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Effect of gender differences on 3-on-3 basketball games taught in a mobile flipped classroom

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ABSTRACT
Physical education emphasizes learning sports skills, which is why it is usually conducted in a face-to-face manner. Instructors focus on explaining rules and demonstrating moves, which the learners are required to repeat and imitate. Flipped classrooms have become a trend; thus, the present study investigated their influence on physical education. A mobile application for novice and advanced basketball players was developed and tested in a course teaching 3-on-3 basketball and various teaching methods were implemented to test for the effects of gender differences on learning outcome. The participants were students enrolled in the aforementioned course in a university in central Taiwan. 326 participants were included in the study, of whom 238 were male and 88 were female. The duration of the experiment was 5 weeks between May and June 2017, during which the correctness of moves, maneuverability, teamwork, sense of balance, and adaptability of the participants were evaluated and graded as their learning outcome. The research team observed the participants each week to gather empirical data for analysis. The results indicate that a mobile flipped classroom is the optimal teaching strategy, followed by projecting teaching; therefore, a mobile flipped classroom is the recommended approach to be integrated into physical education.

1. Introduction

Although Internet teaching has existed for years, its former heavy reliance on computers seriously restricted the locations and environments in which it can be applied. However, the growing popularity of mobile devices has largely lifted such restrictions. As smartphones and tablets gradually become the main source of information for most people, such intimacy with mobile technologies and the omnipresence of information have fundamentally changed people’s lifestyles. Furthermore, the advent of information technologies has also influenced education; numerous domains are now actively seeking new teaching methods with the assistance of cutting-edge technologies and media, to overcome the constraints of conventional practices for novel and profound learning experiences (Leask & Pachler, 2013).

Physical education has always been designed for the learning of sports skills. As such, it is mostly conducted in a face-to-face manner; an instructor demonstrates a move or explains the rules, and then asks the students to imitate and practice (Hill, 2014). From a strategic viewpoint, physical education does not emphasize students to actively look for and learn related knowledge;
instead, the students are placed in a relatively passive position to receive the knowledge and skills offered in the curriculum, rather than expanding their interest besides the sport or skill. Furthermore, whether the teaching contents are in the interest of the students poses a great challenge to the teachers; failing that, the class becomes like a routine, which is far from effective (Franklin & Smith, 2015).

However, the advent of mobile technologies has allowed easy access to the information that people require from the Internet. This practice is also applicable to physical education (Baran, 2014). Other than conventional classroom teaching, efforts can be made to integrate mobile devices into a mobile flipped classroom. Its highly interactive, easily operable, and multimedia-based characteristics create a platform for autonomous learning, allowing students to explore what they are interested in and absorb knowledge in greater depth. From the perspective of physical education, the autonomous learning and exploration experience that accompany mobile technologies allows students to acquire the skills, knowledge, and understanding of sports, which can aid in their classroom performance and practices in a considerable and positive manner (Crawford & Fitzpatrick, 2015). The differences between female and male physiology and sports performance have been discussed in numerous studies. In particular, the female anatomy and the menstrual cycle are variables that researchers have often examined to determine their effects on sports performance (Capranica et al., 2013). This paper will focus on the interaction between the teaching strategies and gender for learning performance.

Regarding university-level physical education in Taiwan, most students either enroll in a course because they are interested in it or because it is the only physical education course available in that school. Therefore, the heterogeneous composition of students often renders the course instructor, who follows conventional teaching practices, unable to pay equal attention to the whole class. Furthermore, the difference in the abilities of men and female to comprehend and absorb knowledge, as well as physiological differences, can prevent the course instructor achieving further success in class (Casey & Jones, 2011).

Figure 1One example is basketball. Players must be familiar with its fundamental concepts, rules, and skills, for a game to proceed smoothly; how well the participants understand the knowledge related to basketball is crucial. Furthermore, when a game is actually played, the players are heavily reliant on muscle strength, endurance, quick response, and body coordination; thus, physique and fitness are also critical factors for excelling in basketball (Walta & Nicholas, 2015).

Song and Kong (2017) examined the framework of affordances and constraints in BYOD-supported learning environment which is useful for understanding the factors that influence teachers’ perception and action on the affordances of BYOD. The present study conducted a flipped classroom experiment, which showcased basketball-related knowledge through multimedia and offered unique contents to participants of each gender (Mariana & Miruna, 2016). The goal was to balance the gender difference in learning through the autonomous flipped learning of the students, and the diversified choice of learning channels. The results were expected to offer teachers greater control on the learning progress of the students and advise them based on their characteristics.

