Influence of Sports App Usage on the Exercise Adherence of University Students

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Abstract—Students from two classes of freshmen accounting majors enrolled in the School of Economics and Management, an undergraduate university in Zhumadian City, Henan Province, China, were chosen as respondents. The Administration Class 1 was used as the experimental class, which adopted sports application (app)-assisted teaching. The Administration Class 2 was used as the control class. The study results showed that the control group only achieved significant paired samples t-test of pre-test and post-test scores in terms of exercise durability ($P = 0.007$***) and exercise efforts ($P = 0.060$*). In comparison, the experimental group achieved obvious improvement in terms of exercise durability, exercise interest, value judgment, cognitive selection, and exercise efforts ($P < 0.01$***). Obvious differences were also observed in the exercise adherence ($P < 0.01$) post-test scores between the experimental and control groups. These findings prove that the intervention of "sports app + sports teaching" has positive effects on students' exercise adherence. The research conclusions serve as important references in disclosing the influencing mechanism of using a sports app to improve university students' exercise adherence, attitudes and behaviors toward physical exercises while using the app. The app can also help students develop scientific exercise habits and strengthen their health management consciousness.

1 Introduction

Internet technology has become increasingly integrated into the daily lives and work of many people, increasing their use and acceptance of the mobile learning mode. Rapid technological development has brought huge reforms to modern society and has even penetrated the field of sports at the highest speed. Traditional sports teaching can no longer meet students' pursuit for sports, and it is expected that modern science and technological teaching will gradually replace traditional sports teaching. The new mobile learning mode can not only increase learning motivations and learning engagement, but also further encourage learners' physical exercise behaviors. In turn, this improves their attitudes toward and achievements in physical exercises.

At present, the extensive use of smart phones has helped promote the rapid growth of mobile phone applications (i.e., "apps") in terms of the increase in categories and quantity. Mobile apps have become completely integrated into people's lives, helping them conveniently solve problems and perform tasks in various fields, such as working, entertainment, learning, and so on. Thus, people have become increasingly dependent on these mobile apps. With the support of national policies and strong market demands, sports apps that combine sports and Internet and smart phone technology have been introduced into the sports industry. At present, university students are given increasing requirements related to sports and physical exercise. However, the traditional sports development mode is no longer applicable to such students. Meanwhile, sports apps are a kind of unique software that integrates emerging scientific technology and provides various functions to university students. Furthermore, these students have relatively advanced ideas and innovation abilities. Thus, sports app developers have designed various functions according to the diverse sports demands of university students to strengthen their enthusiasm for physical exercises.

Sports apps based on mobile Internet can effectively record the exercise and health data of mobile users using database technology, thus popularizing sports health knowledge among users through the front interface and helping them establish accurate concepts of physical exercises, and form good behavioral habits related to them. Indeed, the popularity of mobile sports apps has changed the teaching development of universities to some extent. In the current Internet environment, sports apps can effectively improve teaching efficiency and the methods of teaching sports. On the one hand, the applied pressure (e.g., academic burden) is a factor that influences the participation of university students in sports. On the other hand, the enthusiasm of these students to engage in physical exercises is influenced significantly by the limited space and devices in schools. Related to this, the organic integration of sports apps and "Internet+" with sports teaching brings some spatial and temporal opportunities for university students to participate in physical exercises. Such students can acquire the latest sports information from sports apps, thus enriching their own sports knowledge. With the help of such apps, university students can formulate personalized sports schemes according to their hobbies and exercise habits. With the help of video coaching, university students can then strengthen their exercise skills. Furthermore, by communicating with sports fans on the Internet and establishing the mode of "sports APP +sports teaching," this can not only train sports teachers to embrace new teaching philosophies, such as establishing the educational teaching philosophy of modernized development, but also improves the quality of their classroom teaching. In turn, this changes the traditional teaching concept, increases students' interests in physical exercises, and improves their exercise adherence.

2 Theoretical basis and literature review

2.1 Theoretical basis

Human behavior is the dynamic response of people who engage in psychological activities, such as cognition, thinking ability, emotion, and willingness to adjust

to internal and external environmental factors. The essence of improving the exercise levels of individuals is to modify their individual behaviors. Hence, most studies concerning people's motivation to participate in exercises in their spare time or their pre-mechanism understandings are based on various psychological behavioral change models.

