Development and students’ evaluation of a blended online and offline pedagogy for physical education theory curriculum in China during the COVID-19 pandemic

Huaijin Liu1,7 · Jie Zhu2 · Yanping Duan3,4 · Yingjun Nie2 · Zhiwen Deng5 · Xiaobin Hong2 · Matthew Haugen6 · Julien S. Baker3,4 · Wei Liang3,4

Accepted: 25 May 2022 / Published online: 27 June 2022
© Association for Educational Communications and Technology 2022

Abstract
The outbreak and continuation of the COVID-19 pandemic has challenged the implementation of physical education theory (PET) curriculums among global colleges and universities. This study aimed to describe the design and students’ evaluation of a blended “Sports Multimedia Courseware Design” course among Chinese university students during the COVID-19 pandemic. Using information communication technologies, a 4-month blended course was developed, which consisted of 36 credits (18-credit online self-learning + 18-credit offline group-learning). A total of 1300 Chinese university students who majored in physical education, completed the blended course from Mar to Jun 2020, among which 238 (69.75% males; 21 ± 1.2 years) were randomly recruited to evaluate the course in terms of three aspects: (1) online self-learning, (2) offline group-learning, and (3) overall learning outcomes. A descriptive analysis was conducted using the IBM SPSS 27.0. Students’ overall positive evaluation supported a successful development and implementation of the blended course. Over 90% of students fulfilled the learning tasks and satisfied with the online learning resources. About 83% of students indicated high levels of autonomous motivation and engagement in online self-learning. Approximately 88% of students showed positive attitudes to the offline group-learning content, while the participation rate (60%) was relatively lower than of the online self-learning. Over 50% of the students indicated self-improvements in diverse aspects after attending the blended course. Blended online and offline pedagogy shows apparent promise in delivering the PET course among Chinese university students during the COVID-19 pandemic. Further application and comprehensive evaluation are warranted in the future.

Keywords Information communication technology · Blended pedagogy · Online and offline · Physical education theory course · College students · COVID-19

Huaijin Liu and Jie Zhu are co-first authors.

✉️ Jie Zhu
gracezhu1981@126.com
✉️ Wei Liang
wliang1020@hkbu.edu.hk

Extended author information available on the last page of the article
Abbreviations
COVID-19  Coronavirus disease 2019
PE  Physical education
PET  Physical education theory
ICT  Information communication technologies
3C  Collaborative Cyber Community
WRT  Watch-to-Read-to-Think

Background
The novel COVID-19 pandemic has continued for more than 2 years, substantially influencing the world, especially the education domain (Pokhrel & Chhetri, 2021). The pandemic has led to total closure of schools in more than 200 countries globally with more than 94% of the total number of enrolled students in these countries temporarily forced out of the school environment (Baker et al., 2021; Pokhrel & Chhetri, 2021; UNESCO, 2020). As a result of school closures and social distancing policy, the implementation of curriculums particularly for those that highlight the learner interaction and involvement e.g., physical education theory (PET) curriculum (Varea et al., 2020), were considerably challenged. To address this situation, the pedagogy, “blended learning” (also called “hybrid learning”) which has raised increasing concerns, appears to be promising for facilitating an effective delivery of curriculums during the outbreak and post-COVID-19 period (Calderón et al., 2020; Mahaye, 2020).

Key concept of blended learning
The original concept of blended learning was proposed in the early 1960s, referring to the integration or mixture of traditional face-to-face learning paradigms and the digital or online learning paradigm which is based on information communication technologies (ICT), with the aim of giving full control to the leading role of instructors and learners’ initiative to maximise their individual learning outcomes (Dziuban et al., 2011; Means et al., 2013), and enhancing various skills, such as self-learning and group cooperation (Woltering et al., 2009). Blended learning has evolved in diverse ways that are widely applied in educational systems (e.g., curriculum implementation) in many countries (e.g., Europe, the US, China), and scholars treat the developments as “the new normal” of contemporary education (Dziuban et al., 2018; Norberg et al., 2011).

In China, the Ministry of Education has officially launched a national education plan since April 2019, namely “6-Excellent and 1-Top” (Ministry of Education of the People’s Republic of China, 2019). The education plan suggested the requirement of setting up “blended online and offline curriculums” with high quality, emphasizing the construction, application, and promotion of various online educational resources. It suggested that blended online and offline curriculums should use information technology to localize online learning resources, adopt the mixed teaching model (e.g., flipped classroom-based blended course), and create hybrid courses suitable for the needs of local students.
Blended curriculum of physical education curriculum

Physical education theory (PET) curriculum is an important part of physical education in colleges of China, which aims to teach PE students the scientific knowledge and general objective laws of physical education and enhances their ability and skills of implementing PE curriculum in their future teaching career. Traditionally, the teachers deliver the PET curriculum face-to-face in a classroom during a fixed timeslot, where there are no online components being involved in the course implementation. As most of the PE students are collegiate athletes, the implementation of PET curriculum can be easily disrupted by the students’ participation of diverse sport events and other uncontrollable factors, such as sport injuries, pandemics, and natural disasters (Dziuban et al., 2018; Mahaye, 2020; Shi & Zainuddin, 2020). This supports the demand of integrating the online components into the traditional face-to-face mode (e.g., blended teaching/learning) in the implementation of physical education theory (PET) curriculum among PE students.

To extend the time and space of traditional teaching/learning, Lord and Lomicka (2004) proposed a pragmatic approach for designing virtual teaching/learning section, namely the Collaborative Cyber Community (3C) model. This approach emphasized the interactive and collaborative teaching/learning in the virtual section and suggested setting up two online working areas, where there were different activities in each area targeting different actors (teachers/students) (see Table 1). The 3C approach has been applied in the curriculum and learning platform design in a wide variety of education domains during the past decades, such as language education and cross-cultural learning, which also provides a feasible theoretical framework for designing the virtual parts of PET curriculum (Ko & Chen, 2011; Panigrahi et al., 2018; Shadiev et al., 2015; Wang & Chen, 2012, 2013).

In addition, there has been increasing concerns about the basic components of designing blended theory curriculum in colleges and universities (Ma’arop & Embi, 2016; Shi & Zainuddin, 2020). Thornbury and McCarthy (2016) proposed 12 mixed teaching modes with the use of ICT, underlining the inclusion of input, output, interaction, and scaffolding in the delivery of theory courses. Hockly (2018) developed a comprehensive framework for designing effective blended curriculums, which suggested that nine elements should be considered including task design, material supply, resources integration, curriculum evaluation, and context formation.

