Sportis
Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity

Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

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Vol. 9, n.º 2; p. 413-438, may 2023. https://doi.org/10.17979/sportis.2023.9.2.9494

The Effect of Flipped Learning Physical Education on Students' Knowledge, Skills and Motivation

El efecto de la educación física Flipped Learning en el conocimiento, las habilidades y la motivación de los estudiantes

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Editorial shedule: *Article received 24/01/2023 Accepted: 10/04/2023 Published: 01/05/2023*
https://doi.org/10.17979/sportis.2023.9.2.9494

For cite this article you must use this reference:
Karaman, B.; Arslan, Y. (2023). The Effect of Flipped Learning Physical Education on Students' Knowledge, Skills and Motivation. Sportis Sci J, 9 (2), 413-438 https://doi.org/10.17979/sportis.2023.9.2.9494

Authors' specific contribution: Introduction: BK; Method: BK,YA; Results: BK,YA; Discussion: BK.

Declaration of Conflicting Interests: The authors declare no conflict of interest.

Funding disclosure: There was no funding for this research.

Note: This article was produced from the first author's thesis under the supervision of the second author.

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Abstract

It seems inevitable that the developing technology will be integrated into the field of education. The application of Flipped Learning (FL), which includes a technology component, in physical education will enable us to better understand the reflections of the approach on the lesson. The purpose of this study was to examine the effectiveness of the FL on students' knowledge, motivation and skill development in physical education. A pretest-posttest matched control group design was used. The participants, whose mean age is 14.5±1.0, consists of 62 high school students who have just started their school, including 32 experimental (11 boys, 21 girls), 30 control (10 boys, 20 girls). The FL, which was used in physical education, increased students' knowledge (Z= -4.18, p= .00) and motivation (Wilks' λ= .16, F(1, 60)= 55.60, p= .00, η2= .83) , according to the findings . It only had an impact on the passing technical skill of the volleyball, which was utilized to assess skill development (M= 3.00, Sd= 1.07; p< .05) . As a result, this study offers some evidence that the FL is an important factor affecting students' volleyball content knowledge in physical education and can help to motivate them to participate the lesson. Further studies are needed to test the effect of the FL on skill development in physical education.

Keywords: Flipped classroom; pedagogy; motivation; volleyball skills; volleyball content knowledge.

Resumen

Parece inevitable que la tecnología en desarrollo se integre en el campo de la educación. La aplicación de Flipped Learning (FL) , que incluye un componente tecnológico, a la educación física nos permitirá comprender mejor los reflejos del enfoque en el curso. El objetivo de este estudio es examinar el efecto de FL en el conocimiento, la motivación y el desarrollo de habilidades de los estudiantes en educación física. Se utilizó un diseño de grupo de control apareado pretest-postest. Los participantes, cuya media de edad es 14,5±1,0, son 62 estudiantes de secundaria que acaban de comenzar su escuela, incluidos 32 experimentales (11 niños, 21 niñas), 30 de control (10 niños, 20 niñas). De acuerdo con los hallazgos, la FL utilizada en educación física incrementó el conocimiento (Z= -4.18, p= .00) y la motivación de los estudiantes (λ de Wilks= .16, F(1, 60)= 55.60, p= .00, η2 = .83). Por otro lado, el desarrollo de la habilidad en voleibol tuvo un efecto solo en la habilidad técnica de pase (M= 3.00, Sd= 1.07; p< .05). En conclusión, este estudio proporciona alguna evidencia de que FL es un factor importante que influye en el conocimiento del contenido de voleibol de los estudiantes en educación física y puede ayudar a motivarlos a participar en clase. Se necesitan más estudios para probar el efecto de FL en el desarrollo de habilidades en educación física.

Palabras clave: Aula invertida; pedagogía; motivación; habilidades de voleibol; conocimiento del contenido de voleibol.

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Introduction

Many changes in lifestyle have undoubtedly happened as a result of technology advancements during the previous two decades. People have adapted to technology advancements for a variety of objectives, including collecting information and communicating (Ratheeswari, 2018; Hrastinski & Ekman Rising, 2020). Today's pupils, known as digital natives, were born into this era and speak the language of computers, films, games, and, in short, technology. İn this sense, teachers should favor teaching methods in the language they speak in order to increase digital natives' knowledge and abilities (Prensky, 2001). So, the teacher can improve learning efficiency by designing the lesson around technology-supported learning approachs.

FL is one of innovative approach that involves technology componen. By delivering the lesson's material outside of the classroom with online video accompaniment, the focus is changed from teacher-centered instruction to student-centered learning. These materials, which are offered outside of the classroom, are presented in conformity with the course topic as established by the teacher and in a controlled way (Bergmann & Sams, 2012). More time will be made available in the course for exercises that serve to reinforce these subjects (Roehl, Reddy ve Shannon, 2013; Tucker, 2012). FL is defined as a didactic approach reinforced through practices (Østerlie, Sargent, Killian, Garcia-Jaen, García-Martínez & Ferriz-Valero 2022). In this sense, FL, is recognized as an approach that allows students to learn at their own pace (Autapao & Minwong 2018) and improves student success (Adams & Dove 2018). Recent literature reviews show that it has a positive impact on students' class participation (Huang, Hew, & Lo, 2019) and problem-solving skills (Zhao & Kang, 2020; Sumadyo, Santoso, Sensuse & Suhartanto, 2021).

