



# Efficacy of Usage of Digital Game on Key Competencies among Prospective Chinese Language Teachers

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## Abstract

As a new media, digital games are playing a more and more important role in intelligent education. However, few attempts have been made to investigate efficacy of usage of digital game on key competencies of students in the 21st century in higher education. The objective of the study was to determine efficacy of the usage of digital game on key competencies through new media literacy and critical thinking disposition. A cross-sectional survey conducted by convenience sampling, was adopted involving 159 prospective Chinese language teachers of Leshan Normal University in Southwest China. The research was based on frameworks of Jenkins et al.'s 12 new media literacy skills and Delphi consensus's 7 critical thinking disposition. Structured questionnaire was employed for data collection and one-way MANOVA and a series of one-way ANOVA, Post-Hoc Compare were operated for the data analysis. The findings of this study showed that usage of digital game have significant moderate efficacy on appropriation, inquisitiveness and significant small efficacy on performance, multitasking out of sub dimensions of new media literacy and critical thinking disposition. Accordingly, this study has made it clear in which aspects and to what extent digital games play an important role in key competencies among prospective Chinese language teachers.

**Keywords:** *Usage of digital game; efficacy; key competencies; new media literacy; critical thinking disposition*

## 1 INTRODUCTION

In the 21st century, with the advent of the era of artificial intelligence, the reform of educational evaluation driven by key competencies has gradually attracted people's attention [10]. As new media, digital game has gradually become an important tool to consider in intelligent education. But few attempts have been made to investigate the efficacy of digital game on new media literacy and critical thinking which have been recognized as key competencies in 21st century [1] [4] [6] [8] [9]. To enrich the relevant literature and expand knowledge, the objective of the study tries to investigate the efficacy of the usage of digital game on key competencies through new media literacy and critical thinking disposition in higher education. This was a cross-sectional survey involving 159 prospective Chinese language teachers participants in the

Departments of Literature and Journalism of Leshan Normal University in Southwest China. Jenkins' 12 new media literacy skills and Delphi consensus's 7 critical thinking dispositions provide two frameworks the study based on. Structured questionnaire will be used as tools of data collection. For the data analysis, descriptive statistics, a series one-way ANOVA, one-way MANOVA, Post hoc Test will be used to explore the efficacy of duration of digital game use on key competencies. Structured questionnaire will be used as tools of data collection. And the current study will seek the answers to the following questions

Q1 Do the scores of sub dimensions of new media literacy and critical thinking disposition among prospective Chinese language teachers change with respect to duration of digital game use?

Q2 What extent do the scores of sub dimensions of new media literacy and sub dimensions of critical thinking disposition among prospective Chinese language teachers change with duration of digital game use?

## 2 THEORETICAL FRAMEWORK

### 2.1 Key Competencies in 21st Century

A competency is more than just knowledge and skills. It involves the ability to meet complex demands, by drawing on and mobilizing psycho-social resources in a particular context. In 21st century, global trends such as digitization and the progress of artificial intelligence have brought fundamental challenges to the objectives and methods of education. In the face of profound and extensive changes, people increasingly recognize the need to reconsider educational objectives and the types of abilities of students' development. According to project called Education 2030, OECD (2018) identifies key competencies for personal, social, and economic well-Being, including critical thinking and new media literacy, as a guide for the effective development of these knowledge, skills, attitudes and values in the 21st century teaching system.

### 2.2 New Media Literacy

In the current research, new media refers to various social and cultural platforms or app based on information technology. New media literacy is defined as a series of cultural and social skills needed to survive in the new media landscape and According to Jenkins et al (2006) [3], the new media literacy consist of 12 sub dimensions of new media literacy play, performance, simulation, appropriation, multi-tasking, distributed-cognition, collective-intelligence, judgment, trans-media-navigation, networking, negotiation, visualization. New media literacy emphasizes active participation and production in new media technological environment, especially in artificial intelligence environment as different from traditional media literacy [5]. NML is a profound goal in Chinese language education, and it is one of the key competences of prospective Chinese language teachers in the 21st century.