For example, the health belief model (HBM) proposed by Glanz, K et al. [1] is a very mature theoretical framework that studies the health behaviors of humans at a relatively early stage in their lives. It has strong explanatory power in relation to health-related behaviors and behavioral intervention. HBM is mainly composed of six aspects: perceived susceptibility, perceived seriousness, perceived benefits, disturbance of perception, cues to action, and self-efficacy. Sports apps strengthen the feelings and experiences of users and make exercising easier by providing various functions, such as target setting, customization, real-time feedback, rewards, and group interactions. Most of the existing studies in this field have demonstrated the role of sports apps in improving exercise level and developing the exercise habits of human beings. Moreover, the development and perfection of the functions and features of sports apps has increased exercise frequency and the time people spent on sports activities. They have also shown positive effects on improving the self-efficacy of physical exercises and decreasing the disturbance of perception to exercises. In particular, introduction to the importance of physical activities, goal setting, real-time feedback, social support, and online consultation functions of sports apps are viewed as the most useful strategies that encourage changes in physical activities. However, the behavioral change mechanism corresponding to each function has not yet been explored.

2.2 Literature review

Many studies on sports apps have been conducted, because they are developed with the extensive application of smart phones. In 2010, as smart phones penetrated people's daily lives, more and more sports- and education-related scientific researchers have investigated how sports apps can influence physical exercises, sports teaching, and sports performances. With the continuous exploration and innovation of developers, more functions are added to improve user experiences comprehensively. Apps can improve the exercise enthusiasm of their users by combining exercises and social communication. Users can also establish more social relationships by making friends through exercise activities.

Some scholars have also investigated how sports apps influence the exercise adherence of university students. For example, Lin, C. T et al. [2] investigated the use of sports apps and the influence of object orientation on sports behaviors. They found that the use of sports apps plays an important role in object orientation and strengthens learners' motivations to engage in physical exercises. Qi, X et al. [3] investigated the extensive use of sports apps in the digital era and found that users have significantly different demographic characteristics and that their participation motivation, satisfaction, and loyalty are highly correlated. Rospo, G et al. [4] demonstrated that the user interface of a cardio fitness app is improved through more heartbeat training. Ren, K et al. [5] found that apps have become a daily necessity due to the sharp growth of mobile intelligent terminals and fast coverage of wireless networks.

App-assisted sports teaching in universities can offset the blind pursuit for sports behaviors and improve university students' attitudes and consciousness and how they value sports. Based on technology acceptance model and sports websites acceptance model, Ha, J. P et al. [6] analyzed university students' cognition and degree of acceptance of app-assisted sports teaching. Meng, L et al. [7] conducted a comparative analysis of pre-, in-, and post-monitoring data on a popular running app (i.e., sports world campus app) in relation to the physical exercise activities of university students after classes. The study results showed that the weekly average running times of university students and the proportion of sports population during the in- and post-monitoring periods of the app increased significantly. Furthermore, after three years of monitoring, the weekly average running times increased year by year. Meanwhile, Balsalobre-Fernández, C et al. [8] analyzed the validity and reliability of an iPhone-based app for sports activities. The study results showed that the app can evaluate learners' sports performances in a convenient, accurate, and reliable manner. Damberg, S [9] investigated 591 respondents from the UK and analyzed data using the partial least squares structural equation modeling. The study results proved that habits, perceived gameplay, health consciousness, perception performances, and price value are factors that explain the intention of using fitness apps in the future.

