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Differences between student outcomes in high school physical education: Fitness education curriculum vs. sport-based curriculum

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Abstract

The purpose of this study was to compare the effect of two physical education curricula; fitness education curriculum (FEC) vs. sport-based curriculum (SBC), on Midwest U.S. high school student's ($n = 294$): (a) PA behavior; (b) Autonomy; (c) Perceived competence; and (d) Health-related fitness knowledge. Students participating in the FEC demonstrated significantly greater improvement than the SBC in five of seven measures; perceived health rating ($p = .021$, $\eta^2 = .018$), muscle-strengthening exercise habits ($p = .004$, $\eta^2 = .028$), exercise autonomy ($p = .042$, $\eta^2 = .016$), self-determination ($p = .040$, $\eta^2 = .017$), and health-related fitness knowledge ($p = .005$, $\eta^2 = .042$). This research provides preliminary support for a change from the traditional sport-based curriculum to a fitness education curriculum to provide students with appropriate physical education programs to induce behavioral change for lifetime fitness and health.

Keywords: Exercise, physical activity, autonomy support

1. Introduction

Health status among the U.S. population continues to decline, with physical inactivity being a key factor [3]. Physical education (PE) can play a pivotal role to providing students with the skills and knowledge needed to sustain life long fitness and health [14, 21, 26, 28]. However, a concern for PE professionals is that while PE is suggested to be beneficial to students' health, its impact on physical activity (PA) behaviors [5] and overall fitness levels [4] is limited. A key issue for this limited impact could be the type of curriculum taught in secondary PE. Most PE programs focus on sport and games [23], while the majority of adults indicate they participate in individual fitness-based activities (e.g., running, weight training, cycling) rather than sports [24, 31]. This potential conflict of alignment could be detrimental to long-term health status, and thus, understanding the needs of students and available resources to participate in health enhancing types of exercise/PA should be a vital part of secondary PE curriculum development.

1.1 Self-determination theory (SDT)

This study is exploring the impact of curricula on various health-related factors from the perspective of SDT, where student's motivation enhancement is noted as a critical foundation for promoting positive health behaviors. SDT indicates that a student's motivational disposition can be characterized as intrinsic, extrinsic, or amotivation [8]. Intrinsically motivated individuals have a desire to learn and improve without the need of external reinforcement. Extrinsically motivated individuals seek a means to an end rather than internal satisfaction. Amotivated individuals have little to no desire to engage in a behavior if they feel there is no value, do not perceive themselves as being competent, and/or there is the proposition of no favorable outcome. Overall, intrinsic motivation is the most recognizable behavior that positively affects adherence to a task/situation [8].

SDT states that within motivation, there are three needs that drive behavior: competence, autonomy, and relatedness [9]. Competence is the ability to maneuver within an environment or situation with effectiveness and efficiency. Autonomy is the belief that the individual has control over a situation and has the ability to choose their behaviors, while relatedness is a

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connection with others in a similar environment or situation. Through these three needs of motivation, Deci and Ryan ^[9] postulate that if an individual is able to satisfy these needs, then it fosters self-determination to continue behaviors (i.e., intrinsic motivation is developed). If these needs are not met, the likelihood of behavior continuation is diminished. SDT research involving long-term sustainability of PA has indicated competence in movement, prerequisite knowledge, activity autonomy, and relationships with others in a given activity leads to sustainable behaviors ^[12, 13, 17, 18].

Self-determination Theory resonates well within a PE environment as the premise behind the academic subject is to prepare students with the needed skills/knowledge and dispositions (i.e., motivation and appreciation) to stay physically fit and active ^[14, 25]. In addition, if students are able to develop movement competency to be functional movers and to develop their own health-enhancing fitness plans, they are more likely to be motivated to develop and sustain health-enhancing PA and fitness levels.

1.2 Health-related fitness knowledge (HRFK)

In line with developing competence to drive self-determination, research has indicated a relationship between PA and HRFK (i.e., cognitive competence) ^[10, 15, 29] along with physical fitness and HRFK ^[16, 32]. As students develop HRFK, cognitive competence (e.g., developing a fitness plan aligned with personal goals) is increased, which can possibly drive motivation, enhance autonomy, and lead to better long-term outcomes. Specifically, research comparing traditional high school PE (consisting of sports and games) and conceptual high school PE (cognitive development of HRFK and psychomotor enhancement) found that conceptual PE had better longitudinal PA adherence than traditional PE ^[7]. Other studies also found conceptual PE to have sustained PA adherence ^[1, 11, 20]. Thus, learning HRFK provides valuable components for students to continue to develop a foundation that promotes continued advancement in PA and fitness.