### 2.3 Critical Thinking Disposition

Critical thinking (CT) is a seminal goal in higher education, and it is one of the key competences included in the requirements for professional qualification certification of prospective Chinese language teachers. Nevertheless, there is considerable dispute about how to define critical thinking. Overall, critical thinking involves both cognitive skills and dispositions. These two aspects are captured in a consensus definition reached by a panel of leading critical thinking scholars and

researchers. The resulting Delphi Report defines critical thinking as "purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based". As an important prerequisite for critical thinking cognitive skills, critical thinking disposition were defined by seven sub dimensions named truth-seeking, open-mindedness, analyticity, systematicity, self-confidence, inquisitiveness, maturity [2].

## 3 METHODOLOGY

### 3.1 Research Design

The current study employed the empirical approach which aimed at inquiring into the efficacy of the independent variable on the dependent variable. In the study, the relationships and intensities between time duration and 12 sub dimensions of new media literacy and seven sub dimensions of critical thinking disposition of prospective Chinese language teachers was examined through one-way ANOVA and one-way MANOVA. Among them, time duration was a recorded category, independent variable and divided into four levels named group A, group B, group C and group D, Meanwhile 12 sub dimensions of NML and 7 sub dimensions of CTD were regarded as continuous and dependent variables, and Post Hoc Tests was used to identify which time duration groups had significant differences and what kinds of difference in the key competencies of 21st century. SPSS24.0 software was used to analyze the valid data.

### 3.2 Research Sample

The sample comprises students from Leshan Normal University in southwest China, and they are 159 regular prospective Chinese language teachers studying at school of literature and journalism in the first semester of the academic year 2021-2022. There were 143 (90%) girls and 16 (10%) boys students in the study aged between 19 and 24 years old. The sample can represent the fact that normal students have more girls and less boys.

### 3.3 Research Tools

Here the researcher explains the research tools which Include a demographic information form which contains questions about gender, age of the participants, and 12 sub media literacy skills scales developed by Literat [5] according to the Jenkins' new media literacy framework, and 7 sub scales based on Delphi consensus's 7 critical thinking disposition [2]. In the light of English Chinese two-way conversion and expert surface validity test, there are total of 57 items of new media literacy and 70 questions of critical thinking disposition were retained

and measured. The Likert 5-point scoring method is used in new media literacy measurement to score from 1 to 5 points presenting “strongly disagree” to “strongly agree” respectively. And the Likert 6-point scoring method is used in critical thinking disposition test to score from 1 to 6 points presenting “strongly disagree” to “strongly agree” respectively. Through item parcelling, Cronbach’s Alpha coefficient of the scale of new media literacy was calculated as 0.901 for the overall scale. And Cronbach’s Alpha coefficient of the scale of critical thinking disposition was 0.748 for the overall scale. Therefore, the research tools were credible.

### 3.4 Research Analysis

SPSS24.0 software was employed to analyze the valid data. Firstly, the normality, homogeneity, linearity of the distribution for the overall new media literacy and critical thinking disposition and their sub dimensions scores were tested. Secondly, ANOVA, MANOVA were used to calculate the effect size of time duration variable of digital games use on new media literacy, critical thinking disposition and their sub dimensions. Thirdly, Post Hoc Tests were employed to identify the group that caused the difference. And the .05 significance level was accepted for all tests ran. Fourthly, to compare the groups, partial eta squared ( $\eta^2$ ) effect size statistics were used. The obtained eta squared values were interpreted as .01 = small effect, .06 = moderate level effect, .14 = big effect [7].

## 4 RESEARCH RESULTS

### 4.1 Results Related to the First Problem

For the first question (Q1): Do the scores of sub dimensions of new media literacy and sub dimensions of critical thinking disposition among prospective Chinese language teachers change with respect to duration of digital game use? Table 1, Table 2 and Table 3 showed the research results related to the problem.

**Table 1:** Between-subjects factors.

| Time duration   | Value Label         | N  | Percent |
|---|---------------------|----|---------|
| How much time do you spend on the digital game use every week in past year? | A less than 1 hour  | 75 | 47.2    |
|   | B 1-3 hours         | 38 | 23.9    |
|   | C 3-5 hours         | 27 | 17      |
|   | D more than 5 hours | 19 | 11.9    |

According to the answers given about the question “How much time do you spend on the digital games?” Table 1 showed that 47.2% spend less than 1 hour, 23.9% spend 1-3 hours, 17% spend 3-5 hours and 11.9% spend more than 5 hours on the digital game. In uni-variate analysis of variance, time duration that spent on digital game was regarded as the between-subjects factors. For the factors, Group A (n=75) referred to the use of digital game for less than 1 hour every week, Group B (n=38) referred to the use of digital game for less than 1-3 hours per week, Group C (n=27) referred to the use of digital game for less than 3-5 hours every week, Group D (n=19) referred to the use of digital game for less than 3-5 hours every week.