Meanwhile, Modave, F et al. [10] demonstrated that app-assisted sports teaching can improve the quality of mobile sports teaching and some teaching measures to enhance the effects of sports app-assisted teaching. Holzer, R et al. [11] investigated the influences of sports apps on sports and exercise functions and analyzed the answers of 167 patients with T1DM. The study results showed that health data further integrated by other apps on smart phones can assist in the improvement of the therapy effect. Gao, X [12] analyzed the influences of mobile sports apps on the sports behaviors of university students and found that these apps can effectively facilitate various physical exercise behaviors. Rubio, V. J et al. [13] concluded that sports injuries can be decreased effectively by developing a sports app that can provide accurate and scientific sports information to users. Balsalobre-Fernández, C et al. [14] discovered that sports apps might have precious practical applications to coaches who want to measure the speed and power of users during bench press exercises. Vriend, I et al. [15] developed an app to prevent ankle sprain relapse and found that users have high evaluations of its correlation, definition, practicability, attraction, information, and reliability. Furthermore, the accurate use of APP has important value to electronic health care and mobile health care tasks in the nursing and injury prevention of athletes. Finally, Wei, W et al. [16] concluded that a basketball training teaching app can improve the teaching effect and train students' learning interests and learning consciousness in class. Moreover, the academic performances of the experimental group using app-assisted teaching are significantly better than those of the control group, showing obvious differences.

According to existing studies, mobile sports apps have series of novel and attractive intervention strategies that have advantages and potential in promoting physical activities and improving public health among individuals. Many studies have explored the intervention mechanism and intervention ability of sports apps in sports exercises through randomized controlled trial study designs. Meanwhile, various research conclusions have pointed out that sports apps mainly spread information and sports news,

images, videos, and texts based on the terminal carrier of smart phones. Thus, these app can help users record their excise and fitness data, guide them to take physical exercises, and popularize the concept of healthy living. Hence, sports apps can also play a positive role in improving the psychological health of modern people by helping users release life pressure and eliminate unhealthy emotions.

3 Methodology

3.1 Research objects

In this study, the influences of sports app-assisted teaching on university students' exercise adherence were investigated. Students from two classes of freshmen accounting majors (28 males and 62 females) enrolled in the School of Economics and Management, an undergraduate university in Zhumadian City, Henan Province, China, were chosen as respondents. The Administration Class 1 was used as the experimental class, which adopted sports app-assisted teaching and included 45 respondents (30 females and 15 males). The Administration Class 2 was used as the control class, which included 45 respondents (32 females and 13 males).

3.2 Experimental process

In the early test, exercise adherence scale surveys of the experimental and control groups were implemented by using the questionnaire formulated by Sun Derong et al. [17], authorities in the field of China's sports research. The questionnaire covers 20 items under five dimensions: exercise durability, exercise interest, value judgment, cognitive selection, and exercise efforts. The scale used a 5-point Likert scale ranging from 1 ("strongly agree") to 5 "strongly disagree". The Cronbach's α of this questionnaire was 0.854, conforming to the research requirements of this study. The scores of the two groups in all five dimensions of exercise adherence were acquired through early testing. In the experiment, the experimental and control groups had the same places and equipment for classes. The teaching experiment lasted for 1–16 weeks with 2 class hours per week for a total of 32 class hours. The experimental group used a sports app (Codoonsport), which is often used in universities in China to assist sports teaching. Assisted by this app, they can clearly understand relevant image-text and videos and establish action representation in their minds. During the preview of image-text or videos on Codoonsport, students can directly propose questions and clarify doubts in the teaching group. They can discuss with classmates or independently ask teachers, who can provide them answers. Teachers can also explain and demonstrate actions by using the teaching videos on Codoonsport, while students can further understand by themselves the required actions according to the information found in videos and exercises. In comparison, the control group followed the traditional sports teaching process. After the 16-week experiment, the exercise adherence rates of both groups were tested by a scale, and relevant mathematical statistical analyses were carried out.

4 Results analysis and discussion

4.1 Comparison between the control and experimental groups in term of pre-test scores

Table 1. Independent samples t-test results after comparing the pre-test scores of the control and experimental groups

Test Items	T Value	P Value
Exercise durability	0.52	0.607
Exercise interest	−0.16	0.870
Value judgment	−0.82	0.413
Cognitive selection	0.82	0.412
Exercise efforts	−0.57	0.569

First, an independent samples t-test was performed to compare the pre-test scores between the experimental and control groups. It can be seen in Table 1 that the significance of P values corresponding to the T values of exercise durability, exercise interest, value judgment, cognitive selection, and exercise efforts are all higher than 0.05. All of these are below the significance level, indicating that there are no significant differences between the groups in terms of their pre-test scores. Furthermore, their exercise adherence is relatively close. This ensures that only the differences of teaching mode between the experimental and control groups exist, while the influences of objective factors are excluded. Hence, the differences between two classes in exercise adherence are not significant before the experiment, thus conforming to the conditions for this teaching experiment.

