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Original article

Effectiveness of quality physical education in improving students' manipulative skill competency

Weiyun Chen ^{a,*}, Weimo Zhu ^b, Steve Mason ^a, Austin Hammond-Bennett ^a,
Andrew Colombo-Dougovito ^c

^a School of Kinesiology, University of Michigan, Ann Arbor, MI 48168, USA

^b Kinesiology and Community Health, University of Illinois, Urban-Champaign, IL 61820, USA

^c Department of Kinesiology, University of Virginia, Charlottesville, VA 22904, USA

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Abstract

Purpose: This study aimed to examine the extent to which the quality physical education teaching (QPET) practices contributed to improving 4th- and 5th-grade students' manipulative skill competency.

Methods: Participants were 9 elementary physical education (PE) teachers and their 4th- and 5th-grade students ($n = 2709$ – 3420). The students' skill competency was assessed with 3 manipulative skills using PE metrics assessment rubrics. The PE teachers' levels of QPET were assessed by coding 63 videotaped lessons using the assessing quality teaching rubrics (AQTR), which consisted of 4 essential dimensions including task design, task presentation, class management, and instructional guidance. Codes were confirmed through inter-rater reliability (82.4%, 84.5%, and 94%). Data were analyzed through descriptive statistics, multiple R^2 regression models, and independent sample t tests.

Results: This study indicated that the 4 essential dimensions of QPET were all significant contributors to students' manipulative skill competency. These predictors were significantly higher for boys than for girls in soccer and striking skills, while they were significantly higher for girls than for boys in throwing skill competency. Of the 4 essential dimensions of QPET, task presentation played the most significant role in contributing to all 3 skill competencies for both boys and girls. Further, students who experienced high QPET were significantly more skillfully competent than those students who did not have this experience.

Conclusion: It was concluded that the QPET practices played a significantly critical role in contributing to students' manipulative skill competency.

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Keywords: Assessment of quality teaching; Essential dimensions of teaching; Manipulative skill competency; Skill assessment

1. Introduction

Demonstrating competency in a variety of motor skills and movement patterns is a desired learning outcome that U.S. National Standard 1 describes for all students to be able to achieve as a result of participating in quality physical education (PE) program.¹ Motor skill competency is 1 of the 3 Comprehensive School Physical Activity Program (CSPAP) facilitators underlying PA.² Supporting this theoretical postulation, empirical studies show that motor skill competency is an enabling factor that provides physical foundations necessary for enjoyable and suc-

cessful physical activity (PA) engagement in youth.^{3–7} Children with adequate motor skill competency spend significantly more time in moderate-to-vigorous PA than children with insufficient motor skill competency.^{3–7} As a result, childhood manipulative skill proficiency is significantly associated with adolescents' participation in a variety of PAs and organized sports.^{3,4}

However, children's motor skill competency is not developed naturally as a result of physical growth. Development of motor skill competency is based on the dynamic interaction among the task, the learner, and the environment.⁸ Motor skill development must be learned and practiced within a sequentially structured learning environment based on children's sequence of motor development.^{8–10} How well students are able to demonstrate motor skill competency depends largely on whether or not PE teachers provide students with quality PE program.¹

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* Corresponding author.

E-mail address: chenwy@umich.edu (W. Chen).

Quality physical education (QPE) serves as the heart of the CSPAP for promoting physically active behaviors.^{11–13} QPE is a primary vehicle for equipping students with knowledge, skills, fitness, and positive attitudes to become skillful movers and competent performers necessary to participate in a variety of PAs.^{11–14} QPE offers a wide array of PAs that are developmentally appropriate and meaningful for students. It uses appropriate instructional practices to provide students with maximum learning experiences and create productive learning environments for students.^{11–14} Implementation of QPE in practices consists of 4 essential dimensions including task design, task presentation, class management, and instructional guidance.¹⁴ How well the teacher enacts the 4 essential dimensions in a lesson collectively contributes to the quality of instructional practices.^{15–18}

Task design, one essential dimension, refers to types and natures of learning tasks the teachers design and organize for their students to engage in.^{17,18} To help students accomplish intended learning objectives, the teacher should provide students with learning tasks that are developmentally appropriate, and maximally and actively engaging.^{1,18} Learning tasks that are developmentally appropriate are critical to ensure students to have successful learning experiences. Learning tasks that are maximally and actively engaging provide students with ample learning opportunities and participation.^{15–18}