In summary, the present study examined the following topics:

1. The effectiveness of various basketball teaching strategies pertaining to students’ performance.
2. The effectiveness of a basketball-based flipped classroom activity on the class performance of students of different genders.

2. Literature review

2.1. Mobile and ubiquitous learning

Mobile and ubiquitous computing is the concept that, through ubiquitous cyberspace, each and every person becomes a tiny node in a gigantic computing network and these tiny nodes interact
with the system through wireless mobile devices (Hwang & Tsai, 2011). Hence, what mobile and ubiquitous computing emphasizes is not a mere person or object, but the human–mobile device interaction. As such, mobile and ubiquitous computing technologies satisfy users’ daily information needs in life, and every piece of information becomes a module that, through searching, mixing, and replicating, can be transformed into personalized information. In essence, a society that embraces mobile and ubiquitous computing becomes a society in which technology is ubiquitous and humanized (Chu, Hwang, & Tsai, 2010).

Mobile and ubiquitous learning is characterized by freedom and convenience, personalized learning anytime and anywhere, autonomous learning, and resource sharing and interaction:

2.1.1. Freedom and convenience
Wireless communication enables mobile and ubiquitous learning to expand beyond the confines of a school campus. Moreover, the freedom and convenience of mobile technologies offer greater opportunities to integrate learning into everyday life (Lindquist et al., 2007). The greatest advantage of mobile and ubiquitous learning is that it integrates learning with daily life so well that learners are often not even aware they are learning, which is an ideal state that is least affected by learning problems.

2.1.2. Personalized learning anytime and anywhere
One notable character of mobile technologies is the integration of telephone, camera, and the multimedia player and applying personalized mobile technologies to everyday life has become crucial for lifelong learning. Mobile and ubiquitous learning provides a highly comprehensive digital learning environment, and the mobile devices facilitate a high degree of personalization and contextualization, enabling learning to be performed anytime and anywhere (Hwang, Tsai, & Yang, 2008).

2.1.3. Autonomous learning
Mobile and ubiquitous learning is highly adaptable, allowing students to acquire correct information with the correct method in the correct place. In mobile and ubiquitous learning, learners’ learning behaviors are spontaneous and autonomous, with an emphasis on the learning task, for which mobile technologies facilitate enhanced self-learning ability (Huang & Chiu, 2015).

2.1.4. Resource sharing and interaction
The learning environment of mobile and ubiquitous learning aims to increase the convenience of learning, ease the sharing of resources, and improve student–teacher interactions. It allows convenient acquisition of knowledge both at home and in school, as well as allowing teachers and parents to easily supervise students’ learning progress (Hwang, Lai, & Wang, 2015). Presently, mobile and ubiquitous learning has been implemented in all levels of education in Taiwan. Moreover, it has even been implemented in numerous kindergartens, enabling parents to monitor their children’s activities in the institution online in real-time, as well as allowing parents access to their children’s learning progress and interacting with the teachers online.

2.2. Flipped classroom
The concept of a flipped classroom was devised by two chemistry teachers, Jon Bergmann and Aaron Sams, at the Woodland Park High School in the United States in 2007. To enhance students’ learning motivation and attendance, they recorded their lectures, and enriched the footage with additional materials, which were then edited with additional comments and explanations. Subsequently, they uploaded the videos to YouTube for their students to view online on their own, which turned out to be an effective method. They further improved the method by requiring students to view the videos at home in advance, and using class hours to discuss what they had learned and answer questions. After class, the students can view the videos again for enhanced effectiveness, and they can discuss the materials as an extension of the student–teacher interactions during class. Thereafter,
this strategy of viewing videos before class, discussing them during class, and continued learning after class became known as the “flipped classroom.”

What is innovative about flipped classrooms is not that the teachers compile video footage to aid teaching, but that they develop a framework for the adaptive learning of students, and it also enables increased student–teacher interactions and discussions in class (Sams & Bergmann, 2013). The goal is not to replace the teacher but to encourage autonomous inquiry and collaboration among students outside of class hours; specifically, it encourages interactive learning among peers. During class, the teacher plays a guiding and assistive role instead of taking full control of the class. In essence, flipped classrooms totally “flip” conventional teacher and student roles. Moreover, what conventionally takes place in the classroom now takes place outside of it (Lage, Platt, & Treglia, 2000).