In China, the national Ministry of Education recommended the construction standards for implementing blended curriculums, namely “Two Attributes and One Degree” (Higher-order attribute, Innovation attribute, and Challenge degree) (Huang et al., 2019). Particularly for the PET curriculum, when designing the curriculum content, it is necessary to organically combine knowledge, ability and accomplishment with the aim of cultivating talents and curriculum positioning of college physical education. It has been suggested to make full use of ICT to teach students the cutting-edge achievements of sports and PE theories, so as to improve the challenge degree of the curriculum content. For the delivery mode, it is suggested that online learning and offline learning should be deeply integrated with the consideration of students’ centric need. Besides, teachers should make full use of diverse resources to develop high-quality online courses and increase the higher-order attribute of the theoretical teaching content. Furthermore, with the use of ICT, teachers need to ingeniously design online and offline learning activities for students and enhance the innovation attributes of the PET...
| The Collaborative Cyber Community (3C) | Teacher’s office | The classroom |
|--------------------------------------|-----------------|--------------|
| **Student administration**           | **Course design** | **Asynchronous mode** | **Synchronous mode** |
| – Enrolments attendance status       | – Content upload | – Audio/Video forums | – Audio/Video Text chat/Voice chat |
| – Emailing student                   | – Learning path design | – Assignments | – Group cyber classrooms |
| – Grouping                           | – Forum setup    | – Learning materials | – Interactive white board |
| – Task setup                         | – Assignment setup | – Course Information | |
|                                     | – Test setup     | – Online survey  | |
Development and students’ evaluation of a blended online and...

...curriculum, so as to stimulate the learning interest of sports students. In addition, the disciplinary characteristics and regional distinction should be considered when designing the blended curriculum of PET in colleges and universities (Huang, 2012).

Despite the clearly indicated guidelines and proposed frameworks, there are several limitations of existing blended PET curriculums in China (e.g., lack of systematic planning, disconnection of online and offline learning, and lack of sustainability of curriculum construction) (Liu et al., 2020). This highlights the need of more well-designed blended curriculums of PET in China.

**Brief introduction to the course of “Sports Multimedia Courseware Design”**

Under the background of “Internet Plus”, a variety of ICT and equipment emerge as the times require (Liang et al., 2019; Thomas & Stratton, 2006). This brings a higher demand of information-based teaching ability for PE students who will become PE teachers in the future. For PE students who were born in the information age, they have adapted to the Internet Plus learning environment. They have an intense curiosity and thirst for knowledge of sports multimedia. However, their existing professional knowledge and practice abilities (e.g., more in-depth understanding of the collection and processing of sports multimedia materials, and the design and integration of multimedia courseware) need to be enhanced.

The ability of multimedia production plays an important fundamental role in the delivery of PE curriculum, especially for ICT-based curriculum in the context of “Internet Plus” (Hai et al., 2020). In the traditional PE curriculum, when the PE teachers demonstrate the sports action, the spatial movements cannot be recorded and the consistency of repeated demonstrations cannot be guaranteed due to the limitation of time and space, which may subsequently affect the efficiency and quality of action teaching. Through designing and producing multimedia courseware, PE teachers can address the time and space limitation and overcome the weakness of course delivery in traditional physical education (Li et al., 2021a). For example, when various sports technologies, technical difficulties, key points, and common wrong actions were made into courseware using modern information technology, students could watch, analyze, imitate, and practice the sports actions repeatedly, which may considerably improve the accuracy and quality of sports action teaching.

Considering the above, the course of “Sports Multimedia Courseware Design” was set up and was treated as an important part of PET curriculum in colleges of Hunan province of China. The course is not only a “skills” course but also a content learning course, which introduces the concept of multimedia, the design and application of sports multimedia courseware, the collection and processing tools, software and equipment of multimedia materials, the design methods of common sports multimedia courseware, the design and application of sports multimedia electronic teaching plan, and sports multimedia design network courseware. The purpose of this course is to cultivate the information-based teaching ability of PE students and lay a foundation for them to deliver PE courses in primary and secondary schools following graduation.

Considering that previous application of blended pedagogy (e.g., flipped classroom-based blended curriculum) focused more on the course implementation process while the development and verification of course mode has been comparatively neglected (Fan, 2018; Qiu & Xiao, 2020), and given the lack of studies introducing the development and evaluation of blended PET curriculum, especially the “Sports Multimedia Courseware Design” course in a Chinese context, we therefore, aimed to describe the design of a blended online and offline pedagogy for PET curriculum (i.e., the “Sports Multimedia
Courseware Design” course) among Chinese university students during the COVID-19 pandemic. Further, we aimed to evaluate the students’ evaluation in terms of the learning outcomes and satisfaction with the blended “Sports Multimedia Courseware Design” course. It is expected that the current paper will provide new insights and add value to the future practice of applying blended pedagogy in the sport and physical education domains.

**Methodology**

**Development the blended “Sports Multimedia Courseware Design” course**

**Basic ideas of designing the blended “Sports Multimedia Courseware Design” course**

As suggested by Graham et al. (2019), it is valuable to learn about different models and to select the specific approach that fits well with target teaching philosophy, school culture, and student needs. Considering the uncontrollability of the pandemic, we used the flex model (i.e., core instruction is online within the brick-and-mortar school with in-person support as needed) and enriched virtual (i.e., almost entirely online with supplemental interpersonal contact) approaches in the curricular design and implementation to correspond to the different governmental and school policies (Graham et al., 2019).

![Fig. 1 The basic ideas of blended “Sports Multimedia Courseware Design” course](image-url)
Figure 1 demonstrates the basic ideas of designing the “Sports Multimedia Courseware Design” with the blended pedagogy. The blended course integrated two kinds of learning spaces: (1) a virtual learning space, corresponding to the online digital teaching resources autonomous learning stage, and (2) an intelligent classroom space, corresponding to the offline entity classroom teaching stage. Online visual learning space mainly targeted the delivery of theoretical knowledge and focused on recording digital learning resources, such as multimedia concepts, characteristics, and classification. Course materials were appropriately inserted with knowledge in terms of the combination of theory and practice related to the collection and processing of multimedia materials, and some complex operation processes appropriate for recording micro class videos for students to learn independently. Offline physical classrooms mainly demonstrated the shooting of sports action materials, audio and video clips, and operation of related software and hardware. Through the face-to-face and hand-by-hand guidance of teachers, students could easily address the difficult problems they are confronted with during the learning process. The course components were designed with the aim of cultivating students’ multimedia courseware-design skills based on the characteristics of their own sports specialty. In the blended course, the students were guided to shoot and make personalized multimedia materials independently, aiming to develop their aesthetic and innovative abilities. The overall design of the blended “Sports Multimedia Courseware Design” course followed the national standard of “Two attributes One degree”, and the principle of “student-centred learning” (Levy et al., 2011), aiming to achieve an efficacious integration of online self-learning resources and offline collaborative learning resources. The course would arrange the homework tasks appropriately and encourage students to cooperate in shooting a large amount of multimedia materials by using “Outcomes-based Education” (OBE) (Bralić & Divjak, 2018), where the students were expected to improve their information literacy through mutual evaluation and mutual learning.