4.2 Analysis of the pre- and post-test scores of the control group

Table 2. Paired samples t-test results after comparing the pre- and post-test scores of the control group

Test Items	Scores	Means	Standard Deviation	Mean Standard Error	T Value	P Value
Exercise durability	Pre-test scores	3.3844	0.2845	0.0424	2.83	0.007***
	Post-test scores	3.5762	0.3789	0.0565		
Exercise interest	Pre-test scores	3.5064	0.3090	0.0461	1.20	0.236
	Post-test scores	3.5920	0.3359	0.0501		
Value judgment	Pre-test scores	3.4842	0.2833	0.0422	0.78	0.439
	Post-test scores	3.5377	0.3388	0.0505		
Cognitive selection	Pre-test scores	3.4641	0.2952	0.0440	1.57	0.124
	Post-test scores	3.5801	0.3736	0.0557		
Exercise efforts	Pre-test scores	3.6474	0.3177	0.0474	1.93	0.060*
	Post-test scores	3.5193	0.2885	0.0430		

Notes: *significance under the 10% significance level; ***significance under the 1% significance level.

It can be seen from Table 2 that the exercise durability, exercise interest, value judgment, cognitive selection, and exercise efforts of the control group all improved to some extent. Specifically, the pre- and post-test scores of exercise durability and exercise efforts are significant under the 1% and 10% significance levels, respectively. This might be due to the fact that the exercise durability and exercise efforts of the control group are improved after one-semester of traditional sports teaching. In this teaching mode, teachers offer students a relatively relaxed teaching atmosphere and do not expand the sports knowledge of their students. Hence, the scores of exercise interest, value judgment, and cognitive selection are not improved greatly.

4.3 Analysis of the pre- and post-test scores of the experimental group

Table 3. Paired samples t-test results after comparing
the pre- and post-test scores of the experimental group

Test Items	Scores	Means	Standard Deviation	Mean Standard Error	T Value	P Value
Exercise durability	Pre-test scores	3.4158	0.2925	0.0436	−11.25	0.000***
	Post-test scores	4.0185	0.3380	0.0504		
Exercise interest	Pre-test scores	3.4963	0.2713	0.0404	−10.05	0.000***
	Post-test scores	4.0489	0.3710	0.0553		
Value judgment	Pre-test scores	3.4358	0.2748	0.0410	−11.93	0.000***
	Post-test scores	4.0451	0.3943	0.0588		
Cognitive selection	Pre-test scores	3.5110	0.2417	0.0360	−12.20	0.000***
	Post-test scores	4.1408	0.4252	0.0634		
Exercise efforts	Pre-test scores	3.4826	0.3199	0.0477	−13.21	0.000***
	Post-test scores	4.1645	0.4461	0.0665		

Note: ***significance under the 1% significance level.

As shown in Table 3, the exercise durability, exercise interest, value judgment, cognitive selection, and exercise efforts of the experimental group are all obviously improved. This can be attributed to several reasons. First, after the one-semester experiment of using the sports app-assisted teaching mode, the app has promoted the exercise durability of the university students. The long-term and high-frequency use of the sports app improved their exercise interests as well. On the one hand, the app expanded the students' sports information and provided them with more effective inspirational biography of sports. On the other hand, the app positively influenced their value judgment. Second, with the increase of usage time and usage frequency, the sports app improved students' cognitive selection of sports. Those who used the sports app longer and more frequently developed better cognitive selection, enabling them to choose physical exercises conforming to their own physical and psychological features. Third, the sports app featured numerous exercise videos and individual sharing videos, which helped the users to more fully understand the essence of physical exercises and improve their exercise efforts.
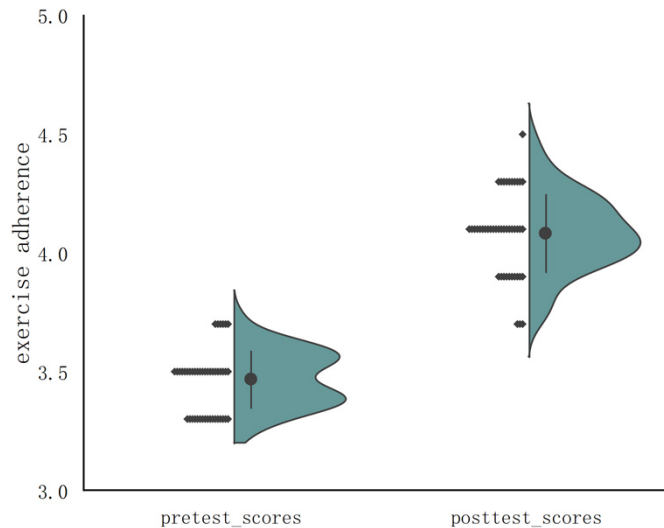
Fig. 1. Comparison between the university students'
pre- and post-test scores in exercise adherence

