Mean below 2.5 meant respondent tend to give positive response to the question; while mean above 2.5 meant respondent tend to give negative response to the question.

Q1 to 4, 6, 7, 9, 10 and 20 were responded positively; while Q2, 3, 5, 8, 11 to 19 were responded negatively. Mean of individual item varied among others, however, the standard deviation was stable, which is in range of .654 to .968. Q20 and Q2 had the lowest and highest standard deviation respectively, which meant the response toward Q20 varied the least while Q2 varied the most.

**Report**

| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6R | Q7R | Q8 | Q9 | Q10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean | 1.86 | 1.96 | 1.92 | 1.92 | 2.74 | 1.98 | 2.38 | 2.52 | 1.94 | 2.26 |
| N | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Std. Deviation | .904 | .968 | .804 | .695 | .853 | .869 | .697 | .839 | .843 | .694 |

**Report**

| | Q11 | Q12 | Q13 | Q14 | Q15 | Q16 | Q17 | Q18 | Q19 | Q20R |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean | 2.56 | 2.66 | 3.38 | 3.58 | 3.34 | 3.48 | 3.58 | 3.60 | 2.88 | 1.98 |
| N | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Std. Deviation | .812 | .872 | .945 | .883 | .939 | .863 | .883 | .881 | .799 | .654 |

Table 8. Mean of Whole Question Set

### iii. Mean of 3 Dimensions

In mean of 3 dimensions, absolute means of understanding, reception and frequency were 12, 17.5 and 15 respectively. 10.4 over 20 was rated in understanding dimension, which was below absolute mean, meant respondents tended to give positive response to understanding dimension; 16.3 over 28 was rated in reception dimension, which was below absolute mean, meant respondents tended to give positive response to reception dimension; 20.96 over 24 respectively was rated in frequency dimension with high standard deviation, which was above absolute mean, meant respondents tended to give negative response to frequency dimension and response toward it varied greatly.

**Report**

| | UnderstandingOver20 | ReceptionOver28 | FrequencyOver24 |
|---|---|---|---|
| Mean | 10.4000 | 16.3000 | 20.9600 |
| N | 50 | 50 | 50 |
| Std. Deviation | 2.54751 | 2.92944 | 5.13078 |

Table 9. Mean of 3 Dimensions

### iv. Correlations of 3 Dimensions

In correlations of 3 dimensions, .007 of 2-tailed significant value with positive Pearson correlation value were scored in reception dimension versus understanding dimension showing that reception dimension had a significantly positive correlation with understanding dimension. .001 of 2-tailed significant value with negative Pearson correlation value were scored in frequency dimension versus understanding dimension showing that frequency dimension had a significantly negative correlation with understanding dimension.

**Correlations**

| | | UnderstandingOver20 | ReceptionOver28 | FrequencyOver24 |
|---|---|---|---|---|
| UnderstandingOver20 | Pearson Correlation | 1 | .375** | -.472** |
| | Sig. (2-tailed) | | .007 | .001 |
| | N | 50 | 50 | 50 |
| ReceptionOver28 | Pearson Correlation | .375** | 1 | .050 |
| | Sig. (2-tailed) | .007 | | .732 |
| | N | 50 | 50 | 50 |
| FrequencyOver24 | Pearson Correlation | -.472** | .050 | 1 |
| | Sig. (2-tailed) | .001 | .732 | |
| | N | 50 | 50 | 50 |

**. Correlation is significant at the 0.01 level (2-tailed).

Table 10. Correlations of 3 Dimensions

## v. Independent sample t-test of gender and 3 dimensions

In independent sample t-test of gender and 3 dimensions, .74592, .38462 and .18182 were scored in mean difference between male and female in understanding, reception and frequency dimensions respectively. There were slightly difference in frequency dimensions only, while in understanding and reception dimensions, where were no significant difference. In 2-tailed significant, .397, .705 and .919 were scored in understand, reception, frequency dimensions respectively for male; .440, .726 and .925 were scored in understand, reception, frequency dimensions respectively for female. As all 2-tailed significant data were above 0.05, there were no significant difference between male and female among all 3 dimensions.

