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**Portable Exercise Equipment for Chinese Middle School Students to
Stimulate their Interest in Exercise**

By

Bowen Zhang

A Thesis submitted
in Partial Fulfillment of the Requirements
for the Degree of
Master of Fine Arts in Industrial Design

School of Design
College of Art and Design
Rochester Institute of Technology
Rochester, NY

May 2, 2022

Thesis Committee

Prof. Lorraine Justice – Chief Advisor

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Keywords:

Exercise equipment, assembled exercise equipment, portable exercise equipment, physical education for students, exercise motivation for students

Abstract:

This study was intended to explore how to enhance Chinese junior high school students' interest in physical education classes and develop lifelong exercise habits through assembled multifunctional exercise equipment. By combining traditional exercise equipment with interactive software, new teaching possibilities for physical education for middle school students were explored. For this case study, the test participants were physical education teachers and students in China. By comparing the designed exercise models with traditional exercise equipment in terms of functionality, material comfort, and attractiveness, the discussion results showed that students had a positive relationship between enhancing physical activity and using the new equipment but showed hesitation in introducing the new teaching system by the instructors. Future research is needed into the physical education systems in China for middle-grade students to further understand their motivations for exercise.

Introduction:

Obesity among adolescents and children is a growing problem in China. Physical activity for young children requires proper guidance, and schools need to promote physical activity for students by improving facilities and teaching. According to China CDC: China's children and youth aged 6-17 are overweight and obese at a rate of nearly 20%. All the research shows exercise is necessary for teenagers; however, only 29.9% of children met the physical activity guidelines that require at least 60 minutes of exercise per day adolescents(Liu, 2019). Research in this area showed that the physical education systems in China need to increase students' motivation for exercise, meet their daily exercise intensity, and develop good habits of lifelong exercise. It was proposed that research and a design project should be conducted in this area because most of the existing physical education curriculum is boring and uninspired, physical education facilities are not updated, and school policies have restrictions on some advanced technology products.

Problem Statement:

Chinese middle school students lose their enthusiasm for exercise due to the boring content of physical education classes and the pressure of physical testing. Therefore, it is necessary to design a teaching system to enhance Chinese middle school students' exercise experience and help them develop lifelong exercise habits.

Project Overview:

A teaching system named Fitpro was designed to enhance Chinese middle school students' exercise intensity & help them develop lifelong exercise habits. Fitpro is comprehensive exercise equipment and system Chinese middle school Physical Education (PE) teachers can use during classes. This product set includes a portable organized case, handles, assembled parts, and an app.

As a case study, I chose to do a project that is a set of portable and self-assembled exercise equipment, including two fitness wheels, two smart handles, two connecting tubes, two cordless jump rope connectors, two elastic bands connectors, and one packing box. This equipment is also equipped with an intelligent interactive system for teaching. The two fitness wheels can be connected with the handle for strength training and combined with the connection tube used as a yoga ring. The handle is connected to the other connectors through quick-release pins, which the connected parts can be unlocked with a single button. In addition to the storage function, the box can also be used as a piece of stand-alone exercise equipment. Connecting the handles with other functional connectors can achieve different exercise effects and stimulate students' interest in exercise through combinations.

Figure 1: Final design model



Study on the current situation of the physical education system in China

Since the reform and opening up in the 1970s, China has increased the importance of physical education for students, and the Ministry of Education is constantly updating scientific education policies. The overall situation of physical education in Chinese schools is good, but there are still shortcomings. The main shortcomings are the formalization of physical education examinations, the unreasonable arrangement of the physical education curriculum, and the inadequacy of venues and facilities.

In recent years, physical education exams have been included as an additional test for junior high school students, with differences in the content of the exams due to different policies in each region. The exams cover ball throwing, standing long jump, running, rope skipping, and pull-ups. The original intention of this policy was to increase the importance of physical education in schools and improve students' overall physical fitness. However, schools have ignored the intrinsic meaning of the policy in order to respond to the test and focus on improving students' test scores. Physical education exams tend to be formalized, and students' physical education scores are 90% perfect, failing to achieve a normal

distribution. (Yang and Zhang,2020) Some schools even falsify their PE scores to ensure the school promotion rate.

In some schools, the content of physical education classes is not well organized; for example, the teaching methods are boring and do not stimulate students' interest in exercise. Many courses only teach students some single movements or directly choose free activities, which leads students to be in a passive state and cannot promote students' interest in physical exercise but rather generate antipathy. Other teachers are afraid of students' injuries and complaints from parents, and hence the content of physical education classes is not complex, intense, or competitive. (Yang and Zhang,2020) Activities in physical education classes cannot be enhanced, leading to a significant decrease in teaching effectiveness.