FL strengthened with practices is seen as an important pedagogical approach that can also be used in physical education and sports lessons (PE) (Sargent & Casey, 2019). PE, which is especially characterized by the concepts of practice and activity, will not ignore the cognitive dimension of the course with the FL. In order to construct a healthy physique or to perform the proper motions, it is critical to have a strong knowledge basis in sports education.

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The student may get knowledge on the subject and configure it in practice with the video assistance offered before the class using FL (Demirer & Aydn, 2017; Yıldız & Ortacıoğlu, 2017; Kavanagh, Reidsema, McCredden & Smith, 2017). Thus, with the FL applied in PE, an increase in the knowledge desired to be gained by the student can be achieved (Østerlie, 2020; Østerlie & Mehus, 2020; Chiang, Yang, & Yin, 2018). FL can also provide an opportunity for extra learning (Killian, Kinder & Woods, 2019). However, there has been little study on its application in PE , and there is also a lack of a framework for understanding the influence of FL on the lesson. In the intervention portion of this study, there is a detailed explanation of the in-class application.We presume that the student has learned knowledge, but that knowledge alone will not help us assess the success of FL if it is not combined with in-class practice.Students will participate in-class studies based on their interest and pleasure for the course. They must act with a purpose of their own volition in order to fully engage in the classroom instruction. Given this knowledge, Self-Determination Theory (Ryan & Deci, 2017), one of the few motivational theories emphasizing on the significance of choice and autonomy in human action, will be an effective motivation framework for FL. When the self-determination theory is studied with FL, it sheds light on the endeavor to internalize the behavior that influences course participation with cognitive satisfaction. Østerline 2020, stated that the videos prepared for FL contributed to high motivation to participate in PE. Although there are limited research on FL used in PE, studies on secondary and high school students have shown excellent results in the motivation of students towards the lesson (Østerlie & Mehus, 2020; Østerlie, 2020).

It is aimed to allocate more time to practises in addition to cognitive development by saving in-class time in the nature of FL (Hwang, Lai, & Wang, 2015). It is thought that allocating more practical time to the physical education lesson, where the application aspect is at the forefront, will increase the physical development as well as the cognitive development. However, no research has been encountered that examines the psychomotor development of the student with the FL applied in high school PE. A research (cognative, affective, psychomotor), which deals with the physical education holistically, will provide guidance to

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practitioners and researchers by detailing the effectiveness of the FL. The FL approach will be used with volleyball teaching, which is included in the students' current lesson plan and includes many techniques. Therefore, the aim of this research is to examine the effect of high school students on motivation, volleyball knowledge and volleyball skill development within the framework of FL.

Method

Desing

Quantitative research paradigm was conducted to examine the effect of physical education taught with the FL on students' knowledge, skills and motivation levels. In the study, a multi-subject experimental design was used to understand, manipulate, interpret and analyze the dependent variables affected by the independent variable. In order to explore the relationship between the variables *(knowledge, motivation and skill),* a pretest-posttest matched control group design was used. Group matching method can be used as an alternative in researches conducted in the continuing education environment or in cases where random assignment cannot be made for matching groups (Büyüköztürk, Kılıç Çakmak, Erkan Akgün, Karadeniz & Demirel, 2017; Fraenkel, Wallen & Hyun, 2011).

In this study, firstly, groups were matched with the Readiness Scale For Flipped Learning in Physical Education and Sports (Karaman & Arslan, 2019). Then, Behavioral Regulations in Sports Scale (BRSS) (Sarrazin, Appleton, Ramis, Gobbi, Erturan, Krommidas, Holzweg, & Papaioannou, 2019), Volleyball Knowledge Test (VKT) (Yüksel, 2014) and Volleyball Skill Test Battery (VSBT) (Gabbett & Georgieff, 2006) were applied as pre-test and post-test. The study covers 7 weeks in which the measurements are made in the first and last week.

Setting and Participants

The participants were 62 hight school students (MAge= 14.5±1.0) from a public school in the Spring term of 2020. Two groups were formed as the control group (10 boys, 20 girls) and the experimental group (11 boys, 21 girls). The Physical Education and Sports

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Readiness for Flipped Learning Scale was used to match the groups and the 2X5 MANOVA results regarding the average scores of the factors (*Learner control and self-directed learning, Technology self-efficacy, Technology self-efficacy, Motivation for learning, Doing previews*) were examined. There was no significant difference between the experimental and control groups (Wilks' λ= .90, F(1, 60)= 1.34, p= .26, η2= .09).

During the study, volleyball was taught to the experimental group by using FL in physical education and to the control group by using traditional teaching methods. Participants did not take any volleyball lessons or courses in high school. The physical education teacher has 9 years of experience and has not previously lessons students in these classes. She also had all the necessary information about the FL and traditional teaching methods used in physical education.

Written informed consent was obtained from all the participants and their parents. All students and parents were notified regarding the research procedures, requirements, benefits, and risks before giving informed consent. The study was approved by the local Ethics Committee and Provincial Directorate of National Education. The study was conducted in a manner consistent with the institutional ethical requirements for human experimentation in accordance with the Declaration of Helsinki.