**Group Statistics**

| | Gender | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| UnderstandingOver20 | 男 Male | 11 | 9.8182 | 2.82199 | .85086 |
| | 女 Female | 39 | 10.5641 | 2.47933 | .39701 |
| ReceptionOver28 | 男 Male | 11 | 16.0000 | 3.22490 | .97234 |
| | 女 Female | 39 | 16.3846 | 2.88020 | .46120 |
| FrequencyOver24 | 男 Male | 11 | 20.8182 | 5.67130 | 1.70996 |
| | 女 Female | 39 | 21.0000 | 5.04715 | .80819 |

**Independent Samples Test**

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| UnderstandingOver20 | Equal variances assumed | .943 | .336 | -.855 | 48 | .397 | -.74592 | .87210 | -2.49939 | 1.00755 |
| | Equal variances not assumed | | | -.794 | 14.646 | .440 | -.74592 | .93893 | -2.75142 | 1.25958 |
| ReceptionOver28 | Equal variances assumed | .000 | .985 | -.381 | 48 | .705 | -.38462 | 1.00893 | -2.41321 | 1.64398 |
| | Equal variances not assumed | | | -.357 | 14.808 | .726 | -.38462 | 1.07618 | -2.68102 | 1.91179 |
| FrequencyOver24 | Equal variances assumed | .109 | .742 | -.103 | 48 | .919 | -.18182 | 1.76958 | -3.73979 | 3.37615 |
| | Equal variances not assumed | | | -.096 | 14.773 | .925 | -.18182 | 1.89133 | -4.21851 | 3.85487 |

Table 11. Independent sample t-test of gender and 3 dimensions..

# Discussion –

# 1. How teacher understand VR and AR?

In general, respondents knew VR and AR in theoretical, however, they were not able to use VR and AR in practical teaching. In specific, male had a slightly higher understanding than female.

### i. Mean of Understanding Dimension

In mean of Q1 to 5(understanding dimension), 10.4 over 20 was rated in mean of understanding dimension, which was below absolute mean, meant respondents tended to give positive response to understanding dimension, showing they understood VR and AR. In Q1 and Q3, 1.86 and 1.92 were scored as mean of them respectively, which were below absolute mean indicating a positive result, showing nature of VR and AR was indicated to be understood by respondents; In Q2 and Q4, 1.96 and 1.92 were scored as mean of them respectively, which were below absolute mean indicating a positive result, showing function of VR and AR was indicated to be understood by respondents. Therefore, respondents understood what VR and AR were theoretically, they understood the nature and function of VR and AR, however, in Q5, 2.74 was scored as mean, which was above absolute mean indicating a negative result, showing they were not able to use VR and AR in practical teaching. In literature review, Yeung (2004) found the phenomenon that most prospective STEM related-subject teachers did not have much prior knowledge about VR and 3D technologies. This situation is getting better now, although teachers are not able to use VR and AR in practical teaching, they know VR and AR in theoretical.

**Report**

| | Q1 | Q2 | Q3 | Q4 | Q5 | UnderstandingOver20 |
|---|---|---|---|---|---|---|
| Mean | 1.86 | 1.96 | 1.92 | 1.92 | 2.74 | 10.4000 |
| N | 50 | 50 | 50 | 50 | 50 | 50 |
| Std. Deviation | .904 | .968 | .804 | .695 | .853 | 2.54751 |

Table 12. Mean of Q1 - 5(Understanding Dimension)

### ii. Mean of Gender vs Understanding

In mean of gender vs understanding, 9.8182 and 10.5641 were scored as mean in male and female respectively versus understanding dimension, male had a slightly higher understanding than female. In a research from Lee, Kozar and Larsen (2003), Male had a slightly higher acceptance in new technology, which meant male may investigate more than female did. Therefore male had a better understanding than female.

**UnderstandingOver20 ReceptionOver28 FrequencyOver24 * Gender**

| Gender | | UnderstandingOver20 | ReceptionOver28 | FrequencyOver24 |
|---|---|---|---|---|
| 男 Male | Mean | 9.8182 | 16.0000 | 20.8182 |
| | N | 11 | 11 | 11 |
| | Std. Deviation | 2.82199 | 3.22490 | 5.67130 |
| 女 Female | Mean | 10.5641 | 16.3846 | 21.0000 |
| | N | 39 | 39 | 39 |
| | Std. Deviation | 2.47933 | 2.88020 | 5.04715 |
| Total | Mean | 10.4000 | 16.3000 | 20.9600 |
| | N | 50 | 50 | 50 |
| | Std. Deviation | 2.54751 | 2.92944 | 5.13078 |

Table 13. Mean of Gender vs Understanding

# Discussion –

# 2. What is teachers' acceptability on using VR and AR in teaching primary Mathematics?

In general, respondents quite accepted using VR and AR, more of them believed it was able to enhance students learning. There were some significant details found, first, respondents who taught the most or the least lesson per week, were more acceptable to use VR and AR in teaching. Second, Shape and Space was the most suitable teaching strand; Algebra was the least suitable teaching strand. Third, respondents who had taught P3 Mathematics, were more acceptable to use VR and AR. Fourth, the acceptance toward VR and AR was directly proportional to future usage frequency of VR and AR.

