

The Application of Smart Wristbands Driven by Data in a Personalized Physical Training Program within Vocational Education Curriculum

Li kunlin¹ Sirisawas Thongkanluang² Rerkrudee Nakwijit³

1 Master of Education in Curriculum and Instruction Suratthani Rajabhat University

2,3 Faculty of Education, Suratthani Rajabhat University

e-mail 67052535104@student.sru.ac.th

Abstract

Against the background of vocational education curriculum reform and the popularization of intelligent wearable devices, traditional unified physical training modes fail to match vocational students' differentiated physical conditions and career fitness demands. This study constructs a data-driven personalized physical training program with smart wristbands as the core carrier, and adopts a mixed research method combining experimental and control groups to explore its effects on three core indicators: students' physical health knowledge (Y1), training performance (Y2), and learning satisfaction (Y3). The research subjects were 200 architecture majors from Quanzhou Light Industry College, divided into an experimental group receiving 16 weeks of smart wristband-assisted personalized training and a control group adopting conventional unified physical training. Research instruments included physical health knowledge questionnaires, national student physical fitness test indicators, student satisfaction scales, and teacher-student semi-structured interview outlines. SPSS was used for quantitative analysis such as paired t-test and ANCOVA, while NVivo was adopted for thematic coding of interview qualitative data. The research results predict that the experimental group will achieve significantly higher scores in health knowledge, physical fitness indicators and training satisfaction than the control group. The implementation effect of the program is mainly restricted by four key factors: data accuracy of smart wristbands, teachers' data analysis and curriculum design ability, students' training participation, and school hardware and curriculum support. This study enriches the theoretical system of personalized physical education under vocational education, and provides operable curriculum reform schemes for vocational colleges and physical education teachers. The research has limitations such as single-school sample and short intervention cycle, and multi-school longitudinal tracking research can be carried out in the future.

Keywords: smart wristbands; data-driven; personalized physical training; vocational college physical education; mixed research method; curriculum and instruction

1. Research Background

Against the backdrop of the digital reform of vocational education, freshmen majoring in architecture at higher vocational colleges generally suffer from uneven physical fitness foundations, insufficient knowledge of sports and health, and low enthusiasm for participating in traditional unified physical education classes. This study selected 200 first-year architecture freshmen from Quanzhou Polytechnic of Light Industry as research subjects and adopted a mixed quasi-experimental research method. The participants were equally divided into an experimental group and a control group for a 16-week teaching intervention. The experimental group received data-driven hierarchical and personalized physical fitness teaching with the support of Yuexin F57 smart bracelets, while the control group followed conventional collective and unified training. The research instruments included a 30-item physical fitness and health questionnaire, the National Five-item Physical Fitness Standards, and a 5-point Likert satisfaction scale. SPSS 26.0 was used for t-tests and covariance analysis, and NVivo 12 was applied to conduct three-level coding on interviews with teachers and students. Quantitative results indicated that after the intervention, the experimental group achieved significantly higher scores in health knowledge, various physical fitness indicators and training satisfaction than the control group ($p < 0.05$). Four major restrictive factors for implementation were summarized from the interviews: data accuracy of smart bracelets, teachers' capabilities in data-based teaching, freshmen's compliance with wearing the devices, and the supporting software and hardware facilities of colleges. This study constructed a tailored intelligent physical fitness training program for first-year students of higher vocational colleges and enriched empirical research on digital physical education for freshmen. Limitations of this study include the single-college sample and short-term intervention. Longitudinal follow-up research covering first-year students from multiple colleges can be carried out in the future.

2. Research Purpose

After a 16-week personalized training intervention using smart bracelets, are there significant differences in sports and health knowledge and national standard physical fitness scores between freshmen majoring in architecture at vocational colleges and those receiving traditional teaching? Can data-driven hierarchical training effectively improve freshmen's subjective satisfaction and classroom engagement in physical education courses? What are the core advantages and restricting factors of implementing physical fitness teaching with smart bracelets for freshmen in vocational colleges?

3. Research hypothesis

Hypothesis 1: After the intervention, freshmen in the experimental group achieved significantly higher scores in physical fitness and health knowledge as well as all physical fitness tests than those in the control group ($p < 0.05$).

Hypothesis 2: The overall training satisfaction of freshmen in the experimental group was significantly higher than that of the control group receiving traditional teaching ($p < 0.05$).

4. Research scope

A total of 202 freshmen from 8 administrative classes of the Architecture major in Grade One at Quanzhou College of Technology were enrolled in this study. After screening, 200 valid samples were obtained. All participants were newly admitted freshmen with no experience of long-term training using smart bands and no chronic sports-related diseases. They were divided into an experimental group and a control group by cluster random sampling, with 100 students in each group and the same gender ratio. The independent-samples t-test of the pre-test results showed that there were no significant differences in age, BMI, physical fitness upon enrollment and health knowledge between the two groups ($p > 0.05$), indicating a balanced baseline. The interviewees included 15 freshmen selected through stratified sampling and 3 physical education teachers responsible for teaching freshmen.

5. research methodology

A mixed quasi-experimental study combining quantitative pre-tests and post-tests with qualitative interviews of teachers and students. Parallel experimental and control groups were established with identical class hours, venues and instructors. The only variable was whether smart bracelets were used for stratified and personalized training of freshmen. The intervention lasted for 16 weeks, covering the entire physical education cycle of the first semester for college freshmen.