Data collection and procedures

Motivation

The Behavioral Regulation in Sport Questionnaire, originally developed by Lonsdale, Hodge and Rose (2008) and adapted to Turkish by Sarrazin et al. (2019) with the name of the Behavioral Regulations in Sports Scale (BRSS) was used measure the motivation levels of the students in the experimental and control groups.

Organismic Integration Theory, which is included in the Self-Determination Theory, focuses on the internalization of people's social and interpersonal behaviors (Ryan & Deci, 2017). This theory was preferred because it focuses on the importance of internalizing the behavior of the student with FL so that it becomes permanent. The Organismic Integration

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Theory based BRSS Scale has five factors and 20 items: intrinsic motivation *(e.g. because I find it exciting)*, identified regulation *(e.g. because I learn good things for my health)*, introjected regulation *(e.g. because if I don't join I feel guilty)*, external regulation *(e.g. because people force me to participate)* and amotivation *(e.g. but I question why I participate in physical education)* (Sarrazin, et. al., 2019).

To determine the validity and reliability of the scale on high school students, it was applied to 104 high school students. Confirmatory factor analysis (CFA) results were examined as proof of validity (χ^2/df= *1.58, RMSEA= .07, SRMR= .07, NFI= .94, CFI= .96, GFI= .91, NNFI= .97*). Cronbach's alpha coefficients were calculated for the reliability of the scale in terms of internal consistency ($.70< \alpha < .89$). Based on the results of the pilot study, it was determined that the BRSS scale produced valid and reliable scores.

Volleyball theoretical knowledge (VKT)

In the study, the VKT developed by Yüksel (2014) was used to measure the students' basic theoretical knowledge of volleyball. In the original test, there are 14 questions with 4 options. In addition to the initial test, four more questions were prepared once they were shown to a Turkish expert. The written questions were presented to a volleyball expert, a program development expert, and an measurement and evaluation expert who were all knowledgeable about the subject, and their responses were solicited. The final trial test was created by making additional corrections on the questions. Then the VKT was administered to 89 students in a public high school after the necessary permissions were obtained. Item-test statistics and item average points for 27% of top and bottom groups were calculated (Büyüköztürk, Kılıç Çakmak, Erkan Akgün, Karadeniz and Demirel, 2019). KR-20 coefficient was found .50 and Paired-t test result for 27% of top and bottom groups' average scores was not significant ($p>.05$). Results showed that the 12-question Volleyball Knowledge Test can produce valid and reliable scores for high school students and can distinguish students who have basic volleyball knowledge from students who do not have this knowledge.

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Volleybal Skill Testing Battery (VSTB)

Volleyboll Skill Testing Battery (VSTB) developed by Gabbett and Georgieff (2006) was used to measure the skill development of the students in the psychomotor field. The test battery covers spiking, passing, setting and serving ability. However, the spiking ability was not included in the test in the study.

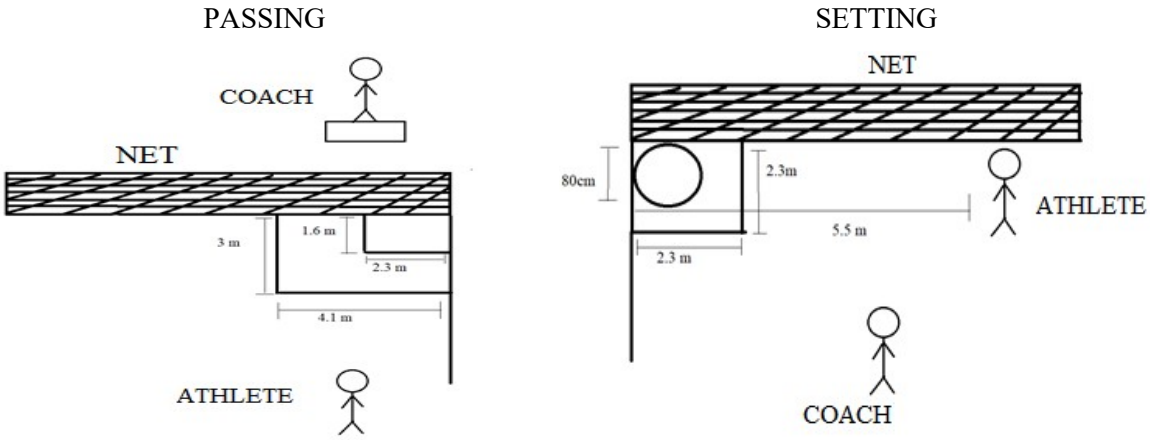

Figure 1. Schematic illustration of passing and setting task

Passing ability of the students was evaluated by determining their ability to pass the target on the right side of the net. The target size was 1.6m long and 2.3m wide. Another area around the target, 4.1 wide and 3 m long, where a pass can be made has been determined. A coach, who was about 10 meters away from the student, made a pass to the student. Students were given 6 shots. 2 points were awarded for the ball thrown by the student to the target, and 1 point was given for the ball thrown into the area outside the target. Passes that did not reach any of the designated areas were not scored.

The setting ability of the students was evaluated by determining their ability to pass the ball to the target next to the net. A coach, who was about 5 m away from the student, threw a ball to the student. Students were asked to throw the ball to an 80cm diameter target.

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A 2.3m-long area where a pass can be made outside the target has been determined. The students were given 6 shots. 3 points for the ball thrown into the target circle. 2 points were awarded for the ball thrown around the target circle and 1 point was awarded for the shot made outside the circle.