1.2 Perceived competence

A building body of research indicates perceived competence in PA and fitness has a strong relationship with actual PA behaviors ^[2]. Within many social cognitive theories, including SDT, perceived competence is indicated as a key contributor to behavior ^[2]. With strong evidence that perceived competence plays an integral role in PA behavior, it can be deduced that if PE curriculum can enhance students' perceived competence in movement, exercise, fitness, and PA, then continued PA and improvement of fitness should be more likely to take place.

Given the overall importance of PE to youth and society as a whole, PE professionals must find the best curriculum to induce behavioral change in students for lifetime fitness by developing positive characteristics of PA determinants. The purpose of this study was to compare the effect of FEC vs. SBC, on high school students: (a) PA behavior: muscle-strengthening exercise habits, cardiovascular exercise habits; (b) Autonomy: exercise autonomy, self-determination; (c) Perceived competence: health rating, athletic competence; and (d) Health-related fitness knowledge. To the knowledge of the authors, no research has compared the two curricula and multifaceted determinants of PA.

2. Materials and Methods

2.1 Participants

Prior to data collection, the institutional review board and

school district's superintendent approved the study. Consent was obtained from parents, students (Assent), and teachers involved in the data collection. Students were recruited from 16 physical education classes (10 SBC, 6 FEC) in a high school (Grade 10, 47%; grade 11, 34%; grade 12, 19%) with approximately 1600 students (83% non-Hispanic white, 25% low socio-economic status) located in a small Midwestern U.S. city. A total of 294 students' (52% male, $n=181$ SBC, $n=113$ FEC) completed the pre and post-test measures used in the analysis.

2.2 Measures

Students took a total of seven online surveys, and five of them were evaluated for this paper. The five surveys included: (a) PA and background questionnaire, (b) Exercise Autonomy: Behavioural Regulation in Exercise Questionnaire 2 ^[22], (c) Self-Determination: Basic Psychological Need Satisfaction and Frustration Scale (BPSF) ^[6], (d) Health-Related Fitness Knowledge (HRFK): FitSmart Test ^[33], and (e) Perceived Competence in Sport: Self-Perception Profile for Children ^[19]. The PA and background questionnaire first examined elements such as gender, grade, semesters of PE, years of organized sport, and socio-economic status. The second part evaluated students' perceived health compared to peers along with cardiovascular exercise habits and muscle-strengthening exercise habits. Cardiovascular exercise habits were evaluated on a 1-6 scale with one being "I do not engage in cardiovascular exercise at all (e.g. drive everywhere, rarely fast walk)" and six being "I engage in both moderate and vigorous cardiovascular exercise that TOGETHER add up to plenty of exercise per week beyond answers 4 and 5". Muscle strengthening habits were evaluated on a 1-3 scale with one being "I do not engage in any muscle-strengthening exercises" and three being "I work my major muscle groups at least TWO days per week".

The Behavioural Regulation in Exercise Questionnaire 2 measured exercise autonomy. This assessment evaluates individuals' outlook towards exercise and delineates whether it is by personal choice (i.e., self-regulation) or if external forces promote the individual in participating or not participating in exercise. The BREQ-2 is based on the SDT and its three behavioral components. For the purposes of this study, we investigated if fitness competency can lead to autonomy to make informed decisions and relatedness to others within the realm of PA and fitness.

The Basic Psychological Needs Satisfaction and Frustration Scale (BPSF) measured self-determination. This scale investigates satisfaction and frustration within daily life. The BPSF is also aligned with the Self-determination Theory as the test is comprised of 24 items with eight each being aligned to competence, autonomy, and relatedness.

HRFK was measured by the FitSmart test, which is a validated measure of HRFK designed for high school students. The test was validated by using item response theory and a panel of experts from the physical fitness field established content validity. The test has five weighted content areas, but for this study because of the extensive set of tests administered, the test was modified by eliminating questions from each weighted area and an overall percentage of correct responses was calculated to comprise a score.

Perceived competence within sport was measured by the Self-Perception Profile for Children, subscale athletic competence. The Harter Scale provides a statement such as "Some kids do very well at all kinds of sports" but "Other kids don't feel that they are very good when it comes to sports". The participant

chooses which statement is more like him/her, then will decide if that statement is “Really True for me” or “Sort of True for me”. From there a total is comprised of the statements within the subscale. Statements evaluated within the athletic competence subscale include: 1) Do well at sports, 2) Good enough at sports, 3) Good at outdoor activity, 4) Better than others at sports, 5) Play rather than watch, 6) Good at new outdoor games.