Task presentation, another essential dimension, refers to how the teacher delivers learning tasks to students.^{17,18} Key teaching components of task presentation include that (a) the teacher precisely and accurately presents the learning task while using appropriate examples or metaphors to help students make a sense of the information; (b) the teacher demonstrates key features of a learning task while presenting learning cues related to the nature of the task; and (c) the teacher uses contextual scenarios to explain why the information should be learned to help students find new information relevant and meaningful.^{15–18}

Class management, the 3rd essential dimension, implies how the teacher organizes the students, equipment, space, and learning resources for the task enactment.^{17,18} Researchers contend that the quality of class management depends on how efficiently and effectively the teacher groups students, distributes physical learning materials/equipment, arranges physical layouts, locates students into working areas, and reinforces class norms and rules.^{15–18}

Instructional guidance, the 4th essential dimension, is defined as how the teacher responds to students' ongoing task engagement.^{17,18} Critical components of instructional guidance include that during the students' task engagement, the teacher closely observes and analyzes students' task performance, timely adjusts the complexities of the task, steers students' focus on task, and provides tailored instructional guidance.^{15–18} The 4 essential dimensions provide a core framework for assessing the quality physical education teaching (QPET) in situated classrooms.^{15–18}

According to the expectations for students in Grades 3–5 of the National Content Standard 1,¹ students should demonstrate mature forms of fundamental movements and basic specialized

skills, be able to combine one skill with another, and apply the skills in dynamic situations. However, due to a lack of performance-based assessment tools in previous studies, motor skill competency was evaluated either using product-oriented criteria with a combined product score or merely process-oriented criteria with “yes” or “no” rating scale.^{3,4,6} To fill these gaps in the assessment of motor skill competency, after 4 years of extensive testing with 4000 students at 90 schools across the nation, the National Association for Sport and Physical Education (NASPE) published *PE Metrics: Assessing the National Standard 1: Elementary*.¹⁹ PE metrics includes a series of performance-based assessment rubrics that are specifically designed to assess levels of students' competency in motor skills and movement patterns using both process- and product-oriented criteria based on grade level expectations.

To date, no such study was found in the literature review that was conducted to examine the progress of 4th- and 5th-grade students' demonstration of motor skill competency assessed with the PE metrics assessment rubrics¹⁹ in school settings. In addition, there has been a lack of empirical studies that investigate to what degree QPET contributes to students' demonstration of motor skill competency in manipulative skills (object-control skills). Therefore, the purpose of this study was to examine the extent to which the QPET contributed to improving 4th- and 5th-grade students' manipulative skill competency that was assessed with selected PE metrics assessment rubrics.¹⁹ This investigation was guided by 2 research questions including: (a) To what degree did the 4 essential dimensions of QPET contribute to students' manipulative skill competency; and (b) How did the impact of essential dimensions of QPET in improving manipulative skill competency differ for boys and girls? The significance of this study lies in providing empirical evidence for how QPET impacts students' achieving desired learning outcomes in relation to the NASPE content standard 1.

2. Methods

2.1. Participants and research settings

Participants in this study were 9 elementary PE teachers and 4th- and 5th-grade students ($n = 2709\text{--}3420$) who were enrolled in 9 elementary schools in the United States. All 9 teachers (5 males and 4 females) were Caucasian. Their ages ranged from 33 to 55 years old and their teaching experience varied from 6 to 26 years. All 9 PE teachers participated in the 2-year study, indicating 100% retention rate. The students' retention rate was 91%. The student population was dominantly White, non-Hispanic (91.2%; 48% girls and 52% boys). The 4th- and 5th-grade students had one 60-min PE class each week for 36 weeks throughout an academic school year. The PE class size ranged from 18 to 28 students.

The University of Michigan Institutional Review Board for Human Subject Research and the school district granted the permission for conducting this study. All 9 PE teachers signed the consent form to indicate their willingness to participate in this study. The parents/guardians of the 4th- and 5th-grade students also signed the consent form to grant permission for

Table 1

A score range for each essential dimension and the total score of the 3 physical education metrics assessments.

Skill assessment	Essential dimensions	Total score
Soccer skill (1 trial)	Dribbling, passing, receiving (0–4)	0–12 (9 = competent)
Baseball overhand throwing (3 trials)	Form (0–4), 1st 2nd 3rd Accuracy to target (0–4), 1st 2nd 3rd	0–24 (18 = competent)
Tennis striking skill (1 trial)	Form (0–4) Continuous strikes (0–4)	0–8 (6 = competent)

their children to participate in this study. An assent form was also distributed to the students allowing them to decide if they wanted to participate in this study or not, even though their parents/guardians approved their participation.