**Table 2:** Homogeneity and normality test statistics on 12 sub dimensions of new media literacy and 7 sub dimensions of critical thinking disposition.

|                         | N         | Minimum   | Maximum   | Mean      | Std. Deviation | Skewness  | Kurtosis   |
|-------------------------|-----------|-----------|-----------|-----------|----------------|-----------|------------|
|                         | Statistic | Statistic | Statistic | Statistic | Std. Error     | Statistic | Std. Error |
| play                    | 159       | 2.6       | 5         | 3.867     | 0.045          | 0.564     | 0.207      |
| simulation              | 159       | 2.2       | 5         | 3.748     | 0.044          | 0.554     | 0.139      |
| performance             | 159       | 1.75      | 5         | 3.492     | 0.049          | 0.615     | 0.042      |
| appropriation           | 159       | 2.2       | 5         | 3.546     | 0.046          | 0.585     | 0.114      |
| distribution cognitive  | 159       | 2.4       | 5         | 3.720     | 0.041          | 0.514     | 0.238      |
| multitasking            | 159       | 2.4       | 5         | 3.586     | 0.045          | 0.571     | 0.175      |
| collective intelligence | 159       | 2.6       | 5         | 3.835     | 0.040          | 0.506     | 0.060      |
| judgment                | 159       | 3         | 5         | 3.857     | 0.042          | 0.534     | 0.111      |
| trans media             | 159       | 1.4       | 5         | 3.904     | 0.049          | 0.614     | -0.264     |
| networking              | 159       | 2         | 5         | 3.580     | 0.047          | 0.597     | 0.272      |
| negotiation             | 159       | 2.4       | 5         | 3.803     | 0.047          | 0.594     | -0.049     |

|                 |     |      |     |       |       |       |        |       |        |       |
|-----------------|-----|------|-----|-------|-------|-------|--------|-------|--------|-------|
| visualization   | 159 | 2.67 | 5   | 3.788 | 0.045 | 0.566 | 0.240  | 0.192 | -0.164 | 0.383 |
| truth seeking   | 159 | 1.2  | 5.4 | 4.004 | 0.048 | 0.601 | -0.631 | 0.192 | 2.193  | 0.383 |
| open minded     | 159 | 2.6  | 5.1 | 4.095 | 0.041 | 0.523 | -0.479 | 0.192 | 0.150  | 0.383 |
| analyticity     | 159 | 2    | 4.7 | 3.341 | 0.046 | 0.584 | -0.070 | 0.192 | -0.427 | 0.383 |
| systematicity   | 159 | 2    | 5.5 | 3.588 | 0.042 | 0.535 | 0.000  | 0.192 | 0.826  | 0.383 |
| self confidence | 159 | 1.3  | 5   | 3.208 | 0.055 | 0.697 | -0.350 | 0.192 | -0.299 | 0.383 |
| inquisitiveness | 159 | 1.5  | 5   | 3.377 | 0.052 | 0.658 | -0.011 | 0.192 | -0.150 | 0.383 |
| maturity        | 159 | 2.7  | 5.6 | 4.484 | 0.050 | 0.635 | -0.618 | 0.192 | 0.179  | 0.383 |

Valid N (listwise)=159, Cook's Distance value, minimum=.000, maximum value=.080.

The skewness and kurtosis index were conduct to identify the normality of data. All related to statistics were presented in Table 2 with Minimum statistic was .000, maximum statistic was -.631 of skewness and Minimum kurtosis statistic was -.027, maximum statistic was 2.193. In addition, mean statistic were no floor and ceiling effects in the new media literacy and critical

thinking disposition. Meanwhile, it was found that Cook's Distance values (minimum value =.000, maximum value=.080) were less than 1. So it can be accepted the null hypothesis of variance homogeneity, normality of dependent variables and parametric tests can be used in the statistical analyze in MANOVA.