Advantages of flipped classrooms are numerous, including increased student–teacher interaction, and improved practical understanding of numerous subjects, such as economics (Roach, 2014), nutrition science (Gilboy, Heinerichs, & Pazzaglia, 2015), and even arts and crafts (See & Conry, 2014). The present study developed a game-based programming learning system that was more interactive than the aforementioned video footage, and applied it in a flipped classroom to observe the differences with video footage in terms of learning effectiveness.

2.3. Female physiology and sports performance

Under the dynamic influence of the menstrual cycle, sports performance of female appears to be higher during the late follicular and early luteal phases. Additionally, a dynamic change with time was observed in female basal body temperature, jumping performance, and fatigue index during a menstrual cycle, which indicates that menstruation’s influence on sports performance is not restricted to one single day, but lasts for several days (Constantini, Dubnov, & Lebrun, 2016). However, alternative opinions exist, such as that of DiBrezzo, Fort, and Brown (1991), who discovered menstrual cycle to have little influence on body weight, body fat percentage, knee extension and flexion strength, or endurance. Despite the inconsistent findings, menstrual cycle has been acknowledged as a possible influence on female sports performance.

In addition, due to anatomical differences, the number of noncontact anterior cruciate ligament injuries female have is six to eight times higher than that of men. The primary reason has been attributed to the wider female pelvis, which creates a larger angle between the femur and tibia; and the estrogen receptors in the anterior cruciate ligament, which can weaken during the menstrual cycle. Therefore, the female anatomy is more prone to injuries. Moreover, female differ from male in muscle mass, muscle strength, and body coordination (Arendt & Dick, 1995).

Data from the 2013 Taipei Fubon Marathon indicated that the top 10 female runners in all age and distance groups invariably required more time than their male counterparts to complete the courses. In the 9 km, half marathon, and full marathon groups, female runners required 30.32%, 32.76%, and 36.85% more time, respectively, than male runners. These figures suggest that females are generally not as strong in muscle strength as male, at least in terms of road running (March, Vanderburgh, Titlebaum, & Hoops, 2011).

3. Instrument

The present study developed a basketball teaching mobile application (henceforth, app), and applied an experimental method to examine its effectiveness in learning basketball-related skills and knowledge. The study location was a university in central Taiwan. The school’s eight classes taking the Physical Education-Basketball course were divided into the Flipped Classroom with app (FCA), Projecting Teaching (PT), and Traditional Teaching (TT) groups, whose performances were compared to determine the difference between learners of different genders, and the influence of flipped teaching.
3.1. Research framework

3.1.1. Independent variables
In this study, the independent variables were “Teaching Strategy” and “Gender.” Teaching Strategy refers to how the teachers taught basketball. Of the three groups, the TT group was taught face-to-face, with the teacher personally demonstrating each skill and move, followed by the students practicing what they had just learned. The PT group was taught by the teacher using a projector to display the app contents in the classroom to augment his or her teaching. The FCA group was taught by the teacher demanding the students to install the app, follow the teacher’s predetermined plan to learn basketball on their own, share and discuss what they learned in class, and review the materials at home.

3.1.2. Dependent variables
In this study, the dependent variables were the learning performance of students of different genders; specifically, two instructors with more than 10 years of basketball teaching experience were recruited to evaluate the students’ pretest and posttest performances in terms of the correctness of moves, maneuverability, teamwork, sense of balance, and response, and to determine any significant improvement in performance. The results were expected to provide a reference for developing gender-specific teaching strategies.

3.1.3. Control variable
The control variables were the pretest performance of the students, the same teacher, and the same venue.

3.2. Developing teaching strategies
The proposed app comprised four modes, namely “How to Play,” “The Referee,” “World of Basketball,” and “The Beauty of Basketball.” The How to Play feature addressed individual and team techniques and strategies. It contained 70 video clips in which the NTNU MASTER Men’s Basketball team and their coach, Tzu-Wei Chen, were invited to demonstrate basic moves, tactics, and positioning strategies. This was the debut of Chen’s unique training methods on multimedia. The Referee taught basic rules, audience etiquettes, techniques, and tactics for basketball, as well as the signature moves of famous basketball stars. World of Basketball was designed to feel like a ride in a time machine, through which the viewer was introduced to the history of basketball, with particular emphasis on the NBA and Chinese Basketball Alliance. Also introduced were well-known basketball players and their news, new trends in the industry, and the Taiwan Sports Lottery. The Beauty of Basketball shared the beauty and culture of basketball with the viewer, such as related popular culture, the evolution of basketball clothing and apparel, photographic techniques for taking static and action pictures of a basketball game, and basketball courts and stadiums. Because the app covers a wide variety of topics, such as moves, tactics, rules, famous players, and history, users could browse topics of interest and learn new information. Through developing this app, the study expected to improve students’ interest and enhance their passion for basketball (Figure 1).