Construction of the blended “Sports Multimedia Courseware Design” course

Expending time and space: online self-learning section We used the 3C model as the theoretical framework to construct the online self-learning section (Lord & Lomicka, 2004), including two working areas: teacher’s office and online-classroom (i.e., students’ learning space). Particularly, the teacher’s office area was a virtual space, where only teachers were allowed to log in. The main tasks included uploading digital teaching resources, students’ online learning management, designing teaching activities, and publishing assignments in the implementation of “Sports Multimedia Courseware Design” course. The virtual office area of teachers was mainly the backstage management module of Superstar teaching platform (STP), which is a module of learning management system (LMS) for teachers to upload and post learning materials. Teachers created online teaching classes, digital teaching resources, online assignments, and discussion areas of “Sports Multimedia Courseware Design” in the above virtual office area and released online theme discussion, group cooperation activities, peer evaluation, and other online teaching activities.

For the students’ learning space (online-classroom), both students and teachers had the authority to access the space, where the learning activities included two modes: asynchronous and synchronous. The asynchronous learning was mainly undertaken on a Superstar learning platform (SLP), which is a special module of learning management system (LMS) for students to view and download the materials supplied by the teacher. Students could log in anytime and anywhere and used various learning materials and modules freely.
e.g., videos, audio, text materials, and discussion areas. For the production and learning of sports multimedia courseware, the synchronous learning space also played an important role in course implementation. The synchronous learning space which was also known as “synchronous cyber classroom” (Levy et al., 2009; O’Connor et al., 2011) consists of diverse components, such as superstar live broadcasting platform, WeChat communication group, and QQ group photo album. The synchronous online classroom had five functional characteristics: playing synchronous teaching audio and video, control panel, text chat box, whiteboard, and sub video window. Based on these five functions, the synchronous network space used in the teaching of “Sports Multimedia Courseware Design” fully applied the real-time interaction, audio and video sharing, discussion and communication, text interaction, and other functions as required in the synchronous teaching of “Sports Multimedia Courseware Design” course. All online teaching activities could be recorded synchronously in the online learning space, which provides status data for subsequent teaching evaluation.

Changing time and space: integrating the virtual technology into offline group-learning section Offline learning was implemented in the seminar-type smart classroom, integrating the new intelligent technology into the classroom learning space. The whole class was taught in a seminar group with 5–6 students in each group. They formed a group learning community. The offline learning was implemented progressively from summary review, group discussion, teacher-student interaction, to assignment presentation. During this progressive process, the online learning content could be systematically reviewed and refined. The offline learning also emphasized the important role of cooperative learning, through which the students are expected to strengthen the in-depth understanding and thinking of sports multimedia materials and promote the divergent thinking and creative thinking. A smart classroom was a kind of entity learning space which integrates various information technology and equipment. All kinds of intelligent learning tools also integrated virtual online communities into entity classrooms, creating new intelligent learning spaces that combine the virtual and real. For example, teachers could carry out on-site check-in, answer submission, public voting, on-site evaluation, and other functions through class management intelligent interactive tools, such as Rain-Classroom (雨课堂) and Xuexitong (学习通), which provided real-time interaction, discussion and communication, mobile evaluation and multiple intelligence teaching services for offline physical classroom learning.

Figure 2 outlines the characteristics of online self-learning and offline group-learning in the blended course. The combination of online virtual space–time and offline virtual reality space–time created a reconstructed learning space–time for the “Sports Multimedia Courseware Design” course. The design and implementation of blended course intended to keep consistency with the requirements of traditional PE curriculum (e.g., emphasizing the interaction of teachers and students and the delivery of both knowledge and skills) and correspond to the purpose of course setup (e.g., promoting the courseware generation and improving students’ information-based literacy and multimedia practice ability). For visual platform, there were two different interactive modules (online discussion and online assignment) alongside the learning modules. In the online assignment module, teachers could upload relevant information about assignments (e.g., assignment content, requirements, and deadlines) and evaluate students’ assignments, while students could check the assignment information posted by the teacher, submit their assignment and conduct peer evaluation. The online discussion module mainly focused on the content of problems and challenges encountered in students’ online self-learning, where questions and confusion
existing in the assignments could also be discussed. The final course performance was determined by weighted scores of the online assignment (40%), group presentation (50%) and classroom performance of online and offline learning (e.g., attendance, initiative) (10%). The former two parts were evaluated by both peers (20%) and teachers (80%), while the last part was evaluated by teachers only. Overall, the virtual reality teaching space of the “Sports Multimedia Courseware Design” course organically integrated and complemented each other. The virtual reality teaching space and time created by integrating a variety of information technology and equipment provides the realization conditions for the smooth implementation of blended course.

**Example of the chapter “Sports Action Video Material Shooting”**

Based on the construction of the blended course mentioned above, we designed six chapters (20 sections) in the “Sports Multimedia Courseware Design” course, such as “Fundamental Knowledge of Multimedia and Sports Multimedia Courseware”, “Introduction to Commonly Used Materials and Software of Sports Multimedia Courseware”, and “Text/Audio/Video Editing Software of Sports Multimedia Courseware”. Here, we took the chapter “Sports Action Video Material Shooting” as an example to introduce how we used the blended pedagogical approach in the course content design and implementation.

The chapter of “Sports Action Video Material Shooting” was designed based on the basic ideas of the traditional sports action learning process of “action demonstration with imitation practice” (Tam, 2020; Thomas & Stratton, 2006). Table 2 presents the content of the “Sports Action Video Material Shooting” chapter. In the online self-learning section, a Watch-Read-Think (WRT) strategy (i.e., action video watching, theoretical materials reading, and warm-up thinking of the “shooting sports action video materials” chapter) was used for encouraging students to preview the learning content before class (Bergmann &

---

**Fig. 2** Characteristics of the blended mode
The online self-learning content included diverse types of materials (e.g., text, video, and animation) and specially designed Q&A module. In addition, teachers guided the students to think about the problems of “traditional sports action teaching difficulties”, “advantages of Sports Multimedia Courseware”, “sports action triangulation shooting creativity”, and “sports action triangulation shooting information environment” with the form of interactive discussion.