**Table 3:** Summary of one-way MANOVA results.

| Variance Source | Dependent Variable      | df    | SSCP Matrix |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       | F     |       |              |              |  |
|-----------------|-------------------------|-------|-------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------------|--------------|--|
| Between Groups  | play                    | 3     | 1.54        | 0.85  | 1.46  | 1.22  | 0.82  | 1.76  | 0.52  | 0.92  | 0.45  | 0.63  | 1.21  | 1.51  | -0.32 | 0.29  | -0.34 | -0.63 | -0.54 | -2.36 | -1.04        | 1.63         |  |
|                 | simulation              | 3     | 0.85        | 1.80  | 2.22  | 1.07  | 0.66  | 2.13  | 1.11  | 0.54  | -0.02 | 0.61  | 1.20  | 0.85  | -1.05 | -0.47 | 0.55  | -0.41 | 0.75  | -1.24 | -0.67        | 1.99         |  |
|                 | performance             | 3     | 1.46        | 2.22  | 3.02  | 2.25  | 0.96  | 2.92  | 1.37  | 0.86  | 0.19  | 1.09  | 1.70  | 1.49  | -1.12 | -0.57 | 0.96  | -0.74 | 1.07  | -1.64 | -1.53        | <b>2.75*</b> |  |
|                 | appropriation           | 3     | 1.22        | 1.07  | 2.25  | 4.56  | 0.50  | 1.82  | 0.63  | 0.53  | 0.53  | 1.64  | 1.02  | 1.46  | 0.03  | -0.86 | 2.48  | -0.92 | 2.28  | 0.92  | -3.11        | <b>4.76*</b> |  |
|                 | Distributed cognition   | 3     | 0.82        | 0.66  | 0.96  | 0.50  | 0.49  | 1.12  | 0.41  | 0.51  | 0.18  | 0.31  | 0.74  | 0.79  | -0.34 | 0.11  | -0.23 | -0.32 | -0.28 | -1.43 | -0.43        | 0.61         |  |
|                 | multitasking            | 3     | 1.76        | 2.13  | 2.92  | 1.82  | 1.12  | 3.03  | 1.31  | 1.07  | 0.28  | 0.98  | 1.85  | 1.74  | -1.11 | -0.24 | 0.31  | -0.79 | 0.35  | -2.59 | -1.33        | <b>3.23*</b> |  |
|                 | collective intelligence | 3     | 0.52        | 1.11  | 1.37  | 0.63  | 0.41  | 1.31  | 0.69  | 0.33  | -0.02 | 0.37  | 0.74  | 0.52  | -0.65 | -0.28 | 0.32  | -0.25 | 0.44  | -0.79 | -0.40        | 0.89         |  |
|                 | judgment                | 3     | 0.92        | 0.54  | 0.86  | 0.53  | 0.51  | 1.07  | 0.33  | 0.56  | 0.25  | 0.32  | 0.74  | 0.88  | -0.24 | 0.21  | -0.34 | -0.36 | -0.45 | -1.57 | -0.48        | 0.65         |  |
|                 | trans-media navigation  | 3     | 0.45        | -0.02 | 0.19  | 0.53  | 0.18  | 0.28  | -0.02 | 0.25  | 0.20  | 0.21  | 0.24  | 0.45  | 0.12  | 0.15  | -0.07 | -0.20 | -0.20 | -0.50 | -0.44        | 0.18         |  |
|                 | networking              | 3     | 0.63        | 0.61  | 1.09  | 1.64  | 0.31  | 0.98  | 0.37  | 0.32  | 0.21  | 0.64  | 0.57  | 0.70  | -0.14 | -0.28 | 0.78  | -0.39 | 0.72  | -0.11 | -1.13        | 0.59         |  |
|                 | negotiation             | 3     | 1.21        | 1.20  | 1.70  | 1.02  | 0.74  | 1.85  | 0.74  | 0.74  | 0.24  | 0.57  | 1.17  | 1.19  | -0.61 | 0.00  | -0.05 | -0.51 | -0.08 | -1.92 | -0.79        | 1.11         |  |
|                 | visualization           | 3     | 1.51        | 0.85  | 1.49  | 1.46  | 0.79  | 1.74  | 0.52  | 0.88  | 0.45  | 0.70  | 1.19  | 1.50  | -0.28 | 0.21  | -0.14 | -0.65 | -0.35 | -2.11 | -1.18        | 1.58         |  |
|                 | truth seeking           | 3     | -0.32       | -1.05 | -1.12 | 0.03  | -0.34 | -1.11 | -0.65 | -0.24 | 0.12  | -0.14 | -0.61 | -0.28 | 0.72  | 0.21  | -0.02 | 0.11  | -0.20 | 0.89  | -0.07        | 0.66         |  |
|                 | open minded             | 3     | 0.29        | -0.47 | -0.57 | -0.86 | 0.11  | -0.24 | -0.28 | 0.21  | 0.15  | -0.28 | 0.00  | 0.21  | 0.21  | 0.58  | -1.06 | 0.01  | -1.22 | -1.18 | 0.44         | 0.71         |  |
|                 | analyticity             | 3     | -0.34       | 0.55  | 0.96  | 2.48  | -0.23 | 0.31  | 0.32  | -0.34 | -0.07 | 0.78  | -0.05 | -0.14 | -0.02 | -1.06 | 2.32  | -0.18 | 2.44  | 2.56  | -1.47        | 2.33         |  |