Since it was sufficient for the ball to pass through the net in the serving skill, a specific shooting technique was not emphasized. The students were given six shots. 1 point is awarded for each ball thrown from the service line to the other court.

The movements of the students during the shooting were recorded with cameras located about 5 meters from behind and next to them. The video recordings were watched by three trainers who were experts in the volleyball branch after the test and used to evaluate the student's technique.

A pilot study was conducted for the test applied in Turkish culture. After obtaining the necessary permissions for VSTB, the test was applied with a total of 31 volunteer students, 10 male (MAge = 14.50, Sd= .51) and 21 female (MAge = 14.85, Sd= .46). Before applying the VSTB, the students were informed about the test. The videos recorded after the application were scored by 3 expert trainers in the field of volleyball independently of each other according to the technical criteria of each skill.

Scores recorded after 6 shots from skill tests were ordered from highest to lowest. When the data were examined, it was determined that it did not show a normal distribution. 27% of the total number of students was calculated and divided into upper and lower groups. The Mann-Whitney U test results for each skill showed that the upper group and lower group mean scores were significantly different ($Z_{Passing}$= -3.66, p= .00; $Z_{Setting}$= -3.64, p= .00; $Z_{Serving}$= -3.84, p= .00). Accordingly, it can be said that skill tests produce results that can distinguish skilled students from less skilled students. The video recordings of VSTB were reviewed and scored by 3 experts. The consistency of the scores given by three experts was calculated with the Intra-Class Corelation Coefficient (ICC). The ICC between the video analysis scores was found to be .91 for passing skill, .92 for setting skill, and .94 for serving

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skill. It can be concluded that the test was a valid and reliable test since test raters show consistency in the measurement results.

Intervention

In the first week of the study, which covers 7 weeks, the BRSS, the VKT and VSTB were applied to the experimental and control groups as pre-test. The students were not told which group was the experiment and which group was the control, as it could have a negative impact on the study. The data were filled in under the supervision of a teacher other than physical education in the classroom after the researcher explained the BRSS and VKT to be used within the scope of the pre-test for both groups. For the VSTB pre-test measurements, students were taken to the gymnasium and informed about the test. The data for the measurement were collected in the presence of three non-study trainers who assisted in the execution of the test.

Iphone 6 plus® 1080p, IPhone 8 plus® 1080p, Samsung Galaxy A11® 1080p and Xiaomi Redmi Note 8® 1080p video cameras were used to record movements in the pre-test VSTB measurements of both groups. After the pre-test, a volunteer student was asked to set up a WhatsApp® group to which all students in the class were attached. The experimental group was informed that the video for the physical education would be uploaded to the Padlet® application and the link would be sent to the students via WhatsApp®. Since one of the students did not have internet access at home, a computer room was allocated to this student at school where he could access the video whenever he wanted.

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Time	40+40 min.
Learning Field	9.1. Movement Competence 9.2. Active and Healthy Life
Sub-learning Field	9.1.2. Movement Concepts, Principles and Related Life Skills 9.2.4. Sports Awareness and Organizations
Achievements	9.1.2.1.1. Apply volleyball-specific warm-up movements. 9.2.4.1.1. Explain the historical development of sports. 9.1.2.1.4. Explains the movements specific to volleyball. 9.1.2.1.5. Applies the volleyball-specific setting action.
Subject	Volleyball, Setting
Teaching Method	Demonstration, Lecture, Practice, Question and Answer
Equipment	12 Volleyball ball
Lesson Area	Gymnasium
Safeness	Students follow gymnasium rules. They wear clothes and sneakers appropriate for the gymnasium.
Öğrenme-Öğretme Süreci	
Learning Activities	**Lesson Entry:** • Line up and roll call (5 min.) **Aplication:** • Volleyball history and organizations, volleyball basic pass types, setting skill and display (25 min) • Explanation and application of warm-up movements specific to the volleyball branch (15 min) • For the setting skill, the ball is hit with two hands on the ground and a practice is made to hold it at forehead level by entering under the ball (5 min) • The ball is dropped to the ground by setting it into the air and the practice of passing up is done again (5 min) • Short distance setting work against the wall (5 min) • Mid-distance setting against the wall (5 min) **Activity one: Wall passing race** Students are divided into groups. Each group is asked to define a name for themselves. Groups stand up against the wall and form a single line. The student in front of the line throws the ball to the wall as setting and runs towards the back of the line. Before the ball thrown by the front student against the wall falls to the ground, the next student continues to setting and goes behind the row. The team that reaches the number determined by the teacher without dropping the ball wins (10 min).
Assesment and Evaluation	**End of lesson and cooling down** (5 min): • Students are asked questions about the importance of warm-up exercises in volleyball • Did you use your hands correctly in the setting shot in volleyball? the question is asked. If necessary, it is requested to be displayed with the application. . • They are asked if they have difficulty while shooting. If they had difficulties, the question was asked at what stage they had difficulties. • They are asked what kind of activities they can do in daily life to strengthen their fingers

