



**EFFECT OF SIX-WEEK CONTENT KNOWLEDGE WORKSHOP ON
WRITTEN TEST PERFORMANCE AMONG PHYSICAL EDUCATION
STUDENTS IN CHINA**

By

GAO YONGQI

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Doctor of Philosophy**

March 2023

FPP 2023 10

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DEDICATION

Dedicated With Love

To

My Beloved Wife, Tian Miao

My Cute daughter, Gao Mingxuan

My Cute daughter, Gao Mingye



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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By

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March 2023

Chairman : Professor Soh Kim Geok, PhD
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The employment problem is particularly prominent among college students majoring in physical education teaching, who are pre-service teachers (PE students). In China, students take public institutions' teacher recruitment exams, which comprise 70% written tests and 30% skills. This study investigates the effect of a 6-week content knowledge (CK) workshop on PE students' written test performance. The objectives are to evaluate the impact of the workshop on the basic theoretical knowledge in sports training design (STD) and teaching design (TD), health promotion knowledge in movement energy metabolism (MEM) and movement techniques (KMT), physical movement knowledge in competition venue planning (CVP) and knowledge of movement rules (KMR) on performance in written tests among PE students in China. In addition, this study also aims to evaluate the effect of the workshop on comprehensive CK scores in written test performance among PE students in China.

The Randomised Controlled Trial was adopted. Volunteers from the Ning Xia Normal University of China participated in this study. Fifty-four (54) participants were randomly selected to participate, all of whom were college students majoring in PE teaching in the fourth year. The Chinese standard examination test measured their performance in written tests. The test content included CK related to STD, TD, MEM, KMT, CVP, and KMR. The participants were divided into two groups: an experimental and a control group. Baseline information includes gender, age, home location, father and mother education. There were no significant differences on demographic characteristics between intervention and control groups at baseline, which indicates the two groups were comparable. The experimental group underwent a workshop intervention, while the control group followed standard classes planned by the university. Both groups were followed up for a six-week intervention program, including three tests: a pre-test at week-0, post-test one at week-3, and post-test two at week-6.

Generalized estimating equations and a two-way repeated measures analysis of variance (ANOVA) were used to analyse the data. The results of the GEE showed that the workshop significantly improved students' TD ($\chi^2 = 17.377$, $P < 0.001$), KMT ($\chi^2 = 10.713$, $P = 0.001$), and CVP ($\chi^2 = 13.091$, $P < 0.001$) written test performance. However, insignificant written test performance results were reported for STD ($\chi^2 = 0.026$, $P = 0.872$), MEM ($\chi^2 = 1.945$, $P = 0.163$), and KMR ($\chi^2 = 3.226$, $P = 0.072$). Simultaneously, the two-way repeated ANOVA results showed that the workshop significantly improved the students' score of comprehensive content knowledge ($F = 19.651$, $P < 0.001$, $\eta^2 = 0.274$). In addition, results also indicated a significant improvement in the written test as early as at 3-weeks of intervention for TD.

In conclusion, the workshop improved students' CK, evidenced in their written test performance, especially in TD, KMT, and CVP. The finding expanded the theory by Ward (2009), which investigated the effect of workshops on the teacher (to ascertain whether CK could be taught better to students after undergoing a workshop). The present study found that students' CK can improve through workshops conducted directly with students to save time and cost while being effective. Future studies should embed the workshop method in year one to three PE classes as this period represents the early stage of learning CK in PE. By graduation, the students' CK is better as they score well on written tests determining their success in applying for a future PE teacher job in China.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**KESAN BENGKEL PENGETAHUAN KANDUNGAN ENAM MINGGU
TERHADAP PRESTASI UJIAN BERTULIS DALAM KALANGAN PELAJAR
PENDIDIKAN JASMANI DI CHINA**