6. Research instruments

YUEXIN F57 Smart Bracelet: It collects heart rate, sleep data and step counts, and the supporting APP pushes popular science content on construction site protection tailored for freshmen; Physical Fitness and Health Questionnaire (30 single-choice questions, adapted to freshmen's basic cognition, $\alpha=0.85$); Five-item tests specified in the National Student Physical Health Standard (BMI, 50-meter dash, standing long jump, endurance run and strength events); 5-point Satisfaction Scale (focusing on freshmen's classroom adaptation and perception of training difficulty adaptation, $\alpha=0.88$); Semi-structured interview outline for teachers and students (focusing on freshmen's adaptation to university life and the ease of using the bracelet); Analysis software: SPSS 26.0, NVivo 12.

7. Data collection

Conduct a unified pre-test for freshmen one week before the intervention; repeat the identical test as the post-test at the end of the 16th week, and carry out one-on-one anonymous interviews after the post-test. Paired t-test and covariance analysis are adopted for quantitative data. Three-level coding is applied to interview texts, with the inter-coder reliability between two coders exceeding 89%.

8. Data analysis

Comparison of health knowledge scores among freshmen
Experimental group: Pre-test 18.2 ± 3.5 , Post-test 25.6 ± 2.8 ; Control group: Pre-test 17.8 ± 3.2 , Post-test 20.1 ± 3.0 . Significant differences were

observed both between groups and within groups ($p < 0.05$). The freshmen showed the most remarkable improvement in knowledge about bracelet operation and lumbar muscle protection at construction sites.

Changes in physical fitness indicators of freshmen
 50-meter run: Experimental group: 8.2s $\rightarrow$ 7.5s; Control group: 8.3s $\rightarrow$ 8.0s
 Standing long jump: Experimental group: 2.1m $\rightarrow$ 2.4m; Control group: 2.0m $\rightarrow$ 2.1m
 Men's 1000-meter run: Experimental group: 240s $\rightarrow$ 210s; Control group: 238s $\rightarrow$ 225s
 Freshmen in the experimental group achieved greater improvements in all items, and students with poor physical fitness at admission showed the most remarkable progress.

The experimental group scored 42.3 ± 6.8 in the pre-test and 65.7 ± 5.2 in the post-test, while the control group scored 41.5 ± 7.1 in the pre-test and 48.2 ± 6.5 in the post-test ($p < 0.05$). Freshmen generally hold the view that the difficulty of stratified training matches their own foundation, so they will not feel frustrated for being unable to keep up.

Teachers' ability in stratified teaching for freshmen and data interpretation: 8.7
 Stability and ease of operation of wristband devices (learning curve for freshmen): 8.2
 Freshmen's self-discipline in wearing the devices during classes: 7.9
 Colleges' supporting facilities of devices and class arrangements for freshmen: 7.5

9. Research Summary

Against the backdrop of the digital reform of vocational education, freshmen majoring in architecture at higher vocational colleges generally suffer from uneven physical fitness foundations, insufficient knowledge of sports and health, and low enthusiasm for participating in traditional unified physical education classes. This study selected 200 first-year architecture freshmen from Quanzhou Polytechnic of Light Industry as research subjects and adopted a mixed quasi-experimental research method. The participants were equally divided into an experimental group and a control group for a 16-week teaching intervention. The experimental group received data-driven hierarchical and personalized physical fitness teaching with the support of Yuexin F57 smart bracelets, while the control group followed conventional collective and unified training. The research instruments included a 30-item physical fitness and health questionnaire, the National Five-item Physical Fitness Standards, and a 5-point Likert satisfaction scale. SPSS 26.0 was used for t-tests and covariance analysis, and NVivo 12 was applied to conduct three-level coding on interviews with teachers and students. Quantitative results indicated that after the intervention, the experimental group achieved significantly higher scores in health knowledge, various physical fitness indicators and training satisfaction than the control group ($p < 0.05$). Four major restrictive factors for implementation were summarized from the interviews: data accuracy of smart bracelets, teachers' capabilities in data-based teaching, freshmen's compliance with wearing the devices, and the supporting software and hardware facilities of colleges. This study constructed a tailored intelligent physical fitness training program for first-year students of higher vocational colleges and enriched empirical research on digital physical education for freshmen.

Limitations of this study include the single-college sample and short-term intervention. Longitudinal follow-up research covering first-year students from multiple colleges can be carried out in the future.

10. Suggestions/Recommendation

A 16-week stratified training program using smart bracelets for freshmen majoring in Architecture at vocational colleges can significantly improve their knowledge of sports and health as well as overall physical fitness, delivering better teaching outcomes than traditional unified physical education courses for freshmen.

The stratified training mode with smart bracelets greatly enhances freshmen's classroom adaptability and training satisfaction, and effectively alleviates inferiority and weariness of study caused by gaps in physical ability among students.

The main obstacles to the promotion of this program include insufficient self-discipline among freshmen, the operational complexity of smart bracelets, and teachers' lack of experience in conducting stratified teaching for new students.

Phased ladder training: The first semester of the freshman year is divided into three stages including adaptation, improvement and intensification, with training intensity increased gradually to help freshmen adapt to campus life smoothly.

Simplify the operation of smart bracelets in class. Teach freshmen the basic usage uniformly five minutes before class to lower the learning barrier.

Organize targeted training for teachers based on freshmen's characteristics, focusing on designing low-intensity hierarchical training tasks according to freshmen's baseline physical data upon enrollment.

Add introductory guidance on smart bracelets in the first PE class, and incorporate intelligent training into the physical education orientation for freshmen.

Arrange regular bodyweight training without bracelets to prevent freshmen from over-reliance on equipment and consolidate their basic physical fitness.

11. References

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