Time	40+40 min.
Learning Field	9.1. Movement Competence 9.2. Active and Healthy Life
Sub-learning Field	9.1.2. Movement Concepts, Principles and Related Life Skills 9.2.4. Sports Awareness and Organizations
Achievements	9.1.2.1.1. Apply volleyball-specific warm-up movements. 9.2.4.1.1. Explain the historical development of sports. 9.1.2.1.4. Explains the movements specific to volleyball. 9.1.2.1.5. Applies the volleyball-specific setting action.
Subject	Volleyball, Setting
Teaching Method	Demonstration, Lecture, Practice, Question and Answer
Equipment	12 Volleyball balls
Lesson Area	Gymnasium
Safeness	Students follow gymnasium rules. They wear clothes and sneakers appropriate for the gymnasium.
Teaching-Learning Process	
Learning Activities	**Lesson Entry:** • Line up and roll call (5 min.) • Questions and answers about videos (5 min.) **Aplication:** • Warm-up movements specific to the volleyball branch are performed (10 min). • For the setting skill, the ball is hit with two hands on the ground and a practice is made to hold it at forehead level by entering under the ball (5 min). • The ball is dropped to the ground by setting it into the air and the practice of passing up is done again (5 min) • Short distance setting work against the wall (5 min) • Mid-distance setting against the wall (5 min) **Activity one: Wall passing race** Students are divided into groups. Each group is asked to define a name for themselves. Groups stand up against the wall and form a single line. The student in front of the line throws the ball to the wall as setting and runs towards the back of the line. Before the ball thrown by the front student against the wall falls to the ground, the next student continues to setting and goes behind the row. The team that reaches the number determined by the teacher without dropping the ball wins (5 min). • Couple sitting setting (5 min) • Setting work in paired shuttle position (5 min) • Mutual ball throwing and setting exercise (5 min) • Short distance mutual setting (5 min) • Middle distance mutual setting (5 min)
Assesment and Evaluation	**End of lesson (5 min);** • Students are asked questions about the importance of warm-up exercises in volleyball . • Did you use your hands correctly in the setting shot in volleyball? the question is asked. If necessary, it is requested to be displayed with the application. . • They are asked if they have difficulty while shooting. If they had difficulties, the question was asked at what stage they had difficulties. • They are asked what kind of activities they can do in daily life to strengthen their fingers .

Figure 3. Example 1. week traditional and flipped classroom lesson plan

The videos of the lesson to which the FL will be applied are associated with the achievements. The five videos created include the mentioned titles; volleyball history / setting, volleyball game field / setting, volleyball positions and players / passing , volleyball game rules / passing, types of serve / serve. In the videos created, knowledge and volleyball content knowledge are equally distributed for student skill development. In the videos, there were skill concepts to be acquired by the students, visuals containing motion analysis, and slow motion videos (Casey & Jones, 2011; Trout, 2013). After 5-6 minutes of videos were prepared, they were watched by an informatics expert and a volleyball expert in terms of image, sound, video ethics and their suitability for the subject, and their approval was obtained. The activities and approaches used in the FL lesson plans are designed to allow students to apply the knowledge they have gained in accordance with the content in the videos. In physical education, taking attendance before the lesson, establishing order, and

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preparing lectures and practice drills all tend to cut down on lesson timeIn lesson plans produced with the FL, students have the opportunity to practice more. Bergman and Sams (2012), mentioned the 90-minute lesson timing of flipped classrooms. Physical education lessons in Turkey are 80 minutes, 40+40. By comparing the FL and traditional physical education, Figure 3 shows the physical education timetable prepared for 80 minutes.

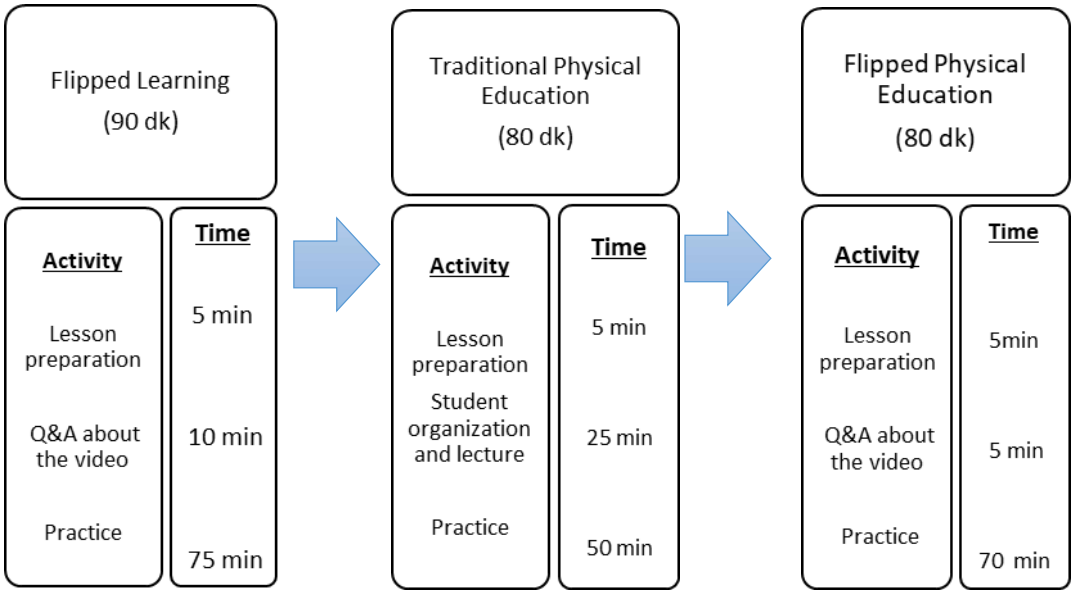

Figure 4 . Flipped learning adapting classroom timing to physical education

In the 7th week, the BRSS and VKT were applied to experimental and control groups in the classroom by a supervisor who was not a physical education teacher. The VSTB measurements were taken in the gym with three assistant trainers, using the same protocol as the pretest.