The students' exercise adherence scores were evaluated by the average scores of exercise durability, exercise interest, value judgment, cognitive selection, and exercise efforts. The differences between the pre- and post-test scores of the experimental group were further analyzed. As shown in Figure 1, the intervention that combines "sports APP+sports education" can stimulate students' interest in physical exercises, improve their physical exercise behaviors, and help them achieve positive self-esteem and satisfaction under the intervention of sports teaching. Due to the indirect monitoring of resources on the sports app and through the teachers, students can positively participate in physical exercises during and after class.

Furthermore, the sports APP can bring students a sense of prides, achievement, and social communication, while also improving the exercise effects. In the long-term exercise environment, students can take exercising as a conscious exercise behavior, in which physical exercises have become a type of relatively stable dynamic stereotype. Other factors, such as knowledge of physical exercise, support from partners, and relatively fixed exercise partners, can all improve students' exercise adherence in varying degrees.

4.4 Comparison of post-test scores between the control and experimental groups

Table 4. Results of the independent samples t-test

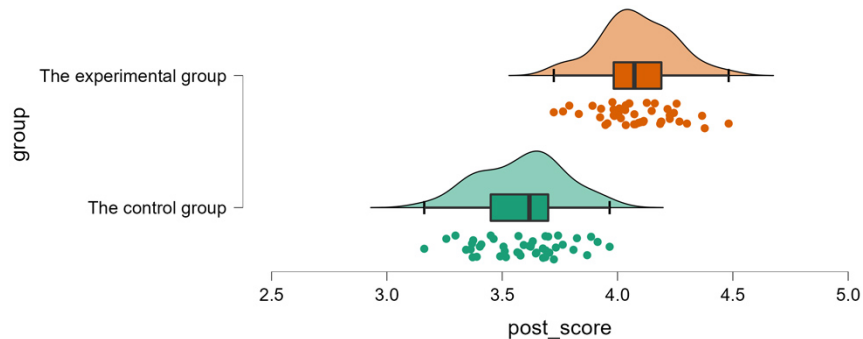| Test Items	*t*	*df*	*p*	Cohen's *d*
Post-test of exercise durability	5.841	86.848	<0.001	1.231
Post-test of exercise interest	6.131	87.194	<0.001	1.293
Post-test of value judgment	6.538	86.025	<0.001	1.378
Post-test of cognitive selection	6.654	86.544	<0.001	1.403
Post-test of exercise efforts	6.338	79.527	<0.001	1.336

Note: Welch's t-test.

Fig. 2. Post-test scores of the control and experimental groups

As shown in Table 4, there are obvious differences between the experimental and control groups in terms of their post-test scores in exercise durability, exercise interest, value judgment, cognitive selection, and exercise efforts. After the 16-weeek teaching experiment, a questionnaire survey on university students' exercise adherence was performed again. According to the independent samples t-test results, the physical quality of the experimental group under the combination of sports app and teaching is better than that of the control group. In the repeated measurement analysis of variance (ANOVA), the P value is smaller than 0.01, indicating significant differences between the two groups in terms of exercise durability, exercise interest, value judgment, cognitive selection, and exercise efforts. Therefore, this finding proves that the "sports APP+sports teaching" intervention has positive influences on the exercise durability of students. Meanwhile, the average scores of exercise durability, exercise interest, value judgment, cognitive selection, and exercise efforts were collected to determine the exercise adherence of the experimental and control groups. The post-test scores in exercise adherence of both groups shown in Figure 2 indicate that the exercise adherence of the experimental group is far better than that of the control group.