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Masalah pekerjaan amat ketara dalam kalangan pelajar kolej jurusan pengajaran pendidikan jasmani, yang merupakan guru praperkhidmatan (pelajar PE). Di China, pelajar mengambil peperiksaan pengambilan guru institusi awam, yang merangkumi 70% ujian bertulis dan 30% kemahiran. Kajian ini menyiasat kesan bengkel pengetahuan kandungan (CK) selama 6 minggu ke atas prestasi ujian bertulis pelajar PE. Objektifnya adalah untuk menilai kesan bengkel terhadap pengetahuan teori asas dalam reka bentuk latihan sukan (STD) dan reka bentuk pengajaran (TD), pengetahuan promosi kesihatan dalam MEM dan teknik pergerakan (KMT), dan pengetahuan pergerakan fizikal dalam perancangan tempat pertandingan (CVP.) dan pengetahuan peraturan pergerakan (KMR) dalam prestasi ujian bertulis dalam kalangan pelajar PE di China. Selain itu, kajian ini juga bertujuan untuk menilai kesan bengkel terhadap markah CK komprehensif dalam prestasi ujian bertulis di kalangan pelajar PE di China.

Percubaan Terkawal Rawak diterima pakai. Para peserta merupakan sukarelawan dari Universiti Ning Xia Normal, China. Lima puluh empat (54) peserta telah dipilih secara rawak untuk mengambil bahagian dan kesemuanya merupakan pelajar kolej dalam jurusan pengajaran PE tahun empat. Prestasi ujian bertulis pelajar diukur menggunakan ujian peperiksaan standard negara Cina. Kandungan ujian termasuk CK yang berkaitan dengan STD, TD, MEM, KMT, CVP dan KMR. Subjek dibahagikan kepada dua kumpulan iaitu satu kumpulan eksperimen dan satu kumpulan kawalan. Maklumat asas termasuk jantina, umur, lokasi rumah, pendidikan bapa dan ibu. Tidak terdapat perbezaan yang signifikan pada ciri demografi antara kumpulan intervensi dan kawalan pada garis dasar, yang menunjukkan kedua-dua kumpulan adalah setanding. Kumpulan eksperimen telah menjalani intervensi bengkel, manakala kumpulan kawalan mengikuti kelas standard yang dirancang oleh universiti. Kedua-dua kumpulan telah disusuli untuk program intervensi selama enam minggu dengan tiga ujian: ujian pra pada minggu-0, ujian pasca satu pada minggu-3, dan ujian pasca dua pada minggu-6.

GEE dan analisis ukuran berulang dua hala bagi varians (ANOVA) digunakan untuk menganalisis data. Keputusan GEE menunjukkan bahawa bengkel telah meningkatkan prestasi ujian bertulis pelajar ($\chi^2 = 17.377$, $P < 0.001$), KMT ($\chi^2 = 10.713$, $P = 0.001$) dengan ketara ($\chi^2 = 13.091$, $P < 0.001$) dan CVP ($\chi^2 = 13.091$, $P < 0.001$). Walau bagaimanapun, keputusan prestasi ujian bertulis yang tidak signifikan telah dilaporkan untuk STD ($\chi^2 = 0.026$, $P = 0.872$), MEM ($\chi^2 = 1.945$, $P = 0.163$), dan KMR ($\chi^2 = 3.226$, $P = 0.072$). Pada masa yang sama, keputusan ANOVA berulang dua hala menunjukkan bahawa bengkel telah meningkatkan markah pengetahuan kandungan komprehensif pelajar secara ketara ($F = 19.651$, $P < 0.001$, $\eta^2 = 0.274$). Di samping itu, keputusan juga menunjukkan bahawa untuk TD, peningkatan ketara dalam ujian bertulis telah dilaporkan seawal 3 minggu intervensi.