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Figure 5. Sample images from the pretest and posttest VSTB video recordings

Data analysis

Results are presented as the mean (*M*) and standard deviation (*Sd*) to summarise the data. For the VKT, each student's total score was calculated by giving '1' point to each correct answer and '0' to each incorrect or blank answers. The Wilcoxon Signed Rank test was used to determine whether there was a difference between the two measures in terms of total scores in applications in different time periods. Mann-Whitney U test was also used to compare the VKT gain scores between experimental and control groups.

The data from the VSTB was separated into two categories: video scoring and hit scoring. Wilcoxon Signed Ranks test was used to determine the difference between pretest and posttest measurements of both hit scores and video scores of the experimental and control groups. Mann Whitney U test was used to compare the VSTB gain scores between experimental and control groups.

For the BRSS, the univariate statistics indicated that the values for skewness and kurtosis were within the ranges of -.90 to +.99 and -.87 to +.63, respectively. The univariate skewness and kurtosis scores met the criterion of being less than ±2 for all variables (Schutz & Gessaroli, 1993). The difference between the pretest and posttest of the BRSS factors' gain scores was examined using 2x5 multivariate analyses of variances (MANOVA). For the 2X5 MANOVA, the BRSS factors served as the dependent variables and groups served as the independent variable. Where the F-value calculated in the MANOVA was significant, the independent samples t test was conducted to assess differences among BRSS factors' gain scores. The effect sizes *(Cohen's d, where .2, .5, and .8 represent small, medium, and large effect sizes, respectively; η^2, where .01, .06, and .14 represent small, medium, and large effect sizes, respectively)* were also calculated to determine practical differences. The level of significance was set at .05 in all analyses.

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Results

Volleyball theoretical knowledge

The mean and standard deviation values of the VKT pretest and posttest scores of the experimental and control groups were calculated. As seen in Table 1, the students in the experimental group showed higher VKT scores.

Wilcoxon Signed Ranks Test was used to explore whether there was a difference between the pretest and posttest total scores of the groups. The results indicated significant difference between the pretest and posttest mean scores of the experimental group (Z= -4.18, p= .00). There was no significant change between control group's pretest and posttest scores (Z= -2.95, p= .76). To examine group differences, first, the VKT gain scores were calculated. The gain (improvement) from pretest to posttest was computed for each student by subtracting each student's pretest score from his or her posttest score. The results of the Mann-Whitney U test on experimental and control groups' VKT gain scores presented in Table 1.

Table 1

Mann-Whitney U Test Results on Experimental and Control Groups' VKT Gain Scores and VKT Pretest and Posttest Score

			Pretest		***Posttest***						
Dependent variable	*Group*	*n*	*M*	*Sd*	*M*	*Sd*	*Mean Rank*	*Sum of Ranks*	*U*	*Z*	*p*
VKT	Experimental	32	5.03	1.99	8.29	1.57	41.74	1294.00	163.00	-4.55	.00*
	Control	30	5.77	1.76	5.67	1.32	21.26	659.00			

*$p < .05$

A comparison of the scores yielded that experimental group obtained significantly higher VKT gain scores (M= 2.35, Sd= 2.18) than control group (M= -0.96, Sd= 1.24). According to this study finding, it is possible to conclude that the FL had an effect to increase the students' basic theoretical knowledge of volleyball.

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Volleyball Skills

To measure students' basic movement skills, the VSTB uses two measures: *technical movement scoring* and *target hit scoring*. Table 2 presents descriptive statistics, regarding technical scores and hit scores of the experimental and control groups.

Table 2

VSTB Pretest and Posttest Technical and Hit Scores of Experimental and Control Groups

			Pretest		Posttest	
Group	**Measure**	**Skill**	***M***	***Sd***	***M***	***Sd***
Experimental (n= 32)	Hit score	Setting	5.94	2.86	7.91	3.14*
		Passing	3.38	2.95	3.47	2.73
		Serving	2.84	1.72	3.38	1.75*
	Technical score	Setting	1.87	.87	2.56	.91*
		Passing	1.69	.78	3.00	1.07*
		Serving	3.25	1.04	3.16	1.05
Control (n= 30)	Hit score	Setting	4.93	2.27	6.47	2.72*
		Passing	2.13	2.09	3.30	2.76
		Serving	2.30	1.87	2.63	2.66
	Technical score	Setting	2.03	.99	2.90	.80*
		Passing	2.50	.77	2.63	.99
		Serving	3.00	.87	3.13	1.16

**Significantly difference from pretest (p< .05); Hit score: The score of the shot made to the hit area specified in the VSTB; Technical score: Video analysis score of the student's movement recorded during skill practice in VSTB.*

Table 2 shows that, with the exception of the experimental group's technical serving scores, both groups' mean scores increased in the posttest. The difference between these scores was examined by Wilcoxon Signed Ranks Test. The test results indicated that experimental group's posttest hit scores of setting skill (*M*= 7.91, *Sd*= 3.14) and serving skill (*M*= 3.38, *Sd*= 1.75), and posttest technical scores of setting skill (*M*= 2.56, *Sd*= .91) and passing skill (*M*= 3.00, *Sd*= 1.07) were significantly higher than pretest scores ($p< .05$). For the control group, mean differences in hit score of setting skill (*M*= 6.47, *Sd*= 2.72) and technical score of setting skill (*M*= 2.90, *Sd*= .80) were significant in favour of posttest scores.