4.5 Discussions

With the continuous development of sports app, they can provide encouragement and reminding functions, exercise plans, social communication functions, and data recording. These functions may improve the ability of university students to participate in physical exercises. For instance, the encouragement and reminding function can enhance loyalty, help them overcome their reluctance, and urge them to perform physical exercises. Moreover, through sports apps, university students can formulate exercise plans that conform to their physical exercising needs, thus making them more customized. Schools can also use sports apps to encourage university students to participate in physical exercises (Courneya, K. S et al. [18]).

Generally, university students lack professional guidance, systematic exercise plans, and explicit goals while exercising in their spare time; which may discourage them from being physically active during this time. Thus, schools can organize some physical exercise activities or competitions according to practical situations by combining

the functional characteristics of sports apps, thus encouraging more university students to participate in physical exercises during their free time while enriching their campus experiences.

With the popularization of smart phones and Internet technology, the quantity of sports apps is increasing day by day. However, sports apps on the market face certain problems, such as serious homogenization, inaccurate data recording, weak user loyalty, and so on (Jung, H. Y et al. [19]). These problems may influence user selection and usage. Hence, developers must study and develop innovative and unique functions to further improve user experiences. The development of sports apps tend to be a professional process. Apart from running and riding apps, apps for power training and speed training can also be perfected continuously so that they can meet users diverse exercise needs. In turn, the continuous perfection in the types and functions of sports apps can enhance students' exercise adherence.

The experimental study on sports teaching for university students fully proves that improvement of the experimental group in terms of exercise durability, exercise interest, value judgment, cognitive selection, and exercise efforts, all of which are significantly better than those of the control group. Thus, the intervention of sports app + sports teaching mode is conducive to improving the exercise adherence of students. During daily exercises, university students can use a sports app, which promotes exercise behaviors and motivations to some extent. University students can also consider establishing a daily physical exercise system, consisting of a sports app or an exercise clock-punch system in schools, which can promote exercise behaviors and habits. Furthermore, sports apps and various smart devices must be optimized and updated according to user feedback, thus enriching app contents and improving usage experiences.

5 Conclusions

New technologies, such as artificial intelligence and Internet-of-Things have penetrated the education industry at present. In particular, with the rapid technological development, great changes have taken place in sports learning behaviors of university students. Related to this, sports app-assisted teaching has become increasingly popular and strengthening exercise levels among students has become a major goal of educational administration. Due to popularization of smart phones and fresh experiences of university students brought about by the usage of sports apps, sports app-assisted teaching is a good intervention to introduce ubiquitous learning.

A comparative experimental study on students from two classes of freshmen accounting majors in the School of Economics and Management, an undergraduate university in Zhumadian City, Henan Province, China, was conducted. The experimental group used the sports app-assisted teaching, while the control group used the traditional teaching mode. Some major conclusions could be drawn. (1) In terms of their pre-test scores, the P values of exercise durability, exercise interest, value judgment, cognitive selection, and exercise efforts of the experimental and control groups are all higher than 0.05, indicating no significant differences between the two groups in their pre-test scores. (2) For the control group, the paired samples t-test results after comparing their pre- and post-test scores are only significant in exercise durability ($P = 0.007***$) and

exercise efforts (P = 0.060*). The exercise durability, exercise interest, value judgment, cognitive selection, and exercise efforts of the experimental group showed obvious improvement (P < 0.01***). (3) There is an obvious difference in the post-test scores in exercise adherence between the two groups (P < 0.01).

These findings prove that a sports app-based teaching intervention can greatly improve students' exercise adherence. Thus, it is suggested that further investigations must be conducted on the influencing mechanism of sports apps on university students' exercise behaviors (e.g., by introducing more variables). The specific roles of different types and functions of apps on the exercise adherence of university students can also be considered. Finally, future studies may want to examine how increasing exercise levels among individuals using a sports app can lead to improvements in public health conditions.

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