Kesimpulannya, bengkel ini meningkatkan CK pelajar, terbukti dalam prestasi ujian bertulis mereka, terutamanya dalam TD, KMT, dan CVP. Penemuan ini memperluaskan teori oleh Ward (2009), yang menyiasat kesan bengkel terhadap guru (untuk memastikan sama ada CK boleh diajar dengan lebih baik kepada pelajar selepas menjalani bengkel). Kajian ini mendapati CK pelajar boleh menambah baik bila menggunakan kaedah bengkel dan ia perlu dilakukan terus kepada pelajar untuk menjimatkan masa dan kos secara berkesan. Kajian akan datang perlu menerapkan kaedah bengkel dalam kelas PE tahun satu ke tiga kerana ini adalah peringkat awal pembelajaran CK dalam PE. Apabila tamat pengajian, CK pelajar akan menjadi lebih baik dengan mendapatkan markah yang baik dalam ujian bertulis yang menentukan kejayaan mereka memohon pekerjaan sebagai guru PE di China pada masa hadapan.

ACKNOWLEDGEMENTS

Completing this doctoral degree has been an experience of great wonder and exploration. I convey sincere gratitude, appreciation, and thanks to the individuals who assisted me and contributed to the successful completion of this study.

First, I express my gratitude to my supervisor, Prof. Dr Soh Kim Geok, for her scholarly guidance, exceptional support, dedication, enthusiasm, and passion for teaching. Her advice made this dissertation possible and made my journey exciting, challenging, and thought-provoking. Prof. Soh's rigorous scientific attitude modelled my research and education. The kind and patient academic guidance she has shown me gave me a new understanding of academic research. Indeed, a thousand words cannot express my gratitude to Prof. Soh. It has been a great honour to be her doctoral student.

Appreciation is given to my committee members, Assoc. Prof. Dr Noor Syamilah Zakaria and Assoc. Prof. Dr Roziah Mohd Rasdi for their arduous work and meticulous thinking that improved my research. Thank you for your support, comfort, and encouragement.

I give endless thanks to my family for their unrelenting support, understanding, and concern that enabled me to complete my studies with peace of mind. Their silent dedication allows me always to find my spiritual belonging when I am the most tired.

Finally, I thank all the respected people who supported me in pursuing this doctoral journey.

This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

CK	Content knowledge
SCK	Specialized content knowledge
CCK	Common content knowledge
PE	Physical Education
PE Students	Physical education teaching students
STD	Sports training design
TD	Teaching design
MEM	Movement energy metabolism
CVP	Competition venue planning
KMT	Knowledge of movement techniques
KMR	Knowledge of movement rules
EAQs	Essay questions
MAQs	Memory questions
CAQs	Choose the question
T/FAQs	True and false questions
NIQs	Noun interpretation
SAQs	Short answer questions
GEE	Generalized estimating equations
CKPE	Content knowledge physical education

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

In recent years, with the expansion of college enrolment and the increasing number of graduates, the unemployment problem caused by a lack of jobs for graduates has become a widespread concern in society (Wang, 2023). In 2022, there were nine million college graduates in China (Jin et al., 2022). Statistics show that in 2001, 340,000 college graduates out of 1.15 million failed to secure a job in China, yielding an employment rate of 70%. Unemployment increased to 370,000 in 2002, 690,000 in 2004, and 790,000 in 2005 (Li, 2021). The above statistics corroborate the poor employment status of Chinese college graduates, especially in PE teaching, who are pre-service teachers (PE students) (Liu, 2014).

Physical education content knowledge (CK) workshops are an innovative way to engage in instructional practice and teach PE curriculum (Jin, 1996). Typically comprising oral exams and group discussion sessions (Fang, 2007), the CK workshop stimulates students to think and explore issues in addition to promoting practice and reflection (Gao et al., 2022; Ørngreen et al., 2017). The workshop focuses on improving student performance in written tests to ensure that each student achieves 90% fidelity (Sinelnikov et al., 2015). This study used the workshop's oral exams, group discussions, and effective feedback teaching methods.