### i. Mean of Reception Dimension

In mean of Q6 to 12(reception dimension), 16.3 over 28 was rated in mean of reception dimension, which was below absolute mean, meant respondents tended to give positive response to reception dimension, showing they accept using VR and AR in teaching. In Q6 and Q9, 1.96 and 1.94 were scored as mean of them respectively, which were in relatively high mean among questions in reception dimension. They were below absolute mean indicating a positive result, showing respondents had a relatively high degree of agreement in Q6 and Q9, indicating that they believed VR and AR were able to enhance students' learning and Shape and Space was the most suitable teaching strand among all. In Q7, 2.38 was scored as mean, which was below absolute mean indicating a positive result, showing respondents believe VR and AR will not reduce teaching effectiveness. In Q8 to Q12, which were asked for acceptance toward five primary Mathematics strands. 2.52, 1.94, 2.26, 2.56 and 2.66 were scored as mean of Number, Shape and Space, Measures, Data Handling and Algebra respectively. Q8, Q11 and Q12 were above absolute mean indicating a negative result, showing respondents not accepted to teach in those 3 strands, however, Q9 and Q10 were below absolute mean indicating a positive result, showing respondents accepted to teach in those 2 strands. The priority for teaching 5 primary Mathematics strands in VR and AR was arranged, with the most suitable strand, Shape and Space, followed by Measures, Number, Data Handling and the least suitable strand, algebra.

**Report**

| | Q6R | Q7R | Q8 | Q9 | Q10 | Q11 | Q12 | ReceptionOver28 |
|---|---|---|---|---|---|---|---|---|
| Mean | 1.98 | 2.38 | 2.52 | 1.94 | 2.26 | 2.56 | 2.66 | 16.3000 |
| N | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Std. Deviation | .869 | .697 | .839 | .843 | .694 | .812 | .872 | 2.92944 |

Table 14. Mean of Q6 - 12(Reception Dimension)

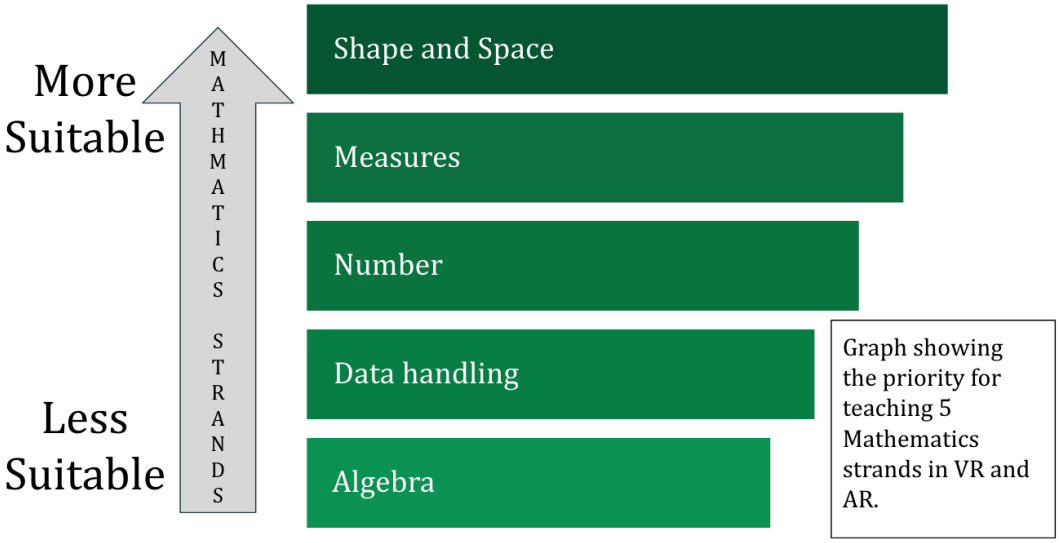



Figure 4. Showing the priority for teaching 5 Mathematics strands in VR and AR.

### ii. Mean of Gender and Teaching Seniority vs Reception

In mean of mean of gender and teaching seniority vs reception, 16.7727, 16.7273 and 14.3333 were scored as mean of 0 to 2, 3 to 9 and equal or more than 10 years of teaching seniority respectively for female respondents in reception dimension, which were gradually increasing while reception mean was decreasing, indicating that female reception was inversely proportional to teaching seniority.