|                 | systematicity           | 3     | -0.63       | -0.41 | -0.74 | -0.92 | -0.32 | -0.79 | -0.25 | -0.36 | -0.20 | -0.39 | -0.51 | -0.65 | 0.11  | 0.01  | -0.18 | 0.31  | -0.10 | 0.65  | 0.69         | 0.36         |  |
| self confidence | 3                       | -0.54 | 0.75        | 1.07  | 2.28  | -0.28 | 0.35  | 0.44  | -0.45 | -0.20 | 0.72  | -0.08 | -0.35 | -0.20 | -1.22 | 2.44  | -0.10 | 2.67  | 2.78  | -1.27 | 1.86         |              |  |
| inquisitiveness | 3                       | -2.36 | -1.24       | -1.64 | 0.92  | -1.43 | -2.59 | -0.79 | -1.57 | -0.50 | -0.11 | -1.92 | -2.11 | 0.89  | -1.18 | 2.56  | 0.65  | 2.78  | 5.82  | -0.21 | <b>4.81*</b> |              |  |
| maturity        | 3                       | -1.04 | -0.67       | -1.53 | -3.11 | -0.43 | -1.33 | -0.40 | -0.48 | -0.44 | -1.13 | -0.79 | -1.18 | -0.07 | 0.44  | -1.47 | 0.69  | -1.27 | -0.21 | 2.17  | 1.82         |              |  |
| Within Groups   | play                    | 48.68 | 22.86       | 22.38 | 22.48 | 21.63 | 22.99 | 17.59 | 18.24 | 17.37 | 18.70 | 17.28 | 17.67 | -1.09 | -2.85 | -6.44 | -4.36 | -4.48 | -2.78 | -1.38 |              |              |  |
|                 | simulation              | 22.86 | 46.62       | 27.46 | 24.37 | 16.12 | 13.00 | 15.78 | 12.93 | 19.72 | 15.42 | 15.42 | 11.49 | 3.72  | -4.23 | -4.58 | 0.25  | 1.21  | 7.45  | 3.19  |              |              |  |
|                 | performance             | 22.38 | 27.46       | 56.78 | 26.78 | 13.34 | 19.91 | 11.48 | 11.41 | 14.35 | 15.39 | 15.71 | 13.08 | -1.37 | -4.74 | -7.43 | -2.73 | 1.87  | 7.24  | -7.57 |              |              |  |
|                 | appropriation           | 22.48 | 24.37       | 26.78 | 49.49 | 21.33 | 21.82 | 16.88 | 15.88 | 26.09 | 24.51 | 23.29 | 23.79 | -5.01 | -0.97 | -9.25 | -5.50 | -3.17 | -2.54 | -9.11 |              |              |  |
|                 | distributed cognition   | 21.63 | 16.12       | 13.34 | 21.33 | 41.21 | 23.23 | 20.88 | 22.62 | 23.27 | 15.43 | 21.22 | 20.76 | -0.21 | 2.84  | -4.63 | 0.69  | -0.08 | 2.47  | 3.55  |              |              |  |
|                 | multitasking            | 22.99 | 13.00       | 19.91 | 21.82 | 23.23 | 48.50 | 16.04 | 20.77 | 19.67 | 19.02 | 21.48 | 19.32 | 1.64  | 0.97  | -4.88 | -0.58 | -3.81 | 3.36  | -0.01 |              |              |  |
|                 | collective intelligence | 17.59 | 15.78       | 11.48 | 16.88 | 20.88 | 16.04 | 39.84 | 24.75 | 25.39 | 19.11 | 24.33 | 21.80 | -0.88 | -4.67 | -5.83 | -3.83 | -8.37 | -2.68 | -3.02 |              |              |  |
|                 | judgment                | 18.24 | 12.93       | 11.41 | 15.88 | 22.62 | 20.77 | 24.75 | 44.41 | 29.70 | 23.42 | 34.36 | 31.42 | -1.62 | -1.11 | -4.63 | -4.70 | -7.96 | 4.76  | -0.89 |              |              |  |
|                 | trans-media navigation  | 17.37 | 19.72       | 14.35 | 26.09 | 23.27 | 19.67 | 25.39 | 29.70 | 59.38 | 33.41 | 34.92 | 29.93 | -0.26 | -2.14 | -8.95 | -8.74 | -6.81 | -0.90 | 1.49  |              |              |  |
|                 | networking              | 18.70 | 15.42       | 15.39 | 24.51 | 15.43 | 19.02 | 19.11 | 23.42 | 33.41 | 55.62 | 33.08 | 22.36 | 0.39  | 0.28  | -9.05 | -2.02 | -2.83 | -0.94 | -0.24 |              |              |  |
|                 | negotiation             | 17.28 | 15.42       | 15.71 | 23.29 | 21.22 | 21.48 | 24.33 | 34.36 | 34.92 | 33.08 | 54.59 | 37.30 | -2.29 | 1.44  | -2.13 | -3.16 | -5.56 | 1.89  | -1.38 |              |              |  |
| visualization   | 17.67                   | 11.49 | 13.08       | 23.79 | 20.76 | 19.32 | 21.80 | 31.42 | 29.93 | 22.36 | 37.30 | 49.04 | -2.50 | 2.52  | -2.22 | -1.45 | -7.07 | 3.42  | -2.65 |       |              |              |  |
| truth seeking   | -1.09                   | 3.72  | -1.37       | -5.01 | -0.21 | 1.64  | -0.88 | -1.62 | -0.26 | 0.39  | -2.29 | -2.50 | 56.33 | 16.79 | 9.65  | 7.46  | -0.64 | 1.56  | 28.32 |       |              |              |  |