2.2. Motor skill assessments

The 4th- and 5th-grade students' manipulative skill competency was assessed with 3 PE metrics assessment rubrics including soccer dribbling, passing, and receiving skill assessment rubric, overhand throwing skill assessment rubric, and striking skill with a racket assessment rubric.¹⁹ Based on the unique nature of a skill, each PE metrics assessment rubric has its own essential dimensions, performance indicators on each of the 0–4 rating scales, and the number of trial for testing. Table 1 presents each of the 3 PE metrics assessments.¹⁹

For the soccer dribbling, passing, and receiving skills assessment, the students' performance levels were assessed on the 3 essential dimensions: dribbling, passing, and receiving with a 0–4 rating scale. Criteria for competence (Level 3) in dribbling is “dribble with control while moving at a slow, consistent jog”, in passing is “sends a receiving lead pass to a partner so it can be caught outside the passing lane without a break in the receiver's stride on at least three passes”, and in receiving is “moves forward and outside the passing lane to meet the ball and receiving at least three receivable passes”.¹⁹ One thousand three hundred and forty-six students in Year 1 and 1377 students in Year 2 completed the soccer dribbling, passing, and receiving skills assessment.

In the overhand throwing skill assessment, students were assessed on their performance levels of form and accuracy to target using a 0–4 rating scale. Criteria for competence (Level 3) in form are: “throws with selected essential elements: (a) throwing elbow shoulder-high, hand back and side orientation in preparation for the throw, (b) trunk rotation, with elbow lagging behind hip, (c) weight transfer to non-throwing forward foot.” For accuracy to target is: “hits target area on wall”.¹⁹ One thousand nine hundred and twenty-four students in Year 1 and 1496 students in Year 2 completed the overhand throwing skill assessment.

For the striking with a paddle assessment, the students' performance levels were assessed on the 2 essential dimensions: form and continuous strikes using a 0–4 rating scale. Criteria for competence (Level 3) in form are: “usually uses a side orientation” and in continuous strikes are: “strikes the ball continuously against the wall five times from 10 feet with added strokes that may be in front of the 10-foot striking line”.¹⁹ PE metrics¹⁹ provides more detailed information about assessment

rubric criteria, performance indicators, assessment tasks, and assessment protocols for each skill assessment. One thousand three hundred and forty-eight students in Year 1 and 1361 students in Year 2 completed the striking with a paddle assessment.

In this study, the Cronbach's α reliability coefficients of soccer skills, throwing skill, and striking skill assessments were 0.92, 0.81, and 0.88, respectively. The results showed that 3 manipulative skill assessments had satisfactory internal consistency reliability.²⁰

2.3. Assessment of QPET

2.3.1. Video-recording lessons

We video-recorded 63 PE lessons taught by 9 PE teachers to their students throughout 4 academic semesters. Prior to the video-recording in the beginning of each semester, we asked the teachers to choose their preferred date and lesson content to be video-recorded on the doodle meeting calendar in order to follow the teachers' regular PE schedule. During each of the first 3 semesters, we video-taped each teacher's teaching 2 lessons to their students. During the 4th semester, we video-taped each teacher's teaching 1 lesson to their students.

To video-record a lesson, a camcorder was placed in an unobtrusive corner of the gymnasium to avoid interfering with the teaching. The teacher wore a wireless microphone throughout the lesson. The voice transmitter was attached to the digital camcorder in order to capture the teacher's and the students' voices. The camcorder's angles were constantly adjusted and zoomed in and out to make sure the teacher and their students were in view. The lesson was digitally recorded when the teacher started his/her teaching and the recording was stopped when the teacher dismissed the class.

2.3.2. Coding the video-recorded lessons

To assess levels of the teachers' QPET, 63 video-recorded lessons were coded with the assessing quality teaching rubrics (AQTR).¹⁶ The AQTR was designed as an observational rubric to assess teachers' QPET in a live PE lesson or a digitally recorded PE lesson. It consists of 4 essential dimensions including task design, task presentation, class management, and instructional guidance with 13 subsumed teaching components. The task design is composed of 2 components: developmental appropriateness and maximum participation. Task presentation includes 3 components: clarity and accuracy, demonstration, and learning cues. Class management is comprised of gaining attention, equipment distribution, grouping students, and transition. Instructional guidance contains

4 components: monitoring, adjusting the task, general feedback, and specific feedback. The performance indicator of each teaching component is defined on a 3-point rating scale to identify a gradation of the quality of teaching practices. For example, a rating of “3” indicates that the teacher fully demonstrated the criteria of quality teaching practices in each teaching component. A rating of “2” indicates the teacher in some degree demonstrated the criteria of quality teaching practices. A rating of “1” indicates that the teacher did not demonstrate the criteria of quality teaching practices. Also an “n/a” indicates that the specific teaching component was not applicable to a given teaching episode.