In the offline group-learning, teachers first guided the students to review the online learning content by asking questions and interactive discussion. Afterwards, teachers would explain the key and difficult points of learning content according to the “hot words cloud image” of thematic discussion (i.e., a common function of the SLP, which can automatically form a visual cloud image according to the frequency of key words in the thematic discussion), with the aim of consolidating and improving the teaching–learning links. For the offline group-learning section, a variety of delivery modes were adopted, such as case-based display, imitation practice, cooperative learning and so on. For example, we designed the open discussion and live shooting demonstration of “Qigong (e.g., Tai Chi) action triangle videos”, through which students could comprehensively copy and innovate the content of this chapter. Students were encouraged to adopt a comprehensive and open-ended thinking to start a collision of ideas (“dialogue and exchange”) in this section, with the aim of enhancing their creative thinking and presentation abilities. At the end of the class, teachers guided the students to shoot action triangle video for their own sports specialty (e.g., basketball, volleyball, gymnastics). After the post-production

| Table 2  | Content of the course chapter “Sports Action Video Material Shooting” |
|----------|---------------------------------------------------------------------|
| Section  | Content                                                             |
| Online self-learning | For teacher  
- Establish the online class  
- Disseminate the online learning task  
- Initiate a special discussion in the Xuexitong platform  
For students  
- Read the online learning materials  
- Preview offline classroom learning content  
- Watch online tutorial micro class video  
Interactive discussion (students & teacher)  
- What are the difficulties of traditional Tai Chi learning?  
- What are the advantages of Computer Assisted Instruction (CAI)?  
- What kind of software and hardware should be used in sports action triangulation video shooting? |
| Offline group-learning | For teacher  
- Teaching task introduction, personalized counselling, video shooting guidance, Q&A  
For students  
- Interactive discussion, imitation practice, division of work and cooperation, learning and shooting  
Assignment (students & teacher)  
- Teachers guide the students to shoot action triangle video for the specific sports they major in |
and authorization, students were asked to upload their video to the homework column of Xuexitong (for teacher’s evaluation) and share with other classmates in the QQ group photo album, where each student can comment on any video assignments and learn from each other.

Innovatively, the interactive multimedia was also involved as an important component in the offline group-learning process as it is expected that these PE students (future PE teachers) should be able to produce multimedia training tools to teach sports action in the future. Taking Tai Chi action as an example, in the collection terminal, one student of the learning group demonstrated the Tai Chi action while other three group members shot Tai Chi movement from three angles (i.e., front view, side view and top view) synchronously by using the smartphones (Fig. 3). In the viewing terminal, a pre-setup computer/laptop recorded the screen of triangle action through the EV screen recording software installed on the server side. To reduce the video transmission jam, both computer and smartphone were connected to the unified LAN (see Fig. 4). It is worth noting that the system could be
also available for students shooting more vivid and real sports action in outdoor scenarios, e.g., playground and stadium. The only difference was that students could use a smartphone/iPad as the viewing end instead of the computer/laptops to improve the flexibility and convenience of course implementation. Finally, all group members were involved in the post-production and authoring activities, where the captions, background music and audio instruction were added to the triangle action video and additional editing for video size, time and quality was undertaken if needed. As an assignment, students needed to insert their video product into the multimedia courseware and uploaded it to the online interactive learning platforms for others reference and evaluation.

**Evaluation of the blended “Sports Multimedia Courseware Design” course**

**Participants and procedure**

During the COVID-19 pandemic (March–June 2020), the blended “Sports Multimedia Courseware Design” course has been implemented in several universities in the Hunan province of China, involving 1300 PE students. The entire course lasted for 4 months, consisting of 36 credits (standard class hours) and 90 min for each class hour. The online self-learning section was first implemented for 2 months with 18 credits, followed by the offline group-learning section for the remaining 2 months (18 credits) (this was determined according to the government policy for the pandemic control).

To investigate the students’ evaluation in terms of their learning outcomes and satisfaction with the blended “Sports Multimedia Courseware Design” course, we randomly recruited 238 Chinese PE students (69.8% males; age = 21 ± 1.2 years, ranging from 19 to 23 years) from one university in Hunan province of China to complete a cross-sectional online survey after the course completion. Eligible students who enrolled the course and fulfilled the 36 credits were asked to sign the informed consent form and complete the questionnaire survey independently and voluntarily. The survey duration lasted for 5–10 min.

**Measures**

Students’ learning outcomes and satisfaction with the course was measured by a 10-item scale. The scale was developed by three experts who have more than 5 years of teaching experience based on the evaluation framework proposed in previous studies (Li et al., 2016). Before the main study, 100 PE students were invited to complete a pilot test and the results supported a good reliability and validity of the 10-item scale (Cronbach’s alpha > .70). The scale included ten items to evaluate the blended course covering three dimensions: (1) online self-learning, (2) offline group-learning, and (3) overall learning outcomes (Table 3). Responses were indicated on a 5-point Likert scale, from “1 = strongly disagree” to “5 = strongly agree” (Cronbach’s alpha = .914, KMO = .846 in the main study).

**Statistical analysis**

Based on the study purpose, we conducted a descriptive analysis for the students’ course evaluation by using the IBM SPSS 27.0. All the 238 students’ responses were included into the analysis and there were no missing values. The frequency and percentage of each response were estimated.
Table 3  The 10-item scale for evaluating the students’ learning outcomes and satisfaction with the blended “Sports Multimedia Courseware Design” course

| Dimension                  | Items                                                                                                                                                                                                                                                                                                                                 |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Online self-learning      | Q1: I am satisfied with the online learning resources of the “Sports Multimedia Courseware Design” course                                                                                                                                                                                                                               |
|                           | Q2: I have the motivation and ability to attend the online self-learning autonomously                                                                                                                                                                                                                                               |
|                           | Q3: I can always complete relevant assignments of the online learning section and well prepare for the offline learning section                                                                                                                                                                                                 |
| Offline group-learning    | Q4: I can actively participate in various group discussions                                                                                                                                                                                                                                                                              |
|                           | Q5: I am satisfied with the content of the offline section as well as the delivery mode of the “Sports Multimedia Courseware Design” course                                                                                                                                                                                               |
|                           | Q6: My questions in the online self-learning can be fully solved during the offline group-learning section                                                                                                                                                                                                                                  |
| Overall learning outcomes | Q7: I improved the information learning literacy and ability of autonomous learning after the blended course                                                                                                                                                                                                                              |
|                           | Q8: I improved the awareness and ability of teamwork after the blended course                                                                                                                                                                                                                                                         |
|                           | Q9: I enhanced the ability of collecting and processing multimedia materials after the blended course                                                                                                                                                                                                                            |
|                           | Q10: I improved the skill of designing sports courseware                                                                                                                                                                                                                                                                               |

Results

As shown in Table 4, about 93.7% of the students indicated a strongly agree for the satisfaction with online learning resources, while 83.2% gave a strongly positive evaluation on their motivation and ability for participating in the online course autonomously.