|                 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| open minded     | -2.85 | -4.23 | -4.74 | -0.97 | 2.84  | 0.97  | -4.67 | -1.11 | -2.14 | 0.28  | 1.44  | 2.52  | 16.79 | 42.61 | 20.06 | 19.75 | 16.37 | 11.58 | 19.10 |
| analyticity     | -6.44 | -4.58 | -7.43 | -9.25 | -4.63 | -4.88 | -5.83 | -4.63 | -8.95 | -9.05 | -2.13 | -2.22 | 9.65  | 20.06 | 51.53 | 18.47 | 31.80 | 25.48 | 9.09  |
| systematicity   | -4.36 | 0.25  | -2.73 | -5.50 | 0.69  | -0.58 | -3.83 | -4.70 | -8.74 | -2.02 | -3.16 | -1.45 | 7.46  | 19.75 | 18.47 | 44.84 | 27.90 | 20.42 | 11.93 |
| self confidence | -4.48 | 1.21  | 1.87  | -3.17 | -0.08 | -3.81 | -8.37 | -7.96 | -6.81 | -2.83 | -5.56 | -7.07 | -0.64 | 16.37 | 31.80 | 27.90 | 73.98 | 37.63 | 12.60 |
| inquisitiveness | -2.78 | 7.45  | 7.24  | -2.54 | 2.47  | 3.36  | -2.68 | 4.76  | -0.90 | -0.94 | 1.89  | 3.42  | 1.56  | 11.58 | 25.48 | 20.42 | 37.63 | 62.53 | 15.84 |
| maturity        | -1.38 | 3.19  | -7.57 | -9.11 | 3.55  | -0.01 | -3.02 | -0.89 | 1.49  | -0.24 | -1.38 | -2.65 | 28.32 | 19.10 | 9.09  | 11.93 | 12.60 | 15.84 | 61.51 |

Wilks' Lambda=0.550, converted to F=1.593, sig P=0.006.