2.3 Data collection

The high school chosen for the study included grades 10-12 and all students were required to take at least three semesters of physical education out of six total semesters. The students had the option to choose between a SBC, FEC, and an outdoor recreation curriculum. Each class was one semester long, five days per week, 52 minutes per class.

Participation for the outdoor recreation curriculum was limited and did not provide a large enough data set to analyze; thus, only the SBC and FEC curricula were investigated. The SBC consisted of traditional sport units involving activities such as basketball, volleyball, ultimate Frisbee, badminton, etc. Students learned sport skills, rules, and game play (large sided and modified). The FEC included weight training, high intensity training, and metabolic/cardiovascular training. Students learned proper exercise technique (body weight, free weights, machines, and other implements), different energy systems training, and how to program exercise plans to reach personal goals.

Four teachers administered the assessments with their classes, three within the SBC and one within the FEC. All assessments were given in a prescribed order, pre and post testing, delivered over three days. The assessments were uploaded to a secure server and taken by computer during PE class. The data was then stored in the server and could only be accessed by study researchers.

2.4 Data analysis

IBM SPSS Statistics 23 was used to analyze data. Data was scanned twice to check for accuracy of data entry. Descriptive statistics were calculated to ensure quality of the data and to describe the sample.

The independent variable used for all analysis was the PE curricula (i.e., SBC vs. FEC). Means were compared for all

pre and post-test data sets. One-way ANOVA's were conducted to evaluate the differences between curricula at the pre- and post-tests and changes in pre and post-test means. Dependent variables include: perceived health rating, cardiovascular exercise habits, muscle-strengthening exercise habits, perceived athletic competence, exercise autonomy, self-determination, and HRFK.

3. Results

A total of 294 students' data sets were used for the study. With 181 students (53.6% male) in the SBC and 113 students (49.6% male) in the FEC.

Students taking the SBC had a significantly higher pre-test score in the perceived health rating ($M = 3.44, SD = .94, p = .005$) and perceived athletic competence ($M = 16.09, SD = 3.87, p = .020$) than the FEC ($M = 3.12, SD = .98; M = 15.01, SD = 3.88$). While the FEC students were significantly higher in the exercise autonomy pre-test ($M = 10.76, SD = 13.77, p = .004$) than SBC ($M = 5.41, SD = 15.77$). Post-testing indicated that the SBC students maintained a significantly higher perceived athletic competence ($M = 16.36, SD = 4.13, p = .015$) over the FEC ($M = 15.16, SD = 4.04$), but there was no significance between the pre to post-test differences amongst the two curricula (see Table 1). The students in the FEC showed a significant post-test difference over the SBC students in muscle-strengthening exercise habits ($M = 2.65, SD = .48, p < .001$), exercise autonomy ($M = 15.14, SD = 13.31, p < .001$), and HRFK ($M = 70.6\%, SD = 15.94, p < .001$). See table 1 for results.

Effects of the SBC did not have any significantly greater increases in outcome variables compared to the FEC. The FEC had five out of the seven measures show a significant difference over the SBC (see Table 2). One-way analysis indicated the following measures to show significant differences between the FEC and SBC (see Table 3): perceived health rating $F(1,292) = 5.42, p = .021, \eta^2 = .018$, muscle-strengthening exercise habits $F(1,292) = 8.36, p = .004, \eta^2 = .028$, exercise autonomy $F(1,264) = 4.17, p = .042, \eta^2 = .016$, self-determination $F(1,248) = 4.25, p = .040, \eta^2 = .017$, HRFK $F(1,187) = 8.20, p = .005, \eta^2 = .042$.