Usually, students score poorly on written tests due to low CK. For instance, in recruiting teachers in Yun Cheng City, Shanxi Province, only 84.7% of final candidates were employed following the written test performance results in 2015 (Luo et al., 2023). In contrast, in the recruitment of teachers in Shanxi in 2013, 98.5% of the final candidates were ranked in their requested positions, and only three (1.5%) succeeded in overtaking others through interviews (Wen et al., 2012). Only those with more than 70% written examination scores are eligible for an interview, thus reducing the chances for low scorers to be appointed. Therefore, improving the CK among graduate students is crucial for doing well in the written examination.

According to *"Investigation and Research on Learning Interest of PE Majors' Professional Theory Courses,"* 50% of PE students are uninterested in learning CK. Only 22.5% were interested in CK (Yu et al., 2011). Limited attention to CK weakens knowledge in this area (Guo et al., 1994). According to another survey, *"Analysis of the Present Situation of PE Students' Attitudes towards Theoretical Courses in Henan Institute of Science and Technology,"* only 45% of college and university students consider CK critical (Yu, 2011).

1.2 Statement of the Problem

Inferior performance on written tests is one of the reasons for students' unemployment (Rong et al., 2015). According to survey research, Chinese students' written test performance is deficient. For example, in a CK examination of fourth-year students, more than 55% scored less than 60 out of 100 points for their written performance (Yang et al., 2015). Written tests examine a graduate's writing performance, which is proportional to employment, while skills examine a graduate's practical ability (Li, 2021). According to "Order No. 6 of the Ministry of Personnel," graduates in public institutions were required to sit for prescribed examinations, comprising 70% written and 30% skill tests (Li, 2016). The employment process started with a written test followed by an interview. Written test scores were listed in descending order to determine the list of candidates to be interviewed.

To decrease the difficulty of finding employment for students majoring in PE, the Chinese Ministry of Education issued a policy to incorporate relevant CK in PE teaching practice (Xia, 2010). Furthermore, according to the "National College PE Curriculum Teaching Guidance Outline", teachers must pay attention to combining skills and CK by incorporating CK in practical teaching skills to improve students' CK (Chen et al., 2010). The government has made efforts to solve this issue. However, the high number of unemployed PE graduates indicates that the government is still unsuccessful.

Numerous factors contribute to the low CK of PE students, one of which is students' learning motivation. According to Hu (2003), PE teaching in colleges and universities only assists students in learning basic PE skills, passing school examinations, and completing credits while ignoring students' need to attain CK (Hu et al., 2003).

Research has investigated the role of workshops for teachers (Ward, 2014) in improving teachers' CK and, consequently, students' CK. Teachers attend CK workshops to enhance their skills in teaching CK to students. However, Ward et al. (2014) found workshops only focused on teachers but not teaching students directly. Additionally, the workshops only emphasised physical skills (Kim, 2016; Sinelnikov et al., 2015; Ward et al., 2015) while ignoring the need to attain writing skills. As such, it has been found that teachers who underwent a CK and skills workshop for badminton twice a day for four hours significantly enhanced their students' badminton skills (Ward, 2014). In addition, teachers from a secondary school in Flanders, Belgium, improved their students' swimming performance after attending a three-hour swimming skills workshop (Iserbyt et al., 2016).

No studies have been conducted in Chinese sports universities. The effectiveness of CK workshops for students has yet to be explored comprehensively. Liu (2023) in Research on the application of cloud classrooms and workshop practice teaching in kinesiology teaching to highlight the scarcity of evidence of such workshop training in China (Liu et al., 2022). Hence, researchers must investigate the effect of CK workshops on PE students' written test performance. Such research is necessary to resolve the current employment problem faced by PE students in China.

1.3 Objectives of Study

1.3.1 General Objective

The general objective of the present study was to investigate the effect of a six-week CK workshop on the written test performance of PE students in China. The details of the objectives are to:

1. Investigate the effects of the six-week CK workshop on PE students' written test scores on basic theoretical knowledge in China.
2. Investigate the effects of the six-week CK workshop on PE students' written test scores on health promotion knowledge in China.
3. Investigate the effects of the six-week CK workshop on PE students' written test scores on competition venue planning in China.
4. Investigate the effects of the six-week CK workshop on PE students' written test scores on the comprehensive CK in China.