\*p < .05 \*\*P< .01 \*\*\*P < .001 n. s. p. >.05

Table 3 was results of MANOVA. It showed the value of Wilks' Lambda=0.550 which was converted to F value =1.593 with P=0.006<.05 at a significant level. It indicated that the different duration of digital game use was significantly different in at least one of 12 sub dimensions of new media literacy and 7 sub dimensions of critical thinking disposition. According to Table 3, it was found that performance (F=2.75, P=.045<.05), appropriation (F=4.563, P=.003<.05), multitasking (F=3.029, P=.024<.05), inquisitiveness (F=4.808, p=.003<.05) was significant at .05 level. These implied that duration of digital game use have significant efficacy

on the 4 sub dimensions of new media literacy and critical thinking disposition among prospective Chinese language teachers

#### 4.2 Results Related to the Second Problem

For the second question (Q2): What extent do the scores of the sub dimensions of new media literacy and critical thinking disposition of prospective Chinese language teachers change with duration of digital game use? Table 4 showed the research results.

**Table 4:** Summary of a series of one-way ANOVA.

| Variance Source  | Dependent Variable | Sum of Squares | df | Mean Square | F       | Sig.  | Partial Eta Squared | Observed Power <sup>a</sup> |
|------------------|--------------------|----------------|----|-------------|---------|-------|---------------------|-----------------------------|
| (Between groups) | Time               | 3.024          | 3  | 1.008       | 2.752*  | 0.045 | 0.051               | 0.657                       |
|                  | duration           | 4.563          | 3  | 1.521       | 4.764** | 0.003 | 0.084               | 0.895                       |
|                  | multitasking       | 3.029          | 3  | 1.01        | 3.227*  | 0.024 | 0.059               | 0.734                       |
|                  | inquisitiveness    | 5.818          | 3  | 1.939       | 4.808** | 0.003 | 0.085               | 0.898                       |
| (Within groups)  | Error              | 3.024          | 3  | 1.008       |         |       |                     |                             |
|                  | performance        | 4.563          | 3  | 1.521       |         |       |                     |                             |
|                  | appropriation      | 3.029          | 3  | 1.01        |         |       |                     |                             |
|                  | multitasking       | 5.818          | 3  | 1.939       |         |       |                     |                             |

\*p < .05 \*\*P< .01 \*\*\*P < .001 a. Computed using alpha = .05

A series of one-way ANOVA were used to conduct on the sub dimensions that were significant in the MANOVA. Effect size statistics (partial eta squared) values of different time duration variables of four sub dimensions of NML and CTD were figured out. For performance (F=2.752, p< .05), it was observed that the effect size (partial eta squared) was .051 with observed Power =.657. For appropriation (F=4.764, p<.05), it was observed that the effect size (partial eta squared) was .084 with observed Power =.895. For multitasking (F=3.227, p<.05) with observed Power =.734, it was observed that the effect size (partial eta squared) was .059. For

inquisitiveness (F=4.808, p<.05) with observed Power=.898 and the effect size (partial eta squared) =.085. According to Pallant that the obtained eta squared values were interpreted as .01=small effect, .06=moderate effect, .14=big effect [7]. Therefore, it can be said that time duration of digital game use have significant moderate efficacy on appropriation sub dimensions, inquisitiveness sub dimensions and have significant small efficacy on performance sub dimensions, multitasking sub dimensions out of new media literacy and critical thinking disposition among prospective Chinese language teacher.