As previously mentioned, the teaching methods examined were FCA, PT, and TT. TT refers to the teacher teaching basketball face-to-face, personally demonstrating each skill and move, after which the students are required to practice what they have just learned; PT refers to the teacher using a projector to display the app contents in the classroom to augment his or her teaching; and FCA refers to the students installing the app to learn basketball on their own, share and discuss what they have learned in class, and review the materials at home.

Regardless of the teaching method, a class lasted 100 minutes. In the first week, the first 80 minutes were devoted to a pretest, and the remaining 20 minutes were used to explain the objectives of the course. From the second to the fifth week, the classes would commence with a 20-minute warm-up first. Subsequently, the FCA group spent 50 minutes discussing, asking questions, and
practicing what they have learned from the materials they were required to view at home in advance. The PT group spent 50 minutes watching the slideshows, explained and demonstrated by the teacher, and then practiced in small groups. In the TT group, the teacher used a white board to explain tactics, and then let the students practice in small groups. The remaining 30 minutes were devoted to team competition. The difference between the three groups was the teaching methods they were subjected to (Figure 2).

4. Experimental design

4.1. Participants

The participants of the experiment were 326 university students whose average age was 20 taking a Physical Education-Basketball course in a university in central Taiwan. They were divided into eight classes and all taught by the same teacher. By random, three of the classes were assigned to the
FCA group, which totaled 122 people (male: 95, female: 27). Another three classes were assigned to the PT group, which totaled 119 people (male: 80, female: 39). The remaining two classes were the TT group, which totaled 85 people (male: 63, female: 22). The course was concluded with a 3-on-3 competition at the end of semester. The eight classes were taught using the same materials (techniques, rules, and tactics) and had comparable class hours.

4.2. Experimental procedure

This study integrated the concept of a flipped classroom into basketball education, and through the digital display of related knowledge and students’ self-participation, the method was expected to enhance their learning outcome. At the beginning of the course, all participants were required to sit a pretest, after which they were divided into three groups and subjected to one of the three teaching methods for a whole semester. A 3-on-3 competition was held at the end of the semester as the posttest for the participants (Figure 3).

4.3. Analytic tools and methods

4.3.1. Performance evaluation

Participants’ performance was evaluated by two physical education teachers with more than 10 years of experience teaching basketball. The aspects evaluated were correctness of moves, maneuverability, teamwork, sense of balance, and adaptability of the students; the ratings were either very good, good, ordinary, flawed, and very flawed, which were awarded 5, 4, 3, 2, and 1 points, respectively. The results were tested for reliability using Cronbach’s α, which yielded a result of 0.833. The scores were added to produce a total score, ranging from 5 to 25. In the 3-on-3 competition, participants from the same class were dressed in jerseys of the same color, albeit with varying numbers, for the convenience of the teachers’ evaluations. The participants relied on teamwork, coordination, dribbling, quick response, and tactics to finish the game, which was taped for subsequent reviews.

According to Table 1, the table shows the pre and post learning performance of five factors for students. The three groups’ post performance in correctness of moves was FCA (mean (M) = 4.08,
Table 1. Descriptive statistics of the pre and post learning performance of five factors between teaching strategies and gender.