**Report**

| Gender | TeachingSeniority | | UnderstandingOver20 | ReceptionOver28 | FrequencyOver24 |
|---|---|---|---|---|---|
| 男 Male | 0 - 2 | Mean | 10.3333 | 15.8333 | 20.5000 |
| | | N | 6 | 6 | 6 |
| | | Std. Deviation | 2.87518 | 3.43026 | 7.20417 |
| | 3 - 9 | Mean | 9.7500 | 17.5000 | 22.5000 |
| | | N | 4 | 4 | 4 |
| | | Std. Deviation | 3.09570 | 1.91485 | 3.00000 |
| | >= 10 | Mean | 7.0000 | 11.0000 | 16.0000 |
| | | N | 1 | 1 | 1 |
| | | Std. Deviation | . | . | . |
| | Total | Mean | 9.8182 | 16.0000 | 20.8182 |
| | | N | 11 | 11 | 11 |
| | | Std. Deviation | 2.82199 | 3.22490 | 5.67130 |
| 女 Female | 0 - 2 | Mean | 11.0909 | 16.7727 | 20.5000 |
| | | N | 22 | 22 | 22 |
| | | Std. Deviation | 1.65929 | 2.67140 | 5.91004 |
| | 3 - 9 | Mean | 10.6364 | 16.7273 | 21.4545 |
| | | N | 11 | 11 | 11 |
| | | Std. Deviation | 3.61311 | 2.72363 | 4.27466 |
| | >= 10 | Mean | 8.5000 | 14.3333 | 22.0000 |
| | | N | 6 | 6 | 6 |
| | | Std. Deviation | 1.64317 | 3.50238 | 2.75681 |
| | Total | Mean | 10.5641 | 16.3846 | 21.0000 |
| | | N | 39 | 39 | 39 |
| | | Std. Deviation | 2.47933 | 2.88020 | 5.04715 |

Table 15. Mean of Gender and Teaching Seniority vs Reception

### iii. Mean of Lesson per Week vs Reception

In mean of lesson per week vs reception, 16.875, 17.2, 18.5, 16.6667 and 15.6538 were scored as mean of respondents who had taught below 15, 15 to 18, 19 to 21, 22 to 24 and more than 24 lessons per week respectively, which was in a pyramid shape with respondents who taught 19 to 21 lessons per week reached the highest mean. Means of reception were decreasing while number of lesson per week being taught was decreasing or increasing, indicating that respondents who taught the most or the least lesson per week, were more acceptable to using VR and AR in class.

| LessonPerWeek | | UnderstandingOver20 | ReceptionOver28 | FrequencyOver24 |
|---|---|---|---|---|
| < 15 | Mean | 10.8750 | 16.8750 | 17.7500 |
| | N | 8 | 8 | 8 |
| | Std. Deviation | 1.88509 | 2.53194 | 6.71353 |
| 15 - 18 | Mean | 11.0000 | 17.2000 | 20.8000 |
| | N | 5 | 5 | 5 |
| | Std. Deviation | 4.84768 | 3.76829 | 6.09918 |
| 19 - 21 | Mean | 9.0000 | 18.5000 | 24.0000 |
| | N | 2 | 2 | 2 |
| | Std. Deviation | 2.82843 | .70711 | .00000 |
| 22 - 24 | Mean | 9.6667 | 16.6667 | 23.0000 |
| | N | 9 | 9 | 9 |
| | Std. Deviation | 1.50000 | 3.16228 | 2.64575 |
| > 24 | Mean | 10.5000 | 15.6538 | 21.0385 |
| | N | 26 | 26 | 26 |
| | Std. Deviation | 2.53377 | 2.89748 | 5.02379 |
| Total | Mean | 10.4000 | 16.3000 | 20.9600 |
| | N | 50 | 50 | 50 |
| | Std. Deviation | 2.54751 | 2.92944 | 5.13078 |

Table 16. Mean of Lesson per Week vs Reception

### iv. Mean of Mathematics Teaching Grade in P3 vs Reception

In mean of Mathematics teaching grade in P3 vs reception, 0 and 1 value of Mathematics teaching grade represented respondents had not and had taught the grade of students in Mathematics respectively. 15.5455 and 17.7647 were scored as mean of respondents who had taught primary 3 students in Mathematics. Significant difference was found in respondents who had or had not taught primary 3 students in Mathematics in their reception dimension, showing respondents who had taught P3 Mathematics, were more acceptable to use VR and AR in teaching.