Table 4  Results of evaluating the students’ learning outcomes and satisfaction with the blended “Sports Multimedia Courseware Design” course (n = 238)

| Item                      | Strongly agree n (%) | Agree n (%) | Neutral n (%) | Disagree n (%) | Strongly disagree n (%) |
|---------------------------|----------------------|-------------|----------------|-----------------|------------------------|
| **Online self-learning**  |                      |             |                |                 |                        |
| Q1                        | 223 (93.7)           | 12 (5.0)    | 3 (1.3)        | Nil             | Nil                    |
| Q2                        | 198 (83.2)           | 21 (8.8)    | 19 (8.0)       | Nil             | Nil                    |
| Q3                        | 215 (90.3)           | 18 (7.6)    | 5 (2.1)        | Nil             | Nil                    |
| **Offline group-learning**|                      |             |                |                 |                        |
| Q4                        | 143 (60.1)           | 77 (32.4)   | 18 (7.6)       | Nil             | Nil                    |
| Q5                        | 162 (68.1)           | 39 (16.4)   | 37 (15.5)      | Nil             | Nil                    |
| Q6                        | 200 (84.0)           | 32 (13.4)   | 6 (2.5)        | Nil             | Nil                    |
| **Overall learning outcomes** |                      |             |                |                 |                        |
| Q7                        | 143 (60.1)           | 92 (38.7)   | 3 (1.2)        | Nil             | Nil                    |
| Q8                        | 122 (51.3)           | 63 (26.5)   | 47 (19.7)      | 6 (2.5)         | Nil                    |
| Q9                        | 186 (78.2)           | 36 (15.1)   | 16 (6.7)       | Nil             | Nil                    |
| Q10                       | 127 (53.4)           | 84 (35.3)   | 27 (11.3)      | Nil             | Nil                    |
More than 90% of the PE students reported that they could complete the assignments of the online learning and well prepare the offline learning section.

For the offline group-learning section, more than 80% of the students appreciated the design and content of the offline course (strongly agree and agree responses), while more than 90% indicated their agreement to the crucial role of the group-learning in addressing the questions remaining in the online class. It is worth noting that the students showed a lower rate of active participation in the offline group-learning (60.1%) compared to that of the online course.

For the overall learning outcomes, more than half of the students strongly agreed that the blended course enhanced their information learning literacy, ability of autonomous learning, and teamwork concept. Over 78% of the students strongly agreed that they enhanced their ability for collecting and processing multimedia materials through participating in the blended course. In addition, positive feedback on the skill improvement in designing sports courseware was reported by more than 88% of the students.

Discussion

This is the first paper to systematically describe the design and students’ evaluation of a blended pedagogy for physical education theory (PET) curriculum (i.e., the “Sports Multimedia Courseware Design” course) in China. The blended course combines the merits of both ICT-based online self-learning and face-to-face group-learning, which showed strong potential for implementing sports-related curriculums during the COVID-19 pandemic and beyond.

Consistent with recent studies using a blended pedagogy for other curriculums (e.g., arts education, business, architectural education) in response to the COVID-19 pandemic (Li et al., 2021b; Megahed & Hassan, 2021; Ng et al., 2020), the current paper has added value to the relevant practice for the sports discipline. The feedback from PE students who completed the blended “Sports Multimedia Courseware Design” course was positive for all three aspects (online self-learning, offline group-learning, and overall learning outcomes), which agrees with the findings of other studies (Lapitan et al., 2021; Li et al., 2021b), implying the feasibility and acceptance of implementing blended online and offline learning for diverse curriculums. It is worth noting that although students showed positive attitudes to the online learning resources of “Sports Multimedia Courseware Design” in our study, their motivation and ability for autonomous learning should be further enhanced, which is also an important issue that needs to be addressed in the future practice of blended curriculum in sports-related subjects. Interestingly, even students’ feedback for the offline learning was positive, the proportions of students who thought they can actively participate in classroom group activities was lower compared to that of online learning activities. This might be attributed to the impacts of the COVID-19 pandemic (e.g., physical avoidant behaviors) as well as the cultural characteristics (e.g., Chinese students are relatively reserved and conservative in class) (Haarms et al., 2018; Tu, 2001; Varea et al., 2020). However, this assumption has not been systematically examined in our study. Future studies using a mixed-methods design (Duan et al., 2022; Ivankova et al., 2006) and investigating the underlying reasons for students’ responses by in-depth qualitative interviews (e.g., adding open-ended questions) are warranted. The above findings imply the need of further cultivating Chinese students’ engagement, initiative, and self-confidence in carrying out group activities and public presentation in the theory courses of sports-related
majors, which is also a critical issue for the design and implementation of future blended PE curricula. In addition, the blended course showed promise in enriching the diverse learning outcomes of students, not only for those that could be obtained from traditional pedagogy (e.g., improving autonomous learning and teamwork), but also for the information-related aspects (e.g., information literacy, information collection and processing, and digital literacy/fluency) (Flierl & Maybee, 2020). It is worth noting that students were more conservative in improving their information-related abilities, which might be due to their dependent learning habits forming in a traditional face-to-face classroom for many years (Haarms et al., 2018; Huang et al., 2018; Tu, 2001). This implies that there is huge potential for improving the information-based literacy and abilities in PE college students in China. Overall, the students’ positive evaluation in terms of their satisfaction with the course and learning outcomes, supports the successful development and implementation of the blended “Sports Multimedia Courseware Design” course.

Limitations

There are several limitations that should be noted. First, the sequence of delivering the online and offline learning sections was determined by the COVID-19 pandemic policy and further implementation should take teachers and students’ preferences into account. Further, the evaluation for the blended PET course was only conducted using a simple survey among students, which may have overlooked more in-depth-information and relevant perspectives of teachers. This should be addressed in future studies (e.g., conducting qualitative studies) that particularly target course evaluation. Moreover, the practice of teaching sophisticated media production skills as part of professional education and the paradigm developed in this study could be further examined in different cultural contexts to contribute to a better generalization of the research findings. In addition, exploring the productive mixes of individualized versus group learning, connected with online versus offline modes should be considered in the future design of blended courses. Finally, the current study did not examine the comparative effectiveness between blended pedagogy and traditional face-to-face approach in the curriculum implementation and learning outcomes. More empirical studies with strict experimental designs (e.g., randomized controlled trial) that address this issue are deserved. Despite these limitations, the current paper provides valuable references for future development and evaluation of multimedia production courses among PE students who are future PE teachers. This paper may also contribute to the future successful application of blended pedagogy in the sport-related curriculum.