Many schools also have limited space and inadequate exercise equipment. Physical exercise requires adequate space, yet most junior high schools in China's second and third-tier cities do not have indoor gymnasiums, making it impossible for students to complete physical exercise outdoors when it is raining. More small rural schools do not even have rubber playgrounds. Due to schools' limited resources, they cannot provide a full range of sports equipment, and some of the sports equipment is worn out due to periodic maintenance, which increases safety risks to a certain extent. Many unfavorable factors have led to the need for new changes in China's physical education system. The government needs to develop a better mechanism for entrance examinations, school authorities should better implement government policies, and schools should actively improve the corresponding venues and equipment.

Factors that cause students to lose interest in exercise

There are many reasons why students lose interest in exercising: school factors, time factors, and family factors. The school factor dominates the loss of interest in exercise. In a survey of students' attitudes toward physical education classes in some schools in Tianjin, it is shown that there are severe problems with the organization of physical education classes, only 22.39% of schools adopt an exquisite teaching style, and most schools have the problem of coping with the formality of teaching. (Cao,2018) Students indicated that schools focus too much on the education of cultural content and not on the development of student's physical and mental aspects, and students cannot develop sports interests and

habits except for the tedious completion of training goals. In a survey of the teaching site equipment facilities in four schools, Fuxing Middle School, Nankai Middle School, Tianjin Middle School, and No. 2 Middle School in Tianjin, it was found that the teaching facilities were not complete, and some equipment was equipped as required but did not achieve the desired results. (Cao,2018)

Chinese junior high schools are generally busy with schoolwork, resulting in students not having extra time and energy for physical activity every day. Many students cannot meet the required daily exercise time, and a few schools have cultural teachers who take up physical education classes. Many students are pressured to go on to higher education and will give priority to cultural studies and physical education. In the students' spare time, the percentage of tutorial classes for cultural subjects is much more significant than hobby activities.

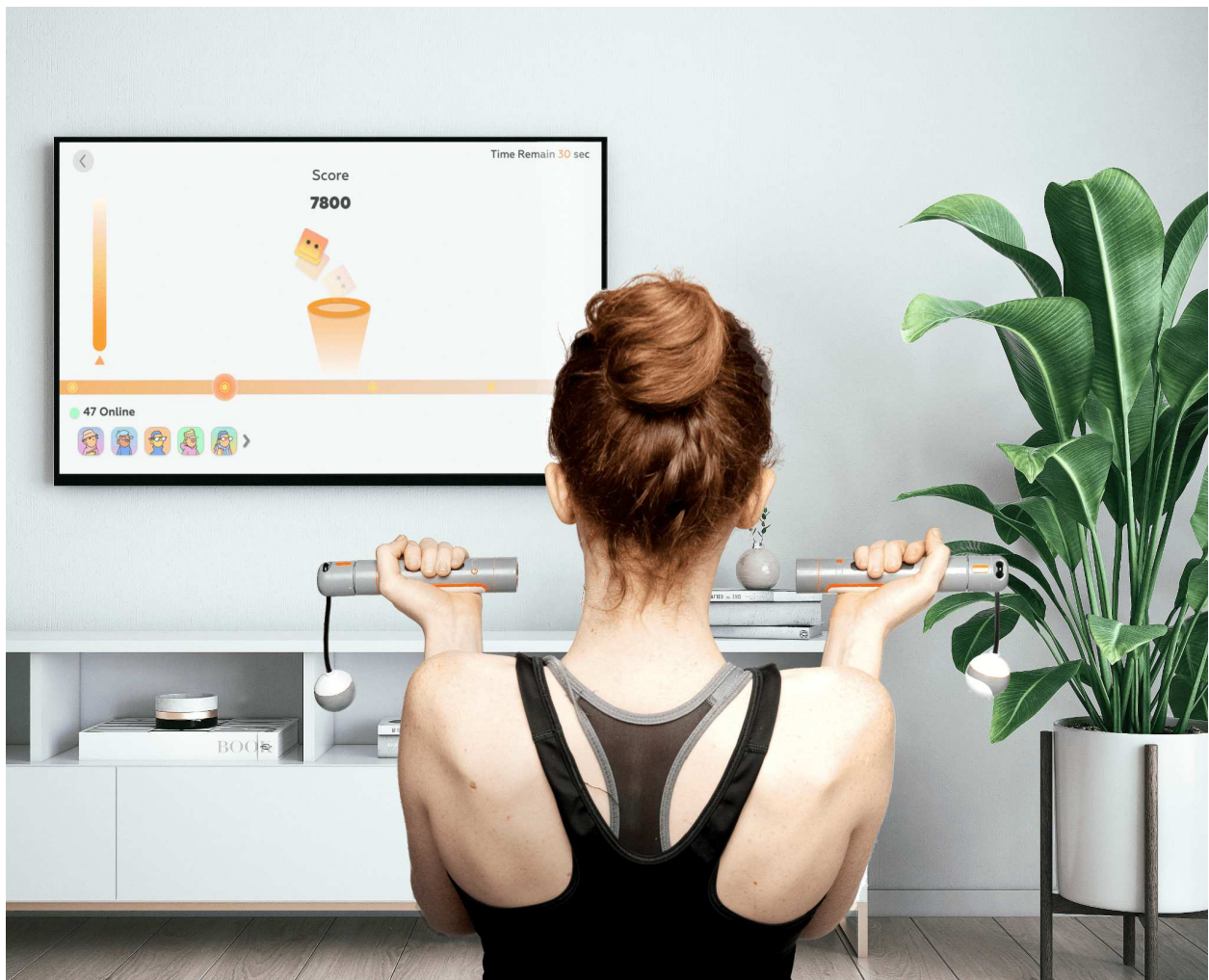
Due to Chinese society's current educational evaluation orientation, most Chinese parents believe that educational achievement is more important than some other things such as physical adeptness, so there is a tendency for parents to focus on their children's performance in cultural subjects and neglect their children's physical development. Some parents even forbid their children to engage in vigorous physical exercise because they are worried that their children's studies will be affected. Young parents, especially those from the 1980s onwards, lack knowledge of physical activity and health, do not set an excellent example for their children at home, and lack opportunities to accompany their children in physical activity.