To help an evaluator objectively assess the teacher’s QPET in a live lesson or a video-recorded lesson, Chen et al.¹⁶ designed the AQTR assessment sheet. The teaching components of the 4 essential teaching dimensions on the AQTR assessment sheet are organized task by task. In other words, each task cycle, starting from the nature of the task, the presentation of the task, organization of the class for the task, and instructional response to the students’ task engagement, is identified as one teaching episode. The AQTR Assessment Sheet allows an evaluator to focus on assessing the teacher’s instructional practices of each teaching component within each task cycle. Accordingly, within each task cycle, the teacher receives a score on each teaching component, a total score on each essential dimension (a composite score on each teaching component within the essential dimension), and a total score for each teaching episode; within an entire lesson, the teacher receives an overall teaching score (a composite score of each teaching episode score), and an overall score of each teaching dimension (a composite score of each essential dimension).

Prior to officially coding the 63 video-recorded lessons, 4 investigators spent a minimum of 15 h studying the AQTR and its coding protocols,¹⁶ and practicing observing and coding 4 video-recorded lessons which were randomly selected from the pool of the videotaped lessons. Then, 4 investigators who were paired-up began to code the other 3 randomly selected video-recorded lessons. While watching each recorded lesson together, each pair independently coded each video-recorded lesson with the AQTR assessment sheet to check the inter-rater reliability (IR). The IR of the coded lessons was examined by checking each investigator’s coding results using the formula: $\%IR = (\text{numbers of agreement} \div (\text{numbers of agreement} + \text{numbers of disagreement})) \times 100$.²¹ According to the formula, the IR of the 3 coded lessons was 82.4%, 84.5%, and 94%. Subsequently, 4 investigators began to officially code the 63 video-recorded lessons with the AQTR assessment sheet using the coding protocols.¹⁶ The 2 investigators watched each recorded lesson together, but each pair independently coded each recorded lesson.

2.4. Data analysis

Descriptive statistics and percentages were computed to determine levels and proportions of the students’ demonstration of competency in each skill assessment. The composite score of each teaching component score was computed as the overall QPET score. To determine to what degree the 4 essential

dimensions of QPET contributed to students’ manipulative skill competency, multiple R^2 linear regression analyses were performed. Subsequently, standardized multiple regression coefficients were analyzed to assess the relative importance of each essential dimension in predicting students’ manipulative skill competency. A mean score of overall QPET was calculated and used as a cut-off point to divide teaching practices into two levels of quality teaching. An independent sample t test was conducted to examine a significant difference of each skill assessment score between the 2 levels of overall QPET. All statistical analyses were conducted by using IBM SPSS statistics (Version 22; IBM Corp., Armonk, NY, USA).

3. Results

3.1. Descriptive statistics of motor skill assessments

For soccer skills assessment, a total score of 9 indicated the overall competent level. Among 2723 students who completed the soccer skill assessment, 2031 (74.6%) demonstrated the competent level or above (9.48 ± 1.90 , mean \pm SD). Regarding the overhand throwing skill assessment, a total score of 18 indicated an overall competent level. Of 3420 students who completed the assessment, 2445 (71.5%) demonstrated the competent level or above (19.48 ± 3.47). For striking skill assessment, a total score of 6 indicated the overall competent level. Of 2709 students who completed the skill assessment, 1623 (59.9%) demonstrated the competent level or above (5.96 ± 1.57).