3.1 Tables and Figures

Table 1: Comparing pre and post-test means between fitness education and sport-based curricula

Variables	Sport-Based Pre-Test		Fitness-Based Pre-Test		Sport-Based Post-Test		Fitness-Based Post-Test	
Perceived Health Rating	M 3.44**	SD .94	M 3.12**	SD .98	M 3.49	SD 1.02	M 3.37	SD .89
Perceived Athletic Comp.	M 16.09*	SD 3.87	M 15.01*	SD 3.88	M 16.36*	SD 4.13	M 15.16*	SD 4.04
Exercise Autonomy	M 5.41**	SD 15.77	M 10.76**	SD 13.77	M 6.41**	SD 16.99	M 15.14**	SD 13.31
Self-Determination	M 19.35	SD 14.33	M 18.77	SD 15.69	M 19.28	SD 15.97	M 21.78	SD 16.98
Health-Related Fitness Know.	M 60.0%	SD 19.34	M 64.2%	SD 16.07	M 60.5%*	SD 19.88	M 70.6%*	SD 15.94
Muscle-Stren. Exercise Habits	M 2.19	SD .68	M 2.34	SD .64	M 2.29**	SD .66	M 2.65**	SD .48
Cardiovascular Exercise Habits	M 3.70	SD 1.14	M 3.53	SD 1.12	M 4.21	SD 1.30	M 4.09	SD 1.26

Note: Comp. = Competence. Stren. = Strengthening. Know. = Knowledge. * $p < .05$. ** $p < .01$.

Table 2: Comparing pre and post-test difference in means between fitness education and sport-based curricula

Variables	Sport-Based		Fitness-Based	
Perceived Health Rating	M .04*	SD .77	M .26*	SD .74
Perceived Athletic Competence	M .23	SD 3.38	M .15	SD 2.55
Exercise Autonomy	M .89*	SD 15.84	M 4.58*	SD 12.05
Self-Determination	M -.65*	SD 12.71	M 2.94*	SD 14.73
Health-Related Fitness Knowledge	M .2%**	SD 16.76	M 6.5%**	SD 13.15
Muscle-Strengthening Exercise Habits	M .10**	SD .62	M .32**	SD .66
Cardiovascular Exercise Habits	M .51	SD 1.07	M .56	SD 1.05

Note: * $p < .05$. ** $p < .01$.

Table 3: One-way analysis of variance of physical education curricula and determinants of physical activity

Source	df	SS	MS	F	p	Eta Squared
Perceived Health-Rating						
Between groups	1	3.140	3.140	5.418	.021	.018
Within groups	292	169.204	.579			
Total	293	172.344				
Muscle-Strengthening Exercise Habits						
Between groups	1	3.341	3.341	8.356	.004	.028
Within groups	292	116.741	.400			
Total	293	120.082				
Exercise Autonomy						
Between groups	1	869.149	869.149	4.169	.042	.016
Within groups	264	55033.257	208.459			
Total	265	55902.406				
Self-Determination						
Between groups	1	785.381	785.381	4.249	.040	.017
Within groups	248	45842.719	184.850			
Total	249	46628.100				
Health-Related Fitness Knowledge						
Between groups	1	1858.339	1858.339	8.199	.005	.042
Within groups	187	42385.471	226.660			
Total	188	44243.810				

4. Discussion

This research is the first known study to compare secondary PE curricula of SBC vs. FEC while investigating multiple measures within PA behaviors, autonomy, perceived competence, and HRFK. These findings warrant attention and consideration for curricular change in secondary PE. First, HRFK in this study was low, which coincides with previous research [16]. Secondly, students in both curricula improved on all measures over the course of the semester from pre-test to post-test with the exception of self-determination within the SBC. Thirdly, the FEC significantly improved over the SBC in five out of seven measures.

4.1 High school students need for HRFK

This research continues to reinforce that K-16 students possess low HRFK and is of concern as HRFK can improve PA behaviors and fitness levels [10, 15, 16, 29, 32]. SHAPE America [27] grade-level outcomes indicate that secondary PE students should be able to develop their own health-enhancing fitness plan. However, if students do not possess the foundational HRFK needed to create such a plan, the likelihood of continued PA and fitness enhancement can be hindered. While SHAPE America has grade-level outcomes for fitness planning, these data indicates the foundational knowledge needed is not being obtained.

The FEC showed significant and promising improvement of HRFK (64.2% to 70.6%) while the SBC showed no improvement (60% to 60.5%). Improvement in HRFK paralleled improvement in exercise autonomy. This could possibly be an indication that as one improves HRFK (knowledge competence), his/her confidence in their ability to exercise/PA and belief in being able to exercise increases (self-determination). A curriculum that is focused on teaching students how to exercise (e.g., movement quality, knowledge of skills, muscles, energy systems, etc.) and program their own health-enhancing fitness plans is a more efficacious and direct way to develop HRFK and fitness/exercise programming capabilities compared to a curriculum that plays sports and games.