1.3.2 Specific Objectives

The specific objectives of this study compartmentalised the general aim to examine the effects of the six-week CK workshop on the written test performance of Chinese PE students. The detailed objectives are:

1. To examine the effects of the six-week CK workshop on the written test performance on sports training design (STD) among PE students in China.
2. To examine the effects of the six-week CK workshop on the written test performance on teaching design (TD) among PE students in China.
3. To examine the effects of the six-week CK workshop on the written test performance on movement energy metabolism (MEM) among PE students in China.
4. To examine the effects of the six-week CK workshop on the written test performance on knowledge of movement techniques (KMT) among PE students in China.
5. To examine the effects of the six-week CK workshop on the written test performance on CVP among PE students in China.
6. To examine the effects of the six-week CK workshop on the written test performance on knowledge of movement rules (KMR) among PE students in China.
7. To examine the effects of the six-week CK workshop on the scores of the comprehensive CK performance in a written test among PE students in China.

1.4 Hypotheses

1.4.1 General Hypotheses

The general objective of this study was to investigate the effects of a six-week CK workshop on the written test performance among PE students in China. Accordingly, the following hypotheses were developed for evaluation:

- H₀1: There is no significant difference in the written test results on basic theoretical knowledge between the control and experimental groups of PE students in China.
- H₀2: There is no significant difference in the written test results on health promotion knowledge between the control and experimental groups of PE students in China
- H₀3: There is no significant difference in the written test results on physical movement knowledge between the control and experimental groups of PE students in China.
- H₀4: There is no significant difference in the written test results on the score of comprehensive CK between the control and experimental groups of PE students in China.

1.4.2 Specific Hypotheses

The specific objectives of this study examined the impact of the six-week CK workshop on the written test scores of Chinese PE students. The related particular hypotheses were:

- H₀1.1: There is no significant difference between the control and experimental groups in STD written test performance among PE students in China.
- H₀1.2: There is no significant difference between the control and experimental groups in TD written test performance among PE students in China.
- H₀2.1: There is no significant difference between the control and experimental groups in MEM written test performance among PE students in China.
- H₀2.2: There is no significant difference between the control and experimental groups in KMT written test performance among PE students in China.
- H₀3.1: There is no significant difference between the control and experimental groups in CVP written test performance among PE students in China.
- H₀3.2: There is no significant difference between the control and experimental groups in KMR written test performance among PE students in China.
- H₀4: There is no significant difference between the control and experimental groups in the comprehensive CK written test score performance among PE students in China.

1.5 Significance of Study

1.5.1 Theoretical Significance

The present study utilized Ward's and Devrilmez's theories as its reference. According to Ward's (2014) theory, workshop-based interventions improved teachers' CK (Ward, 2014). This finding was confirmed by Hasties' (2021) research, which inferred that a workshop could positively influence teachers' CK (Hastie, 2021). However, Ward's theory focused solely on the teacher, and the workshop did not focus directly on students. Since Ward's (2014) approach did not explore the effects of the workshop on students' written test performance, the current study expands on the theory in this aspect. The present study targeted the workshop intervention directly at PE students and their CK to explore whether it has a similar effect as the interventions for teachers.

In contrast, the previous study used different assessment methods. For example, using a questionnaire, Devrilmez's (2019) theoretical analysis evaluated students' CK using only 27 multiple-choice questions (E. Devrilmez et al., 2019). The present research contributes by using improved examination papers to assess students' CK. The examination paper included essays, memory questions (MAQs), multiple choice, true or false, and short answer questions. This assessment form is similar to the actual test and can better predict the students' written test achievement.