<table>
<thead>
<tr>
<th>Factor</th>
<th>FCA</th>
<th>PT</th>
<th>TT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>N</td>
<td>95</td>
<td>27</td>
<td>122</td>
</tr>
<tr>
<td>Correctness of moves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>1.94</td>
<td>0.53</td>
<td>1.76</td>
</tr>
<tr>
<td>Posttest</td>
<td>4.06</td>
<td>0.45</td>
<td>4.15</td>
</tr>
<tr>
<td>Maneuverability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>1.54</td>
<td>0.47</td>
<td>1.62</td>
</tr>
<tr>
<td>Posttest</td>
<td>4.00</td>
<td>0.49</td>
<td>4.15</td>
</tr>
<tr>
<td>Teamwork</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>1.56</td>
<td>0.47</td>
<td>1.43</td>
</tr>
<tr>
<td>Posttest</td>
<td>4.06</td>
<td>0.50</td>
<td>4.20</td>
</tr>
<tr>
<td>Sense of balance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>1.63</td>
<td>0.49</td>
<td>1.39</td>
</tr>
<tr>
<td>Posttest</td>
<td>4.08</td>
<td>0.51</td>
<td>4.04</td>
</tr>
<tr>
<td>Adaptability</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>1.76</td>
<td>0.45</td>
<td>1.69</td>
</tr>
<tr>
<td>Posttest</td>
<td>4.17</td>
<td>0.51</td>
<td>4.11</td>
</tr>
<tr>
<td>Learning performance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>8.43</td>
<td>1.76</td>
<td>7.89</td>
</tr>
<tr>
<td>Posttest</td>
<td>20.38</td>
<td>2.04</td>
<td>20.65</td>
</tr>
</tbody>
</table>
standard deviation (SD) = 0.44) > PT (M = 3.67, SD = 0.43) > TT (M = 2.73, SD = 0.65), clearly indicating that the flipped classroom outperformed the other two in this regard. In terms of maneuverability, FCA (M = 4.04, SD = 0.46) > PT (M = 3.58, SD = 0.41) > TT (M = 2.81, SD = 0.57), indicating that the flipped classroom outperformed the other two in this regard. In terms of teamwork, FCA (M = 4.10, SD = 0.47) > PT (M = 3.63, SD = 0.46) > TT (M = 2.83, SD = 0.56), again indicating that the flipped classroom outperformed the other two in this regard. In terms of sense of balance, FCA (M = 4.07, SD = 0.49) > PT (M = 3.59, SD = 0.42) > TT (M = 2.64, SD = 0.58), indicating that the flipped classroom outperformed the other two in this regard. In terms of adaptability, FCA (M = 4.16, SD = 0.49) > PT (M = 3.61, SD = 0.40) > TT (M = 2.64, SD = 0.53), indicating that the flipped classroom outperformed the other two in this regard. Overall, FCA (M = 20.44, SD = 1.91) > PT (M = 18.07, SD = 1.52) > TT (M = 13.65, SD = 2.54), indicating that the learning outcome of the FCA group was greater than the PT group, which was in turn greater than the TT group.

In terms of gender difference for Table 1, the FCA group male learning outcome (M = 20.38, SD = 2.04) actually surpassed female learning outcome (M = 20.65, SD = 1.35); in the PT group male learning outcome (M = 18.16, SD = 1.42) was roughly comparable with female learning outcome (M = 17.90, SD = 1.72); and in the TT group, male learning outcome (M = 14.19, SD = 2.36) surpassed female learning outcome (M = 12.10, SD = 2.44).

5. Experimental results and analysis

5.1. Analysis of learning performance of different teaching strategy

This study investigated learning outcome under various teaching methods, from which it expected to develop teaching strategies. Before the experiment, a test of learning performance was conducted to understand the differences in the skills of five factors among the three groups. A one-way ANCOVA was performed on the teaching strategies and pretest results, which showed that the three groups of students had equivalent prior skills (F = 1.286, p = .278 < 0.05). Therefore, the use of ANCOVA tests on the pretest and posttest scores was valid. According to Table 2, the results showed that there was a significant difference among the three groups (F = 297.280, p < .001), indicating that the students’ posttest scores were affected by the different learning treatments. The adjusted mean score of the FCA was 20.44; it was 18.07 for the PT and 13.65 for the TT group. Furthermore, the data showed that the learning performance of the PT students was better than that of the students in the TT group, while that of the students in the FCA group was better than that of those in the PT group and of those in the TT group.

Accordingly, it was found that the FCA learning strategy was helpful to the students in terms of improving their learning performance in basketball learning, while the integration of TT and the project teaching did not perform as well as expected. This might be due to no extended materials after school, which caused difficulty for the students.