**UnderstandingOver20 ReceptionOver28 FrequencyOver24 * MathematicsTeachingGradeP3**

| MathematicsTeachingGradeP3 | | UnderstandingOver20 | ReceptionOver28 | FrequencyOver24 |
|---|---|---|---|---|
| .00 | Mean | 10.2121 | 15.5455 | 20.0606 |
| | N | 33 | 33 | 33 |
| | Std. Deviation | 2.49697 | 2.57501 | 5.97358 |
| 1.00 | Mean | 10.7647 | 17.7647 | 22.7059 |
| | N | 17 | 17 | 17 |
| | Std. Deviation | 2.68164 | 3.09292 | 2.08461 |
| Total | Mean | 10.4000 | 16.3000 | 20.9600 |
| | N | 50 | 50 | 50 |
| | Std. Deviation | 2.54751 | 2.92944 | 5.13078 |

Table 17. Mean of Mathematics Teahcing Grade in P3 vs Reception

### v. Mean of Q20 vs Reception

In mean of Q20 vs reception, 15.6, 16.25, 17.1429 and 19 were scored as mean of reception in rating 1, 2, 3 and 4 in Q20 respectively, which were gradually increasing while reception mean was increasing, indicating that reception was directly proportional to future usage frequency(Q20) of VR and AR, showing that respondents would tend to accept more when they knew they have greater chance to use VR and AR in the future.

**UnderstandingOver20 ReceptionOver28 FrequencyOver24 * Q20R**

| Q20R | | UnderstandingOver20 | ReceptionOver28 | FrequencyOver24 |
|---|---|---|---|---|
| 1 | Mean | 10.4000 | 15.6000 | 21.7000 |
| | N | 10 | 10 | 10 |
| | Std. Deviation | 3.74759 | 3.65756 | 4.52278 |
| 2 | Mean | 10.0625 | 16.2500 | 21.0000 |
| | N | 32 | 32 | 32 |
| | Std. Deviation | 1.83052 | 2.81700 | 4.77223 |
| 3 | Mean | 10.8571 | 17.1429 | 21.2857 |
| | N | 7 | 7 | 7 |
| | Std. Deviation | 2.03540 | 2.47848 | 6.75066 |
| 4 | Mean | 18.0000 | 19.0000 | 10.0000 |
| | N | 1 | 1 | 1 |
| | Std. Deviation | . | . | . |
| Total | Mean | 10.4000 | 16.3000 | 20.9600 |
| | N | 50 | 50 | 50 |
| | Std. Deviation | 2.54751 | 2.92944 | 5.13078 |

Table 18. Mean of Q20 vs Reception

# Discussion –

# 3. How frequency are teachers on using VR and AR in teaching primary Mathematics?

In general, respondents use VR and AR very less in frequency, mainly between 0 to 2 times annually. There were some significant details found, first, the usage frequency varied greatly among schools. Second, no significant difference was found in frequency dimension in different school located district. Third, teachers who taught the most or the least lesson per week, tended to use VR and AR more frequently. Fourth, the more frequently in using VR and AR, the more satisfied with current usage.

### i. Mean of Frequency Dimension

In mean of Q13 to 18 (frequency dimension), 20.96 over 24 was rated in mean of frequency dimension, which was greatly above absolute mean, meant respondents tended to give negative response to frequency dimension, showing they use very less VR and AR in teaching. In Q13, 3.38 was scored as mean, which was above absolute mean, meant respondents tended to give negative response, indicating that respondents did not use VR and AR in Mathematics frequently, most of respondent only use 0 to 2 times of VR and AR in teaching annually. 5.13078 was scored as the standard deviation in frequency dimension, which was in relatively high value, showing the usage frequency varied greatly among schools. In Q14 to Q18, which were asked for usage frequency toward five primary Mathematics strands. 3.58, 3.34, 3.48, 3.58 and 3.60 were scored as mean of Number, Shape and Space, Measures, Data Handling and Algebra respectively. All were above absolute mean indicating a negative result, showing respondents not frequently taught in all of those 5 strands. Most of respondents only use 0 to 2 times of VR and AR in all of those 5 strands respectively.

**Report**

| | Q13 | Q14 | Q15 | Q16 | Q17 | Q18 | FrequencyOver24 |
|---|---|---|---|---|---|---|---|
| Mean | 3.38 | 3.58 | 3.34 | 3.48 | 3.58 | 3.60 | 20.9600 |
| N | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| Std. Deviation | .945 | .883 | .939 | .863 | .883 | .881 | 5.13078 |

Table 19. Mean of Q13 - 18(Frequency Dimension)

### ii. Mean of School District vs Frequency

In mean of school district vs frequency, 20.8378, 21.9091 and 18.0 were scored as mean of school district of New Territories, Kowloon and Hong Kong of respondents in frequency dimension, which had a small difference among all, indicating no significant difference was found among school district vs frequency.