4.2 Improvement among measures

Students' improving in both curriculums is encouraging as it indicates secondary PE can make a difference in students'

perceptions, habits, autonomy, and HRFK. This study along with others [14, 21, 25] demonstrate the important role that PE can play to develop students' capability and motivation to stay fit and healthy.

Although any type of PE is better for long-term adherence to PA than not having PE [24], evidence has demonstrated conceptual PE (i.e., learning component/HRFK) is more conducive to long-term sustainability compared to a traditional sport and game PE curriculum [7]. This study reinforces the idea that a fitness education curriculum (conceptual) is a better alternative to a sport and game model curriculum that takes place in many PE settings.

4.3 Fitness education curriculums performance over sport-based curriculum

Physical activity behavior. Promoting health-enhancing PA is a primary initiative of SHAPE America [28]. A main reason for this is the need and push to improve PA levels across all populations to improve health. Muscle-strengthening exercise habits showed significant improvement in the FEC. While cardiovascular exercise habits improved within both groups going from inconsistent behavior that did not reach PA guidelines (adult guidelines of 150 minutes of moderate PA, or 75 minutes of vigorous PA, or a combination of the two) to reaching the 150 minutes of moderate PA guidelines. While both showed improvement within the cardiovascular exercise habits, the FEC was more robust in the students improvement amongst both areas, which is of importance, as to maintain a level of health-enhancing fitness both muscle-strengthening and cardiovascular exercise is needed.

Autonomy: The FEC participants demonstrated significantly greater gains in both, exercise autonomy and self-determination, compared to the SBC participants. While the SBC participants improved in exercise autonomy, they had no improvement in self-determination. If we are able to provide PE curriculum that can enhance students' intrinsic motivation and freedom to choose exercise (i.e., autonomy) when they leave the PE classroom, then the curriculum is providing the opportunity to successfully induce behavioral change. This study indicates that the FEC is more effective at enhancing student autonomy.

Perceived competence: Students perceived rating of health compared to their peers increased more via the FEC. This finding may be connected to students increased confidence in their ability to exercise identified by improved exercise autonomy along with increased muscle-strengthening habits. If the aforementioned elements continue to increase, it is reasonable to suggest perception of health along with actual health should improve.

The other element measured in the area of perceived competence was athletic competence. This is the only area that the SBC improved over the FEC; however, the improvement was not significant. Based on the actual definitions of the curriculum, it would be assumed that the SBC students should improve significantly within this area. It is to be noted that during the pre-test and post-test, the sport-based group scored higher at both time points. As a result, significant growth could be harder to obtain, as baseline scores were already higher. Although, this could also mean that even though students did not perform sports (FEC participants), their overall confidence in physical movement could have increased because their physical prowess and confidence within the physical improved.

4.4 Limitations and future research

There were limitations to the study. First, we only had one FEC teacher while we had three SBC teachers. Teachers' performance and personality can play a role in student learning. Second, the curricula were implemented across only one semester. Demonstrating the impact of different curricula would be enhanced by increasing students' exposure to curricula. Future research in implementing yearlong or multi-year curricular comparisons is recommended to examine the long-term impact of different PE curricula. Thirdly, the SBC only included sport, while the FEC only provided elements of fitness training. Neither curriculum included elements of the other. An evaluation of a blended curriculum including both elements would provide more insight on the impact of a narrowed specific curriculum to more encompassing curriculum. Fourthly, students were able to self-select the course taken. A lack of random assignment can be problematic when evaluating differences in growth amongst measures based on preferences. Fifthly, all measures of PA were survey based. Including objective data for PA behaviors would give additional depth to the current research, direct assessment of fitness and PA data are recommended.

5. Conclusion

Interventions to induce behavioral change in youth and adults to increase fitness and PA continue to be researched. An intervention is already in place for all youth, it is K-12 school based PE. The issue is PE has not been effective in inducing behavioral change based on the dismal health statistics in the United States. The following study indicates that curriculum predicated on fitness education is more effective at equipping students with characteristics (Exercise autonomy, self-determination, muscle-strengthening exercise habits, HRFK, and perceived health competence) likely to sustain exercise/PA for health-enhancing fitness than the traditional sports model of PE (The prominent model in the U.S.)^[23]. If students are provided a curriculum that teaches them to functionally move well, exercise proficiently, and how to program a health-enhancing fitness plan for their personal goals/needs; they will be more likely to enhance PA habits, autonomy, and HRFK. PE professionals should assess and reflect on the effectiveness of their current curriculum to the

potential long-term benefits and/or ramifications on students' exercise/PA habits and lifetime fitness.

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