5.2. The two-way ANCOVA result of learning performance

This study analyzed the participants’ pretest and posttest scores to determine if differences in gender yielded differing results under the various teaching methods. For this purpose, a two-way ANCOVA

<table>
<thead>
<tr>
<th>Teaching strategy</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>F</th>
<th>Pair-wise comparisons</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCA</td>
<td>122</td>
<td>20.44</td>
<td>1.91</td>
<td>279.280***</td>
<td>FCA &gt; PT</td>
</tr>
<tr>
<td>PT</td>
<td>119</td>
<td>18.07</td>
<td>1.52</td>
<td></td>
<td>PT &gt; TT</td>
</tr>
<tr>
<td>TT</td>
<td>85</td>
<td>13.65</td>
<td>2.54</td>
<td></td>
<td>FCA &gt; TT</td>
</tr>
<tr>
<td>Total</td>
<td>326</td>
<td>17.81</td>
<td>3.32</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

***p < .001.
Analysis of variance was conducted to compare the learning outcomes under each method and gender.

A two-way ANCOVA was employed using the pretest scores of learning achievement between strategies and gender as a covariate and the posttest scores of learning performance as the dependent variable. As shown in Table 3, a significant difference was found for the interaction between learning strategies and gender ($F = 8.063$, $p < .001$, Partial $\eta^2 = 0.048$), and hence a simple main-effect analysis was performed. By employing the simple main-effect analysis, correlational effects between gender and learning strategies in different situations were found, as shown in Table 4, while the descriptive statistics of the two groups’ learning achievements are reported in Table 1. No significant difference in the FCA teaching strategy ($F = 0.274$, $p < .05$) showed that, but in the FCA group, the female students (Mean = 20.65) performed better than male students (Mean = 20.38) in terms of learning performance. A significant difference was also observed for the female students ($F = 124.407$, $p < .001$), meaning that the female students with an FCA teaching strategy (Mean = 20.65) performed better than the PT teaching strategy (Mean = 17.90), and better than the TT teaching strategy (Mean = 12.10).

As shown in Figure 4, interaction was found between teaching strategies and gender on learning performance. It was observed that, compared to the gender, it is more beneficial for the male students with a PT and TT learning strategies. Moreover, it is more beneficial for the female students with FCA learning strategies.

### 6. Conclusions and suggestions

In this study, a FCA and projecting materials were developed, and an experiment was conducted to explore its impacts on students’ learning performance in basketball courses. Such a result is similar to the findings of Lai and Hwang (2016), who implemented a self-regulated flipped classroom in a mathematics course, and reported that the students’ learning achievement was significantly improved. It is inferred that the effects of a flipped classroom are mainly on the students’ learning performance.
achievement. In addition, the FCA students showed a high level of interest in using the mobile device to learn, no matter whether gender was employed or not. This suggests that presenting learning content in the mobile device form could be an effective way of promoting students' learning motivation.

In addition, the interaction between the teaching strategy approach and the students' gender was investigated as well. The experimental results showed that there was a significant interaction between the teaching strategy approach and the students' gender on the students' learning performance. Furthermore, when using the FCA strategy, male and female students performed better than those using the projecting strategy and the traditional strategy. It is inferred that, to deal with the knowledge with a complex move, students' learning performance can generally be promoted with the help of the FCA, which enables them to see the whole complex moves of the learning content. Moreover, the approach would benefit students more if their personal factors, such as knowledge levels or preferences, could be taken into account.

This study examined suitable teaching strategies for gender learners and found that, compared to the gender, it is more beneficial for the male students with a projecting learning strategy and traditional learning strategies. Moreover, it is more beneficial for the female students with a flipped learning strategies. It is inferred that, face to complex moves, female students have more chances of watching and repeating their practice on the mobile device.
Integrating the app-enhanced learning outcome. Therefore, the author suggests integrating the FCA and PT methods. This will not only enable students to preview and review the materials, the in-class lecture will further strengthen students’ understanding of the topics and help them in learning the knowledge. If greater manpower and resources become available for the further development of the app to improve its contents and optimize its user interface, the app can become a convenient app for learners to learn basketball.

From the experimental process, various levels of familiarity with basketball could be observed among the participants. Those who liked to play with ball games or had a longer attention span performed well in all of the evaluated aspects. However, this study had some limitations. Students who lacked interest were generally unable to achieve a favorable learning outcome. Furthermore, the time allocated for the students to answer the questionnaire appeared to be too short, which may have influenced the experimental results.

Moreover, as a preliminary investigation of the effect of gender differences in learning outcome under various teaching strategies, the present study should also have accounted for personal traits, such as prior knowledge and learning preference. This would have been a relatively ideal approach for the development of teaching strategies, which is particularly true in this era, as emergent technologies and teaching strategies are being constantly proposed.

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