| SchDistrict | | UnderstandingOver20 | ReceptionOver28 | FrequencyOver24 |
|---|---|---|---|---|
| NT | Mean | 10.2973 | 16.3514 | 20.8378 |
| | N | 37 | 37 | 37 |
| | Std. Deviation | 2.75746 | 3.05702 | 5.39811 |
| KL | Mean | 10.5455 | 16.5455 | 21.9091 |
| | N | 11 | 11 | 11 |
| | Std. Deviation | 2.01810 | 2.69680 | 4.61421 |
| HK | Mean | 11.5000 | 14.0000 | 18.0000 |
| | N | 2 | 2 | 2 |
| | Std. Deviation | .70711 | .00000 | .00000 |
| Total | Mean | 10.4000 | 16.3000 | 20.9600 |
| | N | 50 | 50 | 50 |
| | Std. Deviation | 2.54751 | 2.92944 | 5.13078 |

Table 20. Mean of School District vs Frequency

### iii. Mean of Lesson Per Week vs Frequency

In mean of lesson per week vs frequency, 17.75, 20.8, 24.0, 23.0 and 21.0385 were scored as mean of respondents who had taught below 15, 15 to 18, 19 to 21, 22 to 24 and more than 24 lessons per week respectively, which was in a pyramid shape with respondents who taught 19 to 21 lessons per week reached the highest mean. Means of frequency were decreasing while number of lesson per week being taught was decreasing or increasing, indicating that respondents who taught the most or the least lesson per week, used VR and AR more frequently in teaching.

| LessonPerWeek | | UnderstandingOver20 | ReceptionOver28 | FrequencyOver24 |
|---|---|---|---|---|
| < 15 | Mean | 10.8750 | 16.8750 | 17.7500 |
| | N | 8 | 8 | 8 |
| | Std. Deviation | 1.88509 | 2.53194 | 6.71353 |
| 15 - 18 | Mean | 11.0000 | 17.2000 | 20.8000 |
| | N | 5 | 5 | 5 |
| | Std. Deviation | 4.84768 | 3.76829 | 6.09918 |
| 19 - 21 | Mean | 9.0000 | 18.5000 | 24.0000 |
| | N | 2 | 2 | 2 |
| | Std. Deviation | 2.82843 | .70711 | .00000 |
| 22 - 24 | Mean | 9.6667 | 16.6667 | 23.0000 |
| | N | 9 | 9 | 9 |
| | Std. Deviation | 1.50000 | 3.16228 | 2.64575 |
| > 24 | Mean | 10.5000 | 15.6538 | 21.0385 |
| | N | 26 | 26 | 26 |
| | Std. Deviation | 2.53377 | 2.89748 | 5.02379 |
| Total | Mean | 10.4000 | 16.3000 | 20.9600 |
| | N | 50 | 50 | 50 |
| | Std. Deviation | 2.54751 | 2.92944 | 5.13078 |

Table 21. Mean of Lesson Per Week vs Frequency

### iv. Mean of Q19 vs Frequency

In mean of Q19 vs frequency, 6.0, 18.6875, 21.7619 and 23.8333 were scored as mean of frequency in rating 1, 2, 3 and 4 in Q19 respectively, which were gradually increasing while frequency mean was increasing, indicating that frequency was directly proportional to current satisfaction on using VR and AR(Q19), showing that respondents would tend to use VR and AR more when they were more satisfied with current VR and AR usage.

**UnderstandingOver20 ReceptionOver28 FrequencyOver24 * Q19**

| Q19 | | UnderstandingOver20 | ReceptionOver28 | FrequencyOver24 |
|---|---|---|---|---|
| 1 | Mean | 14.0000 | 16.0000 | 6.0000 |
| | N | 1 | 1 | 1 |
| | Std. Deviation | . | . | . |
| 2 | Mean | 11.4375 | 17.1875 | 18.6875 |
| | N | 16 | 16 | 16 |
| | Std. Deviation | 2.73176 | 2.07264 | 6.80900 |
| 3 | Mean | 9.6190 | 15.6667 | 21.7619 |
| | N | 21 | 21 | 21 |
| | Std. Deviation | 1.49921 | 2.68949 | 2.93095 |
| 4 | Mean | 10.0833 | 16.2500 | 23.8333 |
| | N | 12 | 12 | 12 |
| | Std. Deviation | 3.26018 | 4.15878 | .57735 |
| Total | Mean | 10.4000 | 16.3000 | 20.9600 |
| | N | 50 | 50 | 50 |
| | Std. Deviation | 2.54751 | 2.92944 | 5.13078 |

Table 22. Mean of Q19 vs Frequency

# E. Conclusion and Suggestion

## 1. Suggestion from Respondents

In Q22, asking about the method to improve teachers' use of VR and AR in Mathematics teaching, five aspects of suggestion were collected and list below. For individual, it was suggested to boost teachers' intra-communication; for school, it was suggested to improve school facility and equipment; for EDB, it was suggested to set up prior scheme and prior schools, hold teacher training workshop, give teaching template and provide technical support; for society, it was suggested to create user-friendly apps; for government, it was suggested to conduct research in learning efficiency.