Conclusion

A blended pedagogy comprising online self-learning and offline group-learning for the PET curriculum (i.e., the “Sports Multimedia Courseware Design” course) was developed for Chinese PE students to surmount the challenges caused by the COVID-19 pandemic. Students’ overall positive evaluation in terms of the learning outcomes and course satisfaction supported a successful development and implementation of the blended course. In the future, developments should consider the sequence of delivering different learning sections and different cultural influences. In addition, more comprehensive evaluations for such an application in the sports-related curriculum is warranted.
Author contributions HL, JZ, and WL conceived the study and drafted the manuscript; all authors contributed to the design and implementation of the study; WL and JSB revised the manuscript; All authors reviewed and approved the final manuscript.

Funding This study was funded by: The Key projects of Hunan Social science achievement appraisal committee in 2021, “Problems and Countermeasures of online teaching resources in Colleges and Universities under the normalization of epidemic prevention and control” (XSP21ZDI006); The “13th five year plan” of Hunan Education Science in 2020” theoretical framework and practical path research on the construction of online “golden course” of physical education in colleges and universities (XJK20BTW002); The teaching reform research project of “Hunan Institute of science and technology in 2020”, “exploration and practice of online and offline hybrid “golden course” construction of physical education in colleges and universities (2020B05)”; 2021 Provincial Teaching Research Grant of Hubei Universities: Research on the political-ideological construction approach and practice of psychology curricula system in institutes of physical education from the perspective of "Sanquan Education" (2021409).

Data availability The data is available from first authors and correspondence upon reasonable request.

Declarations

Conflict of interest All authors declare no conflict of interests.

Informed consent All participants have completed the informed consent form prior to completing the survey.

Research involving human and/or animals participants This is non-clinical research and the project has been approved by the Hunan Institute of Science and Technology and Hunan Social Science Achievement Appraisal Committee projects “Problems and Countermeasures of online teaching resources in Colleges and Universities under the normalization of epidemic prevention and control” (XSP21ZDI006), “13th five year plan” of Hunan Education Science in 2020 “theoretical framework and practical path research on the construction of online” golden course of physical education in colleges and universities (XJK20BTW002), New liberal arts research and reform practice project of Hunan Institute of science and technology in 2021 “Innovation and practice of teaching methods for college physical education teachers integrating modern information technology” (Hu Li Gong Zheng Tong [2021] No.14:11), and 2021 Provincial Teaching Research Grant of Hubei Universities: Research on the political-ideological construction approach and practice of psychology curricula system in institutes of physical education from the perspective of "Sanquan Education" (2021409).

References

Baker, J. S., Liang, W., Jiao, J., Quach, B., Dutheil, F., & Gao, Y. (2021). Obesity prevention environment: Is it time to empower educators and remobilize schools in the post-COVID-19 period? Physical Activity and Health. https://doi.org/10.5334/paah.92

Bergmann, J., & Sams, A. (2012). Flip your classroom: Reach every student in every class every day. International Society for Technology in Education.

Bralić, A., & Divjak, B. (2018). Integrating MOOCs in traditionally taught courses: Achieving learning outcomes with blended learning. International Journal of Educational Technology in Higher Education, 15(1), 1–16. https://doi.org/10.1186/s41239-017-0085-7

Calderón, A., Scanlon, D., MacPhail, A., & Moody, B. (2020). An integrated blended learning approach for physical education teacher education programmes: Teacher educators’ and pre-service teachers’ experiences. Physical Education and Sport Pedagogy. https://doi.org/10.1080/17408989.2020.1823961

Duan, Y., Liang, W., Wang, Y., Lippke, S., Lin, Z., Shang, B., & Baker, J. S. (2022). The effectiveness of sequentially delivered web-based interventions on promoting physical activity and fruit-vegetable consumption among Chinese college students: Mixed methods study. Journal of Medical Internet Research, 24(1), e30566.

Dziuban, C., Graham, C. R., Moskal, P. D., Norberg, A., & Sicilia, N. (2018). Blended learning: The new normal and emerging technologies. International Journal of Educational Technology in Higher Education, 15(1), 1–16. https://doi.org/10.1186/s41239-017-0087-5
Dziuban, C., Hartman, J., Cavanagh, T. B., & Moskal, P. D. (2011). Blended courses as drivers of institutional transformation. In *Blended learning across disciplines: Models for implementation* (pp. 17–37). IGI Global. https://doi.org/10.4018/978-1-60960-479-0.ch002

Fan, X. (2018). Research on oral English flipped classroom project based teaching model based on cooperative learning in China. *Educational Sciences: Theory & Practice*. https://doi.org/10.12738/estp.2018.5.098

Flierl, M., & Maybee, C. (2020). Refining information literacy practice: Examining the foundations of information literacy theory. *IFLA Journal, 46*(2), 124–132. https://doi.org/10.1016/j.ifla.org.10.1007/2018.5.098

Graham, C. R., Borup, J., Pulham, E., & Larsen, R. (2019). K–12 blended teaching readiness: Model and instrument development. *Journal of Research on Technology in Education, 51*(3), 239–258.

Haarms, R., Holtzman, J., Tiki, X. U. E., & Darbyshire, D. (2018). Chinese students’ cultural and behavioural differences among domestic and internationally oriented educational institutions. *International Journal of Psychology and Educational Studies, 5*(2), 30–38.

Hai, W. P., Zhong, C. L., & Li, Y. L. (2020). The application of multimedia technology in physical education. *The International Journal of Electrical Engineering & Education*. https://doi.org/10.1177/0020729X2092036838

Hastie, M., Chen, N. S., & Kuo, Y. H. (2007). Instructional design for best practice in the synchronous cyber classroom. *Journal of Educational Technology & Society, 10*(4), 281–294.

Hockly, N. (2018). Blended learning. *ElT Journal, 72*(1), 97–101. https://doi.org/10.1093/elct/ccx058

Huang, J., Meng-Zhu, C. A. O., & Ke-Xin, L. I. A. N. (2019). Research on the construction of evaluation system of classroom teaching in applied undergraduate colleges from the perspective of “Golden Course.” *DEStech Transactions on Economics, Business and Management, (icaem)*. https://doi.org/10.12783/dtem/icaem2019/31097

Ivankova, N. V., Creswell, J. W., & Stick, S. L. (2006). Using mixed-methods sequential explanatory design: From theory to practice. *Field Methods, 18*(1), 3–20.

Ko, L., & Chen, N. S. (2011). Online-interpreting in synchronous cyber classrooms. *Babel, 57*(2), 123–143.

Lapitan, L. D., Jr., Tiangco, C. E., Sumalinog, D. A. G., Sabarillo, N. S., & Diaz, J. M. (2021). An effective blended online teaching and learning strategy during the COVID-19 pandemic. *Education for Chemical Engineers, 35*, 116–131. https://doi.org/10.1016/j.ece.2021.01.012

Levy, M., Wang, Y., & Chen, N. S. (2009). Developing the skills and techniques for online language teaching: A focus on the process. *International Journal of Innovation in Language Learning and Teaching, 3*(1), 17–34.