Countermeasures to cultivate secondary school students' interest in exercise and habit formation

Increasing interest in exercise and developing exercise habits in all students needs to be done both in and outside of school during school hours. Schools need to optimize the content of physical education classes, improve sports equipment, and establish effective mechanisms and platforms. Schools and physical education teachers need to take complete account of the curriculum's diversity, competitiveness, and fun nature. It is essential to focus on students' mental health while developing their exercise knowledge. Research has shown that peer groups significantly affect the amount of time youth spend exercising, with the effect being about 80% of the effect of individual characteristics, 1.8 times the effect of family characteristics, and 1.4 times the effect of classroom and school characteristics. (Quan

and Lu,2020) Re-optimize instructional approaches to meet the needs of students at different levels and focus on recreational and fun presentations of physical education programs to develop healthy physical behavior. For example, students should develop a sense of competition to increase motivation to exercise competitively. Games can also be introduced into the curriculum to allow students to play and exercise simultaneously, achieving the goal of fun and education. Fitpro's app incorporates a game mode, allowing students to exercise through games and simultaneously allowing multiple people to exercise online.

Figure 2: UI system overview



At the same time, schools need to strengthen the investment in basic sports facilities, actively create conditions for regular inspection of sports equipment and facilities found to be broken or leaky to immediately repair, improve sports facilities, and eliminate the hidden external dangers of students learning in physical education classes.

The early models consisted of foam material, and the primary purpose was to explore the functionality of Fitpro and how to connect the individual parts. The core of the design was two handles, the ends of which were used to connect the components. The parts include:

- Two dumbbell pieces wrapped in soft material.
- Two joints for the cordless jump rope.
- Two elastic band joints.
- One handle connecting rod.
- An inflatable pad.

In addition, there is a cardboard box used to integrate all the parts and as part of the exercise equipment.