1.5.2 Practical Significance

The practical significance of the present study draws from Li et al.'s (2019) "Technical Movement Analysis and Instructional Step Design" and Sheng et al.'s (2021) "Basketball Teaching and Training: The Application of a Course Model Based on Real Combat Situations." Based on these references, a six-week CK workshop was designed for students (Li, 2019; Sheng et al., 2021).

The current study conducted the six-week workshop for PE students following a protocol based on the interventions for six different CK knowledge points. One CK knowledge point was to be completed per week during the 6-week intervention. The intervention order was: Week 1 - STD (i.e., basketball); Week 2 - TD (i.e., basketball); Week 3 - MEM (i.e., basketball); Week 4 -KMT (i.e., basketball); Week 5 - CVP (i.e., Track and Field); and Week 6 - KMR (i.e., Track and Field). Hence, future research on student-focused CK workshops may reference the present six-week workshop protocol. Moreover, PE teachers, coaches, and other PE training institutions may use the workshop as a guideline to develop their students' CK.

1.6 Delimitations

This study examined the effects of a six-week CK workshop on written test performance among Chinese graduates. Therefore, this study only covered college graduates in China, specifically fourth-year students majoring in PE. These students would eventually have to participate in teacher recruitment to become in-service teachers.

The present study focused solely on the workshop's impact on students' written test performance. CK is a specific subject matter taught by teachers to undergraduate college students. It is closely related to the content of the written test that PE students take for the teacher recruitment examination. Specifically, the assessment contains topics on PE training design, basketball class hours, teaching plan, energy supply system, movement, prescription, track and field venue planning, and basketball rules. Written test performance was the only variable used to measure students' CK in the present study. The examination paper utilized was sourced from the Ministry of Education China, which stipulated the examination paper's content which determined the research scope (Xia, 2010). As a result, the written test content set in this study is similar to standards set by the Ministry of Education in China.

1.7 Limitations

Various psychological factors, such as the student's learning motivation and learning fatigue, could have affected the results of this study's experiment. For example, according to Alexander (1983), individual learning motivation can influence student performance. During the experimental period, students could have been motivated at times but demotivated at other times, depending on emotions and mood.

To minimise the impact of these factors on the trial results, the researcher guided the students to maintain a good learning attitude. Publicity materials were distributed to the students before the experiment. The researcher also explained the importance of the research to stimulate the students' motivation to participate. Moreover, the six-week CK workshop was incorporated as an undergraduate elective. The students were informed that their performance in the six-week intervention plan would be assessed through courses. Hence, making the students more committed and motivated to join the study.

1.8 Definition of Terms

The essential terms used in this study are CK, written test performance, workshop, and PE student. This section provides the conceptual and operational definitions of these critical terms.

Content Knowledge (CK)

Conceptual Definition: Content Knowledge (CK) refers to the subject matter knowledge one needs to teach a subject (Ward, 2009). Specifically, it involves knowing how to perform an activity and what to teach during the activity (Ward, 2009; Ward et al., 2018). CK can be assessed by the number of courses taken, the grades obtained from content courses, and the standardized CK tests for specific subjects such as PE (Educational Testing Service [ETS], 2016).

Operational Definition: CK includes theories, principles, and concepts of PE that teachers must know to educate PE students (Li et al., 2019). The Chinese teacher recruitment examination is not limited to a specific course. Based on the outline of this teacher recruitment examination, CK is defined as basic theoretical, health promotion, and physical exercise knowledge (Li, 2016). CK is majoring in PE teaching, who are pre-service teachers (PE students) need knowledge (He, 2018).

Written Test (Performance)

Conceptual Definition: The written test is a test corresponding to the interview. It assesses the applicant's knowledge level and is administered on paper or through a computer as an exam. Thus, a test taker of the written test could respond to specific items by writing or typing within a given space on the test or a separate form or document (Li, 2022).

The written test performance is a piece of information, often a number, which conveys an examinee's performance on a test. It may formally be defined as a summary of the evidence contained in an examinee's responses to the items of a test related to the construct(s) being measured (Li, 2020; Yang, 2019).