**Table 5:** Summary of a series of post - hoc of multiple comparisons (LSD).

| Dependent Variable | (I)                  | (J)                  | Mean Difference (I-J) | Std. Error | Sig.  | 95% Confidence Interval |             |
|--------------------|----------------------|----------------------|-----------------------|------------|-------|-------------------------|-------------|
|                    |                      |                      |                       |            |       | Lower Bound             | Upper Bound |
| performance        | more than 5 hours(D) | Less than 1 hour(A)  | .4195*                | 0.155      | 0.008 | 0.112                   | 0.727       |
|                    | 3-5 hours(C)         | 1-3hours(B)          | .3076*                | 0.142      | 0.032 | 0.027                   | 0.589       |
| appropriation      | more than 5 hours(D) | Less than 1 hour(A)  | .3931*                | 0.145      | 0.008 | 0.106                   | 0.680       |
|                    | more than 5 hours(D) | 1-3hours(B)          | .5789*                | 0.159      | 0.000 | 0.265                   | 0.893       |
|                    | more than 5 hours(D) | Less than 1 hour(A)  | .4254*                | 0.144      | 0.004 | 0.142                   | 0.709       |
| multitasking       | Less than 1 hour(A)  | 1-3hours(B)          | .3112*                | 0.126      | 0.015 | 0.061                   | 0.561       |
| inquisitiveness    | 3-5 hours(C)         | 1-3hours(B)          | .5272*                | 0.160      | 0.001 | 0.211                   | 0.843       |
|                    | 3-5 hours(C)         | more than 5 hours(D) | .5193*                | 0.190      | 0.007 | 0.144                   | 0.895       |

Based on observed means. The error term is Mean Square (Error) = .403.\* The mean difference is significant at the .05 level.

With the one-way ANOVA procedure, an Honestly Significant Difference (HSD) of Post Hoc Test was conducted. In Table 5, it was observed that there were significant differences in the mean scores on the dependent variables across groups which lie among group A, group B, group C and group D among sub dimensions named performance, appropriation, multitasking, inquisitiveness out of the sub dimensions of new media literacy and sub dimensions of critical thinking disposition. And the mean score of group C was significantly higher than that of Group D in the inquisitiveness sub dimension of critical thinking disposition among them. These mean that it may be more economical to spend 3-5 hours a week on digital game for more than 5 hours on key competencies among prospective Chinese language teacher education in 21st century.

## 5 RESEARCH CONCLUSION AND SUGGESTIONS

### 5.1 Research Conclusion

In this study, the efficacy of the usage of digital game on new media literacy and critical thinking disposition out of key competencies of 21st century among the prospective Chinese language teachers was examined. Through convenient sampling, 159 future Chinese teachers from Leshan Normal University in Southwest China participated in the cross-sectional survey. The research was based on Jenkins et al.'s new media literacy

framework and critical thinking disposition framework provided by "The Delphi Report". Structured questionnaire was used as data collection tools. And a series of one-way analysis of variance (ANOVA), multivariate analysis of variance (MANOVA), Post Hoc Test were used for the data processing.

It was observed that the usage of digital games caused differences in subs dimensions of performance, appropriation, multitasking, inquisitiveness towards new media literacy and critical thinking disposition out of the key competencies of student in 21st century. The findings of this study showed the duration of digital game use has significant moderate efficacy on appropriation and inquisitiveness, and small efficacy on performance and multitasking towards new media literacy and critical thinking disposition among the prospective Chinese language teachers. In addition, a disturbing phenomenon has been found that although the longer the use time of digital games has a positive efficacy on key competencies for the 21st century, such as new media literacy and critical thinking disposition, the use of digital games will lead to a negative difference in the level of inquisitiveness out of critical thinking disposition after a specific period of time.

### 5.2 Suggestions

The results are promising and could be useful for the design of artificial intelligence educational interventions aimed at promoting key competencies for the 21st century in prospective Chinese language teachers. In

view of the significant positive efficacy of digital game use on appropriation, performance and multitasking of new media literacy, AI workers and AI educators need to provide students with more media content for sampling and mixing, more alternative identities for improvisation and exploration, more environments with key details so as to integrate digital games into school curricula to develop the key competence of students in the 21st century. Considering the usage of digital games has complex efficacy on inquisitiveness, artificial intelligence worker and curriculum developers should carefully consider time variables to avoid its change from positive impact to negative impact after a certain period of time when integrating digital games into learning activities to correctly develop students' critical thinking disposition as another of key competencies of students in the 21st century.

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