3.2. Prediction of QPET to motor skill competency

To examine the extent to which the 4 essential dimensions of QPET contributed to students’ soccer skill competency, the multiple R^2 linear regression model was conducted with specifying task design, task presentation, class management, and instructional response as independent variables and the overall competent score of soccer skills as dependent variable while using Weighted Least Squares Regression-Weighted by school method. Table 2 presents the results of the regression model. The results revealed that the 4 dimensions of QPET significantly predicted soccer skill competency for the total sample ($F = 96.54$, $p < 0.01$), for boys ($F = 67.41$, $p < 0.01$), and for girls ($F = 45.48$, $p < 0.01$). The 4 dimensions of QPET explained 12.4% of the total variance in soccer skill competency for the total sample, 15.7% for boys, and 12.5% for girls. Subsequently, for boys, the results of standardized regression coefficients indicated that task presentation ($\beta = 0.29$), task design ($\beta = 0.20$), class management ($\beta = 0.18$), and instructional guidance ($\beta = 0.10$) were significant contributors to soccer skill competency. In contrast, for girls, management and task presentation displayed significant β weight ($\beta = 0.27$, $\beta = 0.26$) at a significant level of $p < 0.01$, but task design and instructional guidance did not display significant β weights.

To determine the extent to which the 4 essential dimensions of QPET contributed to students’ throwing skill competency, the multiple R^2 linear regression model was conducted with specifying the 4 teaching dimensions as independent variables and the overall competent score of throwing skill

Table 2
Results of regression model using overall quality physical education predicting soccer skill competency.

	<i>R</i>	<i>R</i> ²	<i>F</i>	Sig.	<i>p</i>	β	<i>t</i>	Sig.	<i>p</i>
Total sample									
Model	0.353	0.124	96.54	0.000	<0.01				
Task design						0.12	2.75	0.006	<0.01
Task presentation						0.26	8.72	0.000	<0.01
Management						0.21	9.02	0.000	<0.01
Guidance						0.04	1.17	0.240	>0.05
Boy									
Model	0.397	0.157	67.41	0.000	<0.01				
Task design						0.20	3.46	0.001	<0.01
Task presentation						0.29	7.19	0.000	<0.01
Management						0.18	5.93	0.000	<0.01
Guidance						0.10	2.05	0.040	<0.05
Girl									
Model	0.354	0.125	45.48	0.000	<0.01				
Task design						0.04	0.62	0.533	>0.05
Task presentation						0.26	5.90	0.000	<0.01
Management						0.27	7.70	0.000	<0.01
Guidance						0.03	0.48	0.629	>0.05

as dependent variable with using Weighted Least Squares Regression-Weighted by School method. Table 3 presents the results of the regression model. The results indicated that the 4 essential dimensions of QPET significantly predicted throwing skill competency for the total sample ($F = 201.38, p < 0.01$), for boys ($F = 75.82, p < 0.01$), and for girls ($F = 130.73, p < 0.01$). The 4 teaching dimensions accounted for 19.1% of the total variance in throwing skill competency for the total sample, 14.2% for boys, and 24.9% for girls. Furthermore, for boys, the results of standardized regression coefficients (β) indicated that task presentation ($\beta = 0.49, p < 0.01$), task design ($\beta = 0.12, p < 0.05$), and class management ($\beta = 0.06, p < 0.05$) were significant contributors to predict throwing skill competency, but not instructional guidance. In contrast, for girls, task presentation ($\beta = 0.48$) and class management ($\beta = 0.23$) were signifi-

cant contributors to predict the daily PA in school at $p < 0.01$ level, but task design and instructional guidance were not.

To test the extent to which the four essential dimensions of QPET predicted students' striking skill competency, the multiple R^2 linear regression model was performed with specifying the 4 teaching dimensions as independent variables and the overall competent score of striking skill as dependent variable with the use of Weighted Least Squares Regression-Weighted by School method. Table 4 shows the results of the regression model. The results revealed that the 4 teaching dimensions significantly predicted striking skill competency for the total sample ($F = 67.75, p < 0.01$), for boys ($F = 46.89, p < 0.01$), and for girls ($F = 24.97, p < 0.01$). The 4 teaching dimensions explained 9.1% of the total variance in striking skill competency for the total sample, 11.5% for boys, and 7.4% for girls.

Table 3
Results of regression model using overall quality physical education predicting throwing skill competency.

	<i>R</i>	<i>R</i> ²	<i>F</i>	Sig.	<i>p</i>	β	<i>t</i>	Sig.	<i>p</i>
Total sample									
Model	0.437	0.191	201.38	0.000	<0.01				
Task design						0.06	2.15	0.031	<0.05
Task presentation						0.48	25.73	0.000	<0.01
Management						0.12	5.24	0.000	<0.01
Guidance						0.02	0.70	0.49	>0.05
Boy									
Model	0.377	0.142	75.82	0.000	<0.01				
Task design						0.12	2.26	0.024	<0.05
Task presentation						0.49	13.33	0.000	<0.01
Management						0.06	2.03	0.043	<0.05
Guidance						0.04	0.91	0.364	>0.05
Girl									
Model	0.499	0.249	130.73	0.000	<0.01				
Task design						0.01	0.09	0.928	>0.05
Task presentation						0.48	13.04	0.000	<0.01
Management						0.23	7.69	0.000	<0.01
Guidance						0.02	0.38	0.706	>0.05

Table 4
Results of regression model using overall quality physical education predicting striking skill competency.