Levy, R., Dickerson, C., & Teague, J. (2011). Developing blended learning resources and strategies to support academic reading: A student-centred approach. *Journal of Further and Higher Education, 35*(1), 89–106. https://doi.org/10.1080/0309877X.2010.540317

Li, N., Marsh, V., & Rienties, B. (2016). Modelling and managing learner satisfaction: Use of learner feedback to enhance blended and online learning experience. *Decision Sciences Journal of Innovative Education, 14*(2), 216–242. https://doi.org/10.1111/dsji.12096

Li, H., Zhang, H., & Zhao, Y. (2021a). Design of computer-aided teaching network management system for college physical education. *Computer-Aided Design and Applications, 18*(S4), 152–162.

Li, Q., Li, Z., & Han, J. (2021b). A hybrid learning pedagogy for surmounting the challenges of the COVID-19 pandemic in the performing arts education. *Education and Information Technologies*. https://doi.org/10.1007/s10639-021-10612-1

Li, N., Marsh, V., & Rienties, B. (2016). Modelling and managing learner satisfaction: Use of learner feedback to enhance blended and online learning experience. *Decision Sciences Journal of Innovative Education, 14*(2), 216–242. https://doi.org/10.1111/dsji.12096

Li, H., Zhang, H., & Zhao, Y. (2021a). Design of computer-aided teaching network management system for college physical education. *Computer-Aided Design and Applications, 18*(S4), 152–162.

Li, Q., Li, Z., & Han, J. (2021b). A hybrid learning pedagogy for surmounting the challenges of the COVID-19 pandemic in the performing arts education. *Education and Information Technologies*. https://doi.org/10.1007/s10639-021-10612-1

Li, Z., Wang, Q. X., & Xu, L. P. (2020). Discussion on the construction and implementation of online and offline hybrid “golden course” in application-oriented universities. *Jiangsu Higher Education, 11*, 86–89.

Lord, G., & Lomicka, L. L. (2004). Developing collaborative cyber communities to prepare tomorrow’s teachers. *Foreign Language Annals, 37*(3), 401–408. https://doi.org/10.1111/j.1944-9720.2004.tb02698.x

Ma’arop, A. H., & Embi, M. A. (2016). Implementation of blended learning in higher learning institutions: A review of the literature. *International Education Studies, 9*(3), 41–52.
Mahaye, N. E. (2020). The impact of COVID-19 pandemic on education: Navigating forward the pedagogy of blended learning. Research Online. Available at: https://www.researchgate.net/profile/Mahaye-Ngogi-Emmanuel/publication/340899662_The_Impact_of_COVID-19_Pandemic_on_South_African_Education_Navigating Forward_the_Pedagogy_of_Blended_Learning/links/5ea315ae45851553f4aa31ae/The-Impact-of-COVID-19-Pandemic-on-South-African-Education-Navigating-Forward-the-Pedagogy-of-Blended-Learning.pdf

Means, B., Toyama, Y., Murphy, R., & Baki, M. (2013). The effectiveness of online and blended learning: A meta-analysis of the empirical literature. Teachers College Record, 115(3), 1–47.

Mecham, J. A. (2021). Biology & human rights: Short segments can broaden student acceptance. The American Biology Teacher, 83(1), 12–16.

Megahed, N., & Hassan, A. (2021). A blended learning strategy: Reimagining the post-Covid-19 architectural education. Archnet-IJAR: International Journal of Architectural Research. https://doi.org/10.1108/ARCH-04-2021-0081

Ministry of Education of the People’s Republic of China. (2019). “6-Excellent and 1-Top” education plan. Retrieved from http://www.moe.gov.cn/jyb_xwb/gzdt_gzdt/moe_1485/201904/t20190429_380009.html

Ng, T., Chu, S., Li, X., Reynolds, R., & Chan, M. (2020). Business (teaching) as usual amid the COVID-19 pandemic: A case study of online teaching practice in Hong Kong. Journal of Information Technology Education: Research, 19(1), 775–802.

Norberg, A., Dziuban, C. D., & Moskal, P. D. (2011). A time-based blended learning model. On the Horizon, 3, 207–216. https://doi.org/10.1108/10748121111163913

O’Connor, C., Mortimer, D., & Bond, S. (2011). Blended learning: Issues, benefits and challenges. International Journal of Employment Studies, 19(2), 63–83.

Panigrahi, R., Srivastava, P. R., & Sharma, D. (2018). Online learning: Adoption, continuance, and learning outcome—A review of literature. International Journal of Information Management, 43, 1–14.

Pokhrel, S., & Chhetri, R. (2021). A literature review on impact of COVID-19 pandemic on teaching and learning. Higher Education for the Future, 8(1), 133–141. https://doi.org/10.1177/2347631120983481

Qiu, X. C., & Xiao, L. H. (2020). Research on the development and verification method of flipped classroom teaching mode. Foreign Languages, 6, 147–156.

Shadiev, R., Hwang, W. Y., & Huang, Y. M. (2015). A pilot study: Facilitating cross-cultural understanding with project-based collaborative learning in an online environment. Australasian Journal of Educational Technology. https://doi.org/10.14742/ajet.1607

Shi, S., & Zainuddin, Z. A. B. (2020). A review of the research on blended learning in physical education in China and international. Journal of Critical Reviews, 7(11), 672–686.

Sun, Y. Z., Tang, J. L., & Cai, J. (2017). Research on the mixed teaching mode of humanities and general education for English majors. Audio Visual Foreign Language Teaching, 1, 8–15.

Tam, R. L. W. (2020). Computer-assisted instruction, changes in educational practice as a result of adoption of ICT. In Encyclopedia of education and information technologies (pp. 341–347). Springer International Publishing.

Thomas, A., & Stratton, G. (2006). What we are really doing with ICT in physical education: A national audit of equipment, use, teacher attitudes, support, and training. British Journal of Educational Technology, 37(4), 617–632. https://doi.org/10.1111/j.1467-8535.2006.00520.x

Thornbury, S., & McCarthy, M. (2016). Educational technology: Assessing its fitness for purpose. In The Cambridge guide to blended learning for language teaching (pp. 25–35). Macmillan.