## 2. Suggestion for EDB

Teachers knew what VR and AR are, but they lacked of practical experience in using. EDB could provide workshop teaching how to apply VR and AR in teaching Mathematics rather than teaching concepts of VR and AR.

EDB could corporate with mature facility. In literature review, the faculty of education in a university in Hong Kong which was passionate in promoting and improving VR and AR in education was found. It could be a role of facilitator as current needs of VR and AR development in Hong Kong Mathematic education was matched by its role.

### 3. Grade and Topic to Teach

P.3 students are suggested to be a prior teaching class, as the teacher acceptance and usage frequency in VR and AR were the highest among all grade. At the same time, shape and space was the most suitable teaching strand. Therefore, 3S1, parallel and perpendicular; 3S2, quadrilaterals (II); 3S3 angles(II); 3S4 triangles are suggested to form as a teaching template.

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# Appendix 1 -

# Links for the VR/AR conference in CUHK

香港中文大學 VR/AR 學與教之實踐 — 教學案例研討會 樂善堂梁球鋸學校(分校) 張家螢老師

https://www.youtube.com/watch?v=-NldJCR_DdE

香港中文大學 VR/AR 學與教之實踐 — 教學案例研討會 裘錦秋中學(元朗) 黃志威老師

https://www.youtube.com/watch?v=b6NqT6c9vaA

香港中文大學 VR/AR 學與教之實踐 — 教學案例研討會 香港中文大學 學習科學與科技中心 陸晋軒先生

https://www.youtube.com/watch?v=JJvIbJ6NOf0

# Appendix 2 - Questions of Questionnaire

## 研究小學教師在數學教育中使用虛擬實境和擴增實境接受度和使用頻率。Investigate the acceptance and usage frequency of teachers on using virtualreality(VR) and augmented reality(AR) in primary Mathematics education.

INFORMATION SHEET

You are invited to participate in a project supervised by Dr FOK, Ping Kwan and conductedby Lam Chung Tak, who are staff / students of the Department of Curriculum and Instructionin The Education University of Hong Kong.

This project aims at investigating the acceptance and usage frequency of teachers on usingvirtual reality(VR) and augmented reality(AR) in primary Mathematics education.
In this research, only the primary school teachers will be invited as participants.

Your participation in the project is voluntary. You have every right to withdraw from the studyat any time without negative consequences. All information related to you will remainconfidential, and will be identifiable by codes known only to the researcher. So, there is nosignificant risk involved and the data collected will only be used for the UndergraduateStudent Research Project.

If you would like to obtain more information about this study, please contact Lam Chung Tak at telephone number or his supervisor Dr FOK, Ping Kwan at telephone number .

If you have any concerns about the conduct of this research study, please do not hesitate to contact the Human Research Ethics Committee by email at hrec@eduhk.hk or by mail to Research and Development Office, The Education University of Hong Kong.
Thank you for your interest in participating in this study.

Lam Chung Tak
Principal Investigator

* Required

## CONSENT

I hereby consent to participate in the captioned research supervised by Dr FOK, Ping Kwan and conducted by Lam Chung Tak, who are staff / students of Department of Curriculum and Instruction in The Education University of Hong Kong.

I understand that information obtained from this research may be used in future research and may be published. However, my right to privacy will be retained, i.e., my personal details will not be revealed.

The procedure as set out in the attached information sheet has been fully explained. My participation in the project is voluntary.

I acknowledge that I have the right to question any part of the procedure and can withdraw at any time without negative consequences.

此問卷一共22題，只需大約10分鐘完成，感謝您抽空填寫！
There are totally 22 questions, can be completed within around 10 minutes, thank you so much!

1. *
   Mark only one oval.