Figure 4: Pink foam model

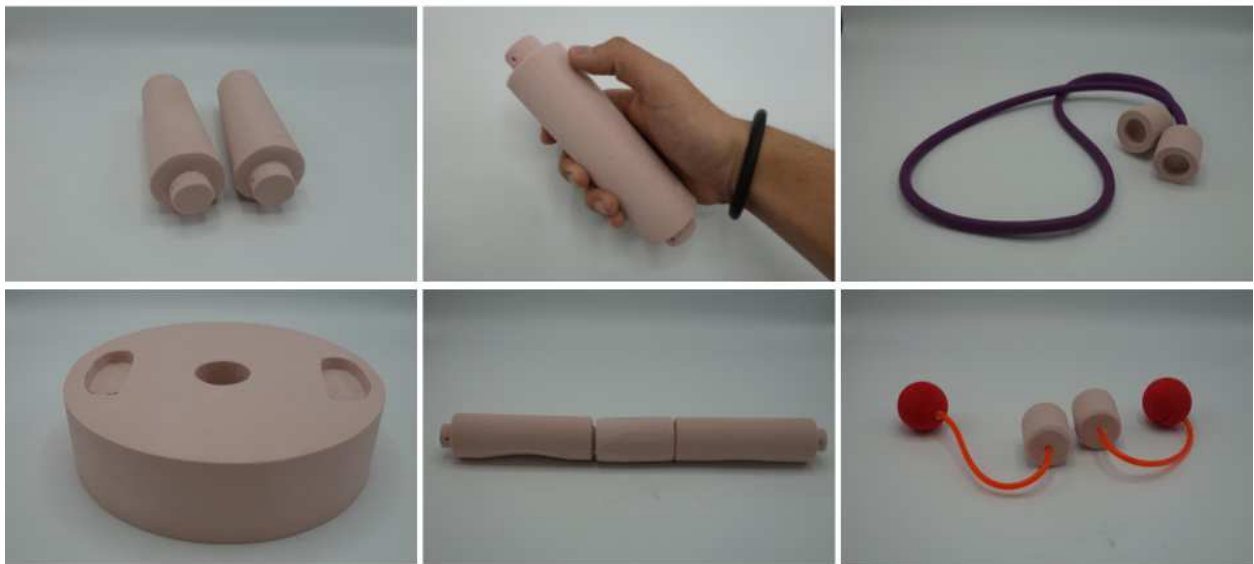


Figure 5: cardboard storage box



Before the final design is determined, there is a more focused model and testing. The model material consists of PVC pipes, and the storage box is wooden for predicting the weight and load-bearing capacity. In this model test, the final decision is to move the quick dissipation plug from the handle to other plugs, which can be done more quickly to assemble and disassemble the exercise equipment. In the test of the handle and plug connection firmness, it was found that the plug length between 1-1.5inches is the highest firmness. The model also determined all the final product components:

- Two handles
- Two cordless jump rope plugs
- Two elastic band plugs
- One elastic band
- One handle connecting rod
- Two dumbbell pieces
- One dumbbell connecting rod
- One functional storage box

Figure 6: Final mock-up



Figure 7: Testing



I use PVC pipe and wooden sticks to test how long the connection can be firmly connected parts



0.5 Inch

1 Inch

1.5 Inch

The connection is very weak

The connection is generally firm, bending with force will be deformed

Very strong, no deformation even with strong force

On February 5, 2022, one user test was conducted with four Chinese students at Appleby College in Oakville, Toronto. These studies abroad had previous experience in junior high school in China and covered physical education classes in multiple cities. After explaining the design concept and use of the integrated exercise equipment, the users conducted tests and overview for overall design

impressions, design implement ability predictions, handle attachment methods, color preferences, and handle materials. The findings are:

- Students generally believe that schools may not purchase this product in significant quantities for teaching purposes.
- Most students thought this product could be used for home fitness and that parents would be more willing to purchase it.
- Students suggested that the suggested fitness rings could be considered interchangeable weights.
- Compared to practicality, students pay more attention to the fun nature of this product.
- Male students want to keep the color choice low-key, traditional monochrome.
- Physical education classes in large cities are inclusive, and the facilities are advanced, so introducing new teaching equipment is possible.