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The Mann-Whitney U test was then conducted to see if there were any significant differences between the experimental and control groups' gain scores. The results were summarised in Table 3.

Table 3

Mann-Whitney U test results on experimental and control groups' VSTB gain scores

Gain		Group	Mean Rank	Sum of Ranks	U	Z	p
Hit score	Setting	Experimental	32.75	1048.00	440.00	-.56	.57
		Control	30.17	905.00			
	Passing	Experimental	29.23	935.50	407.50	-1.03	.30
		Control	33.92	1017.50			
	Serving	Experimental	31.36	1003.50	475.50	-.06	.94
		Control	31.65	949.50			
Technical Score	Setting	Experimental	30.02	960.50	432.50	-.70	.48
		Control	33.08	992.50			
	Passing	Experimental	41.78	1137.00	151.00	-4.86	.00*
		Control	20.53	616.00			
	Serving	Experimental	29.80	953.50	425.50	-.79	.42
		Control	33.32	999.50			

*p< .05**

Table 3 shows, significant difference was only found for technical score of passing skill, due to experimental group obtained higher scores ($p< .05$). Overall, in terms of the development of volleyball basic skills, there seems to be no difference between a standard physical education and a flipped physical education.

Motivation

Examining students' motivation levels according to the BRSS factors provided more information for this study. The mean and standard deviation values for intrinsic motivation, identified regulation, introjected regulation, external regulation and amotivation were calculated for both groups, and represented in Table 4.

Table 4

Experimental and control groups' BRSS pretest and posttest scores.

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Variables	Experimental Group				Control group			
	Pretest		Posttest		Pretest		Posttest	
	M	*Sd*	*M*	*Sd*	*M*	*Sd*	*M*	*Sd*
Intrinsic motivation	3.05	.83	4.46	.55	3.68	.83	3.46	.72
Identified regulation	2.83	.55	4.46	.47	4.42	.78	4.41	.69
Introjected regulation	2.57	.82	1.56	.62	2.79	1.07	2.75	1.03
External regulation	2.62	.70	1.50	.56	1.82	.68	1.87	.70
Amotivation	2.66	.83	1.76	.81	2.83	1.05	2.87	.95

Table 4 indicates that the experimental group's posttest mean scores for intrinsic motivation and identified regulation increased, but the control group's posttest scores decreased. The pretest and posttest mean scores of the introjected regulation decreased in both the experimental and control groups, but the decrease in the control group was less. The external regulation mean score decreased in the experimental group, however increased in the control group. Finally, the experimental group's amotivation sub-dimension decreased while the control group's increased.

The results of 2X5 MANOVA, on the mean scores of the BRSS factors' gain scores revealed significant differences between experimental and control groups (*Wilks'* λ= .16, $F_{(1, 60)}$= 55.60, p= .00, η^2= .83). Based on the MANOVA results, the independent samples t test was conducted for each dependent variable (see Table 6).

Table 5

The independent samples t test results on experimental and control groups' BRSS gain scores.

	Experimental Group (n= 32)		Control Group (n= 30)			
Gain Scores	*M*	*Sd*	*M*	*Sd*	*t*	*Effect Size*
Intrinsic motivation	1.40	.80	-.21	.49	9.61*	2.44
Identified regulation	1.62	.58	-.00	.58	11.01*	2.79
Introjected regulation	-1.00	.53	-.04	.87	-5.18*	1.31
External regulation	-1.12	.70	.04	.63	-6.85*	1.74
Amotivation	-.90	.65	.04	.45	-6.58*	1.67

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$p< .05^{*}$

The analyses revealed significant differences in intrinsic motivation ($t_{(60)}$ = -9.61, p= .00; *Cohen's d*= .2.44) and identified regulation ($t_{(60)}$ = 11.01, p= .00; *Cohen's d*= 2.79), due to the students in experimental group reported higher intrinsic motivation and identified regulation scores. The significant decrease in introjected regulation in experimental group ($t_{(60)}$ = -5.18, p= .00, *Cohen's d*= 1.31) together with the increase in identified regulation confirmed that students have more autonomous motivation. After 7 weeks of intervention, students in the experimental group were able to participate more autonomously by internalizing the lessons.

External regulation and amotivation are undesirable dimensions of the student's reason for participation in the lesson. As can be seen in Table 5, while the mean scores of external regulation ($t_{(60)}$ = -6.85, p= .00; *Cohen's d*= 1.74) and amotivation ($t_{(60)}$ = -6.58, p= .00; *Cohen's d*= 1.67) significantly increased in control group, they decreased in experimental group. With this result, it can be stated that the student participated the lesson in traditional classrooms for other people or for no reason.