Tu, C. H. (2001). How Chinese perceive social presence: An examination of interaction in online learning environment. Educational Media International, 38(1), 45–60. https://doi.org/10.1080/09523980010021235

United Nations Education Scientific and Cultural Organization. (2020). COVID-19 educational disruption and response. Retrieved from https://en.unesco.org/covid19/educationresponse

Varea, V., González-Calvo, G., & García-Monge, A. (2020). Exploring the changes of physical education in the age of Covid-19. Physical Education and Sport Pedagogy. https://doi.org/10.1080/17408989.2020.1861233

Wang, Y., & Chen, N. S. (2012). The collaborative language learning attributes of cyber face-to-face interaction: The perspectives of the learner. Interactive Learning Environments, 20(4), 311–330.

Wang, Y., & Chen, N. S. (2013). Engendering interaction, collaboration, and reflection in the design of online assessment in language learning: A reflection from the course designers. In Computer-assisted foreign language teaching and learning: Technological advances (pp. 16–39). IGI Global.
Wang, Y., Chen, N. S., & Levy, M. (2010). Teacher training in a synchronous cyber face-to-face classroom: Characterizing and supporting the online teachers’ learning process. *Computer Assisted Language Learning, 23*(4), 277–293. https://doi.org/10.1080/09588221.2010.493523

Woltering, V., Herrler, A., Spitzer, K., & Spreckelsen, C. (2009). Blended learning positively affects students’ satisfaction and the role of the tutor in the problem-based learning process: Results of a mixed-method evaluation. *Advances in Health Sciences Education, 14*(5), 725–738. https://doi.org/10.1007/s10459-009-9154-6

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Huaijin Liu is an associate professor of the School of Physical Education and Health, Nanning Normal University, China. His research interests include Development and Application of Educational Technologies in Physical Education, Innovation of Educational Technologies, and Curriculum Design and Evaluation of Physical Education. He has successfully obtained more than ten competitive grants and published more than 20 peer-reviewed articles in internal and international high-impact journals.

Jie Zhu is an associate professor of the Department of Health and Sciences, Wuhan Sports University, China. Her research interests include physical education, sport and exercise psychology. She has successfully obtained more than ten competitive research grants and published more than 10 peer-reviewed articles in internal and international high-impact journals.

Yanping Duan is an assistant professor of the Department of Sport, Physical Education and Health, Hong Kong Baptist University. She has diverse research interests in the areas of health behaviour promotion, sport psychology, and health education. Dr. Duan’s main research area focuses on the environmental, psychosocial and socio-cultural factors of physical activity, behaviour change process and its underlying psychosocial mechanism. She has published more than 50 peer-reviewed publications which cover diverse samples (e.g., university students and staff, office-based employees, older adults, cardiac rehabilitation patients) applying various approaches including observation, interview, questionnaire survey, onsite-, web- and app-based interventions. Currently, Dr. Duan is the Executive Committee member of Behaviour and Health Division of China Psychology Society, the Executive Committee member of Australasian Society for Physical Activity, the Associate Editor of Health Psychology Section in Frontiers in Psychology, and the Asian Editor of the American Journal of Health Behaviour.

Yingjun Nie is an associate professor of the Department of Health and Sciences, Wuhan Sports University, China. His research focus includes physical education and sport sciences. He has successfully obtained more than 20 provincial or national competitive research grants and published a series of research outputs in high-impact peer-reviewed journals.

Zhiwen Deng is a lecture of the College of Physical Education, Xi’an University, China. His research focus includes physical education and sport sciences. He has years of experiences in developing and implementing physical education curriculum in universities. Dr. Deng has successfully obtained four provincial research grants and published several articles in high-impact peer-reviewed journals.

Xiaobin Hong is an associate professor of the Department of Health and Sciences, Wuhan Sports University, China. His research interests include sport and exercise psychology. He has successfully obtained more than 10 competitive research grants and published more than 40 articles in high-impact peer-reviewed journals.

Matthew Haugen was a Fulbright Scholar in the Kinesiology Cultural, Interpretive, and Science Studies Program at the University of Illinois, Urbana-Champaign, from which he obtained a Ph.D. in 2021. His current research interest is sport development in China. He previously worked as the Head Tennis Coach in Hebei Province for the Chinese government Olympic development program. While in China, he completed a M.Ed. in Education, Physical Education Pedagogy, from Boise State University.

Julien S. Baker is Head of the Sport, Physical Education and Health Department at Hong Kong Baptist University. He is also the Director of the Centre for Health and Exercise Science Research. Professor Baker has published over 480 articles in peer reviewed journals. His research areas include, physical education, sport
sciences, oxidative stress, immune function, hormonal control of exercise, metabolism, cardiovascular disease, diabetes and obesity, vascular biology and biomechanics. He is a Fellow of the Physiological Society, and has fellowships with the Royal Society of Biology, the Human Biology Association, the Institute of Clinical Research and the Institution of Engineering and Technology. Prof Baker is also a member of the American Physiological Society, and the Society for the Study of Biology (SSOB). In addition, he has membership of the British Pharmacological Society, and the Federation of American Societies for Experimental Biology (FASEB). Professor Baker is an Honorary Professor at the University of Ningbo, and has Visiting Professor status at the University of Sydney and Ningbo University Ninth Hospital Medical Research Centre.

Wei Liang is a Postdoctoral Research Fellow of Centre for Health and Exercise Science Research (CHESR), Hong Kong Baptist University. He has diverse research interests in the areas of health and exercise sciences. Dr. Liang is interested in people’s multiple health behavior change process (e.g., physical activity and dietary behaviour) and its underlying psychosocial mechanism, mental health, and applying digital technologies into health and education domains. He has published more than 10 peer-reviewed publications in high-impact journals. Dr. Liang has experiences in conducting centre-based and web-based health promotion programs using both quantitative and qualitative approaches. Currently, Dr. Liang is the South East Asia subcommittee member of Australasian Society for Physical Activity (ASPA), the member of the International Society of Sport Psychology (ISSP), and the member of the Asian South-Pacific Association of Sport Psychology (ASPASP).

Authors and Affiliations

Huaijin Liu1,7 · Jie Zhu2 · Yanping Duan3,4 · Yingjun Nie2 · Zhiwen Deng5 · Xiaobin Hong2 · Matthew Haugen6 · Julien S. Baker3,4 · Wei Liang3,4

1 School of Physical Education and Health, Nanning Normal University, Nanning, Guangxi, China
2 Department of Health and Sciences, Wuhan Sports University, Wuhan, Hubei, China
3 Department of Sport, Physical Education and Health, Hong Kong Baptist University, Hong Kong, China
4 Centre for Health and Exercise Science Research, Hong Kong Baptist University, Hong Kong, China
5 College of Physical Education, Xi’an University, Xi’an, Shaanxi, China
6 Department of Kinesiology and Community Health, University of Illinois Urbana-Champaign, Champaign, USA
7 College of Physical Education, Hunan Institute of Science and Technology, Yueyang, China