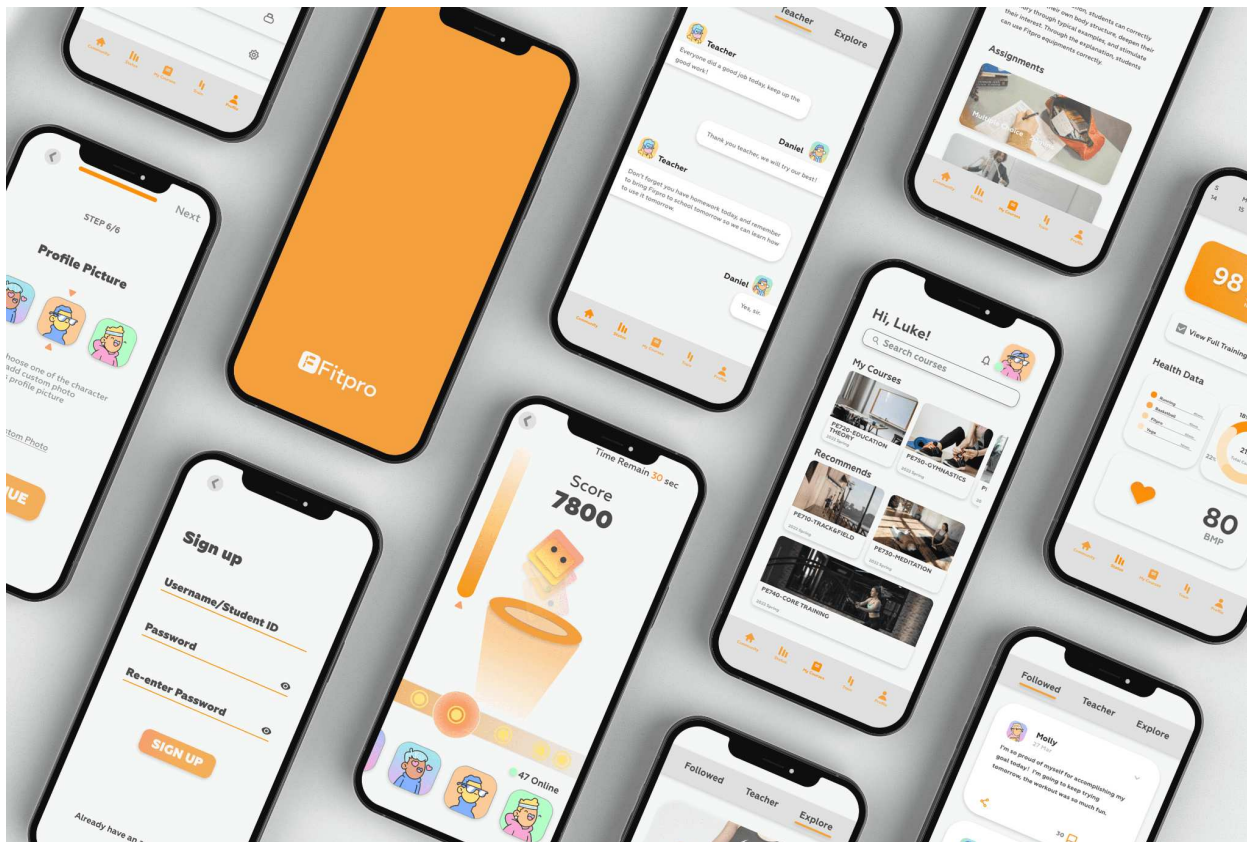
Figure 8: User Test & Interview



The exercise system needs to increase the enjoyment, so consider combining the game form that junior high school students like with the exercise equipment. The teacher can unify the students to participate in the game content through screencasting in physical education class. Fitpro UI system supports multiple people to participate online at the same time. Fitpro also supports teacher mode, where

teachers can collect student feedback, assign homework and answer questions for students in the background. So Fitpro can help students develop exercise habits; it can help teachers teach more efficiently.

Figure 9: UI system



The final version is a complete set of functional exercise equipment. Two smart grips with Bluetooth function on the grips can be automatically connected to Fitpro software through a switch. The storage case can charge the handles wirelessly. The handles are made with silicone anti-slip pads for added comfort and easy cleaning. An extended grip handle can measure heart rate and calorie consumption. Students' data will display in real-time in the software. The two ends of the handle are hollowed out and connected to the sports plug through a quick dissipation plug. Sports plugs include two cordless jump rope plugs, two elastic rope plugs, and a handle connecting rod. The pins are equipped with buttons on both sides to change the combination form quickly. The design also includes two lightweight dumbbell piece plugs, which outer layer wrapped in soft material, through the dumbbell connector can be connected to two pieces of dumbbell head to form a yoga for / foam axis. All parts are

stored in a portable storage box, while the storage box as part of the exercise equipment can also be done in a specific exercise mode.

Figure 10: Final design concept



Figure 11: Final design concept



Conclusions:

The research process found that the deficiencies of physical education policies in China today are a significant factor in students' loss of interest in exercising. Combined with the inappropriate arrangement of physical education class contents and the lack of sports equipment in schools in different regions, it is difficult for junior high school students to develop lifelong exercise habits. In designing solutions to this problem, it was found that increasing the variety of exercise equipment can effectively increase students' desire to exercise. Improving the comfort and attractiveness of exercise equipment is an effective way to motivate students to exercise. In the current environment of increasingly advanced technology, combining exercise with games is an effective way worth considering for future junior high

school physical education classes in China. Students and teachers agree that better school policies are needed for the UI system under design to support it in the future.

Further product optimization directions are to reduce costs to meet the needs of schools in remote and poor areas. The second is to design a physical education system better suited to China's educational policies. Thirdly, to develop more diversified equipment components for different students' needs.

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