Discussion

This study examined the effect of the FL on students' knowledge, skills, and motivation levels in physical education compared to traditional classrooms. The use of technology-assisted teaching methods has a good impact on today's students (Pang, Varea, Cavallin, ve Cupac, 2019). The use of the FL, which is one of these innovative techniques, in physical education has demonstrated that it may generate effective learning environments in these classes that go beyond psychomotor development. According to studies, using the FL in physical education improves student knowledge (Østerlie & Mehus, 2020; Østerlie, 2020; Zhao & Kang, 2020). Because of the FL's nature, students are required to increase their capacity to apply knowledge (Hwang, Lai, & Wang, 2015). In this study, the experimental group students reported that using lecture videos as pre-class preparation helped them better understand the concepts and were able to learn at their own pace due to the flexibility to pause and replay sections of the video. Additionally, it can be stated that with the FL, better results

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were obtained in the cognitive development of the student compared to the traditional methodology (Love, Hodge, Grandgennet & Swift, 2013; Muir & Geiger, 2015).

Examining the BRSS's factors within the context of Organismic Integration Theory (OIT) allowed us to see how the intervention, we used in this study influences the student's autonomy. In addition, organismic integration theory enabled us to understand the processes of internalizing students' behaviors in lessons taught with traditional and FL approaches. The ability of an individual to integrate the reasons of conduct while doing his or her behavior is the subject of OIT (Deci & Ryan, 1885), and autonomy-promoting motivations are crucial in the formation of a sports personality (Ntoumanis & Standage, 2009). In the study, it was determined that students in the flipped physical education have significantly higher intrinsic motivation (Lin et al. 2021; Østerlie & Mehus, 2020). The rise in identified regulation, which displays the autonomous type of extrinsic motivation, shows that students in the flipped classroom can engage in more autonomous activities, according to the OIT. External regulation based on internal controls such as emotion and self-esteem is known as introjected regulation (Ryan & Deci, 2017). It is more similar to extrinsic motivation's autonomous dimension than to extrinsic regulation. The flipped physical education's introjected regulation is believed to be reduced more than the traditional classroom's. This is a good sign for the FL. Because a decrease in introjected regulation is expected for the behavior to occur with intrinsic motivation. External regulation occurs when behavior is totally determined by external factors, and when these factors are absent, activity may diminish (Ryan & Deci, 2017). The flipped physical education's decrease in external regulation indicates that the behavior has begun to be internalized. The striking point is that the rise in external regulation in traditional classrooms indicates that behavior has begun to be influenced by outside causes. Our findings suggest that being motivated by external stimuli in physical education, which adds to our lifelong sports habit, may result in unfavorable experiences in the future. The absence of an aim or cause for the activity is referred to as amotivation. The flipped physical education gives a reason for the students' actions, as seen by their decreased amotivation. The

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rise in amotivation in traditional classrooms indicates that students are engaging in activity solely for the sake of engaging in it.

The number of studies looking at the impact of the FL on the development of technical skills in physical education is quite small (Chiang et al, 2018; Lin et al. 2019). In this study, the skill development of students in physical eduction where volleyball related pre-lesson video support was used showed no significant differences. The results of the current study revealed only significant difference for passing technical skill. Although there is no difference in other skills, this difference only in passing technical skill is thought-provoking. There may be many reasons for this. The fact that the experimental group students had less experience about passing before can explain this finding. Although no data were collected regarding this situation, the fact that the volleyball passing technical score average of the experimental group in the pre-test was lower than that of the control group may support this inference. On the contrary, it can be said that FL shines a light on student skill development. More studies are needed for the effect of FL on skill development.

The fact that videos transmitted to the flipped pysical education can be shared with the traditional classroom is a possible limitation for this effort that will need to be validated in the future. The students in this study requested more accessible platforms be used. It will be possible to share on more controllable platforms in future investigations. Another drawback is that it takes a week to master the serving talent. It is adequate for serving if the ball thrown in the test battery passes to the opposing court. There is no one-size-fits-all method for mastering the art of service. For more precisely measured skills, the study can be repeated. If study is rescheduled, the overall serving technical measuring criteria should be reassessed, and the amount of time allotted to each talent should be equal.

According to Bergmann and Sams (2012), the lesson is presented as a block and lasts 90 minutes in the FL time planning. In Turkey, classes consist of 40 minutes of lectures followed by ten minutes of recess. The study was place in a public school with a continuous education and training program. The fact that pupils returned to class right after the break may have had a negative impact on the lecture. Future research can be used in physical education

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by setting out 40 minutes or blocks of time in class. This study was designed by analyzing the physical education session quantitatively in terms of knowledge, abilities, and motivation. It is expected that combining quantitative and qualitative data for future research will allow for more in-depth interpretations.

As a result, with this research, it was aimed to examine the effects of the lessons taught by applying FL and traditional teaching method in physical education and sports lessons on students' basic volleyball knowledge level, volleyball skills and motivation for the lesson. Volleyball knowledge level and motivation of the students in the FL physical education lesson (experimental group) increased more than the volleyball knowledge level and motivation of the students in the traditional physical education lesson (control group). However, more research is needed to understand the effect of FL on student's skill development in physical education and sports classes.

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Sportis
Revista Técnico-Científica del Deporte Escolar, Educación Física y Psicomotricidad
Scientific Technical Journal of School Sport, Physical Education and Psychomotricity

Editor: University of A Coruña. A Coruña. Spain
ISSN-e 2386-8333
E-mail: sportis.journal@udc.es Web: https://revistas.udc.es

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