Operational Definition: A test in which individuals must answer questions in writing. There are seven primary formats of written tests: multiple-choice, yes-no, matching, fill-in-the-blank, short answer and answer questions, and short essays. Each written test format has advantages and disadvantages (Xia, 2010). The multiple formats can effectively measure differences in writing quality and ability as tools to screen talent in qualification examinations (Mao, 2019a, 2019b). The written examination for recruiting PE teachers includes essays, memory, multiple choice, true or false, and short answer questions (Haibin et al., 2014).

Written test performance indicates an individual's ability to excel in an academic subject and gain the necessary skills and knowledge, as indicated by the written test scores obtained by students after their studies (Ma et al., 2009). This study's total written test performance was based on the sum of scores for the various questions, totalling 100 points (Ma et al., 2009).

Workshop

Conceptual Definition: A workshop may be defined as a specific working method that involves uniting people to acquire new knowledge, exchange experiences, demonstrate creativity, and find solutions to various problems (Ørngreen et al., 2017).

Operational Definition: An advantage of workshops is the possibility of processing various teaching content for students and teachers. Besides being more engaging and exciting for students, it provides teachers with the knowledge they would otherwise not gain through traditional teaching (Ørngreen et al., 2017). When utilized to teach PE, the workshop approach allows the interconnection of activities that encourage proper growth and development by achieving targeted educational goals (Jevtić et al., 2019). In addition, based on the CK acquired, the workshop focuses on improving written test achievements (Sheng, 2021). The critical developmental goal of the workshop is to enhance students' written test performance. This study focused on the workshop's effect on classroom studies, oral test exchanges, and written test performance of Chinese PE majors. The workshop was held once a week for three hours.

Physical Education Students (Pre-service Teacher)

Conceptual Definition: Physical Education, often abbreviated to Phys Ed. or PE, is taught worldwide in schools. It is usually conducted during primary and secondary education and encourages psychomotor learning in a play and movement exploration setting to promote health and physical fitness (Anderson, 1989; He et al., 2020).

Physical Education student: Majoring in PE teaching, who are pre-service teachers (PE students). A student who masters the basic theory of educational psychology, sports biological science, sports social science, and sports technology. By graduation, the student comprehensively masters essential technologies and PE skills while having established expertise in overall development. Furthermore, the student becomes competent in teaching PE, after-school sports training, sports department management, and scientific research (Li, 2016; Li et al., 2021).

Operational Definition: Physical education is not limited to primary and secondary education. Colleges and universities also teach PE in a four-year pedagogical undergraduate major known as the science of PE (Xia, 2010).

Physical education student: majoring in PE teaching, who are pre-service teachers (PE students). According to the "Sports and Health Teaching Reform Guidance Outline (Trial)," the student's length of study is four years, during which they must achieve 140

to 170 credits (Xia, 2010). The future employment goal of these students is to engage in teaching related to PE in schools or other educational institutions (Gu, 2013; Su, 2021). The PE students involved in the present study were pre-service PE teachers, which refers to students majoring in PE teaching in colleges and universities who will become on-the-job teachers after graduation (He, 2018).

Comprehensive Content Knowledge (Score of Comprehensive Content Knowledge)

Conceptual Definition: It is a comprehensive examination set up for the open recruitment of teachers in primary and secondary schools. The public subjects of the written examination are the vocational aptitude test and comprehensive application ability (*Interim Provisions on Public Recruitment of Public Institutions*).

Score of Comprehensive Content Knowledge: Score of Comprehensive Content Knowledge: Written test subject category, primary and secondary school teacher examination papers total score 100 points (*Interim Provisions on Public Recruitment of Public Institutions*).

Operational Definition: Comprehensive Content Knowledge includes: STD, TD, MEM, KMT, CVP, and KMR (Xia, 2010).

Score of Comprehensive Content Knowledge: Score of Comprehensive Content Knowledge= (STD +TD +MEM + KMT +CVP + KMR) score=100 (Xia, 2010).

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