   同意 Agree

# 問題 1-5 Question 1-5

1=非常同意；2=同意；3=不同意；4=非常不同意
1=Strongly Agree; 2=Agree; 3=Disagree; 4=Strongly Disagree

2. **虛擬實境是電腦模擬出的虛擬世界。**
   VR is a virtual world simulated by computers.
   Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

3. **虛擬實境能讓使用者感到身歷其境。**
   VR can make users feel immersed.
   Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

4. **擴增實境融合虛擬世界和現實世界場景。**
   AR merges virtual worlds with real-world scenarios.
   Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

5. **擴增實境能讓使用者從現實場景中獲得更多資訊。**
   AR allows users to get more information from real-world scenarios.
   Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

6. **我懂得在教學中運用VR和AR。**
   I know how to use VR and AR in teaching.
   Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

# 問題 6-12 Question 6-12

1=非常同意；2=同意；3=不同意；4=非常不同意
1=Strongly Agree; 2=Agree; 3=Disagree; 4=Strongly Disagree

7. **VR和AR*降低*學生學習氣氛。**
   VR and AR reduce the learning atmosphere of students.
   Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

8. **VR和AR*降低*教學效能。**
   VR and AR reduce teaching effectiveness.
   Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

9. **VR和AR適用於 數 範疇**
   VR and AR are suitable for number strand
   Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

10. **VR和AR適用於 圖形與空間 範疇**
    VR and AR are suitable for shape and space strand
    Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

11. **VR和AR適用於 度量 範疇**
    VR and AR are suitable for measures strand
    Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

12. **VR和AR適用於 數據處理 範疇**
    VR and AR are suitable for data handling strand
    Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

13. **VR和AR適用於 代數 範疇**

VR and AR are suitable for algebra strand
Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

## 問題 13-18 Question 13-18

1=使用6次以上；2=使用3-6次；3=使用1-2次；4=從未使用
1=More than 6 times; 2=3-6times; 3=1-2times; 4=Never

14. **VR和AR在數學教學上的使用頻率（每年）**

Frequency of use of VR and AR in mathematics teaching (annually)
Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

15. **VR和AR在 數 範疇上的使用頻率（每年）**

Frequency of use of VR and AR in number strand (annually)
Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

16. **VR和AR在 圖形與空間 範疇上的使用頻率（每年）**

Frequency of use of VR and AR in shape and space strand (annually)
Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

17. **VR和AR在 量度 範疇上的使用頻率（每年）**

Frequency of use of VR and AR in measures strand (annually)
Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

18. **VR和AR在 數據處理 範疇上的使用頻率（每年）**

Frequency of use of VR and AR in data handling strand (annually)
Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

19. **VR和AR在 代數 範疇上的使用頻率（每年）**

Frequency of use of VR and AR in algebra strand (annually)
Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

## 問題 19-22 Question 19-22

1=非常同意；2=同意；3=不同意；4=非常不同意
1=Strongly Agree; 2=Agree; 3=Disagree; 4=Strongly Disagree

20. **我滿意現時VR和AR在數學教學上的使用頻率**

I am satisfied with the frequency of use of VR and AR in mathematics teaching.
Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

21. **我未來在數學教學上只會*越少*使用VR和AR**

I will only use VR and AR less in mathematics teaching in the future.
Mark only one oval.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| ◯ | ◯ | ◯ | ◯ |

22. **試舉例你在數學教學上所使用過的VR或AR應用程式。**

Give examples of VR or AR applications you have used in mathematics teaching.

23. **如何提升教師使用VR和AR與數學教學上？**

How to improve teachers' use of VR and AR in mathematics teaching?

## 個人資料

Personal Information

我們所收集的個人資料只用於學術研究用途，並於研究後三個月內銷毀。
The personal data we collect is for academic research purposes only and is destroyed within three months of the study.

24. **任教年資**

Teaching Seniority
Mark only one oval.

- ◯ 0 - 2
- ◯ 3 - 6
- ◯ 7 - 10
- ◯ 10 - 20
- ◯ > 20

25. **性別**

Gender
Mark only one oval.

- ◯ 男 Male
- ◯ 女 Female

26. **主要任教科目**

Major Teaching Subject
Mark only one oval.

- ◯ 數學 Mathematics
- ◯ Other: _____

27. **每週任教堂數（5天計）**

Lesson Per Week
Mark only one oval.

- ◯ < 15
- ◯ 15 - 18
- ◯ 19 - 21
- ◯ 22 - 24
- ◯ > 24

28. **主要任教年級**

Major Teaching Grade
Check all that apply.

- ☐ 小一 Primary 1
- ☐ 小二 Primary 2
- ☐ 小三 Primary 3
- ☐ 小四 Primary 4
- ☐ 小五 Primary 5
- ☐ 小六 Primary 6

29. **數學科任教堂數**

Mathematic Lesson Per Week

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30. **數學科任教年級**

Mathematics Teaching Grade
Check all that apply.

- [ ] 小一 Primary 1
- [ ] 小二 Primary 2
- [ ] 小三 Primary 3
- [ ] 小四 Primary 4
- [ ] 小五 Primary 5
- [ ] 小六 Primary 6

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