	<i>R</i>	<i>R</i> ²	<i>F</i>	Sig.	<i>p</i>	β	<i>t</i>	Sig.	<i>p</i>
Total sample									
Model	0.302	0.091	67.75	0.000	<0.01				
Task design						0.11	3.25	0.001	<0.01
Task presentation						0.23	10.03	0.000	<0.01
Management						0.07	2.47	0.014	<0.05
Guidance						0.06	2.03	0.043	<0.05
Boy									
Model	0.339	0.115	46.89	0.000	<0.01				
Task design						0.08	1.25	0.203	>0.05
Task presentation						0.29	6.69	0.000	<0.01
Management						0.08	2.59	0.010	<0.01
Guidance						0.07	1.27	0.204	>0.05
Girl									
Model	0.272	0.074	24.97	0.000	<0.01				
Task design						0.01	0.11	0.911	>0.05
Task presentation						0.25	5.28	0.000	<0.01
Management						0.01	0.23	0.817	>0.05
Guidance						0.04	0.74	0.460	>0.05

Subsequently, the results of standardized regression coefficients indicated that task presentation ($\beta = 0.29$, $p < 0.01$) and class management ($\beta = 0.08$, $p < 0.01$) were significant contributors to boys' striking skill competency. In contrast, only task presentation was a significant contributor to girls' striking skill competency ($\beta = 0.25$, $p < 0.01$).

3.3. Differences of manipulative skill competency between 2 QPET groups

The mean score (2.66) of overall QPET was computed and was used to classify 63 videotaped lessons into 2 groups: above and below average QPET group. Table 5 presents descriptive statistics of each skill assessment between the 2 QPET groups. To determine if there was a significant mean score difference in each of the 3 manipulative skill assessments between the 2 QPET groups, an independent sample *t* test was conducted separately. The results of *t* tests revealed that the students in the above average QPET group significantly outperformed their counterparts in the below average QPET group in soccer skill ($t = 6.53$, $df = 2456.9$, $p < 0.01$), throwing skill ($t = 10.72$, $df = 3348.35$, $p < 0.01$), and striking skill ($t = 13.55$, $df = 2493.68$, $p < 0.01$).

4. Discussion

According to NASPE appropriate instructional practice guidelines,²² the essence of QPE encompasses maximal learning opportunities, meaningful learning content, and appropriate instructions. In line with the key features of QPE,^{1,2,11} this study

provided empirical evidence that the 4 essential dimensions of QPET including task design, task presentation, class management, and instructional guidance were all significant contributors to students' 3 manipulative skill competency. Interestingly, the 4 essential dimensions of QPET collectively accounted for a relatively high percentage of total variance in throwing skill competency (19.1%), soccer skills competency (12.4%), and striking skill competency (9.1%). While the limitation of this study was a lack of baseline assessment of the students' competency in 3 skills, the students who had experienced high quality of QPET were significantly more competent in all 3 manipulative skills than those students who did not have this experience. This study confirmed that a high quality of instructional practices in PE lessons did contribute to students' demonstration of manipulative skill competency.

Corroborating the results of previous studies,^{15–18} this study empirically confirmed that providing developmentally appropriate and maximally engaging learning tasks; presenting learning tasks accurately and precisely, accompanied with high quality of demonstration and relevant learning cues; organizing students, space, formation, equipment, and transition efficiently; providing timely, specific, and tailored instructional guidance, and adjusting learning tasks flexibly based on students' ongoing learning responses, all collectively played significant roles in building students' manipulative skill competency. In other words, to better equip students with manipulative skill competency, PE teachers should enact high quality of all four essential dimensions in a PE lesson.

Furthermore, the results of this study indicated that the significant contribution of the 4 essential dimensions of QPET to students' manipulative skill competency was gender-specific. The results of regression models showed that the 4 essential dimensions of QPET explained the amount of total variance in soccer skill competency and striking skill competency was higher for boys than for girls. In contrast, the 4 essential dimensions of QPET accounted for much higher percentage of total variance in throwing skill competency for girls, compared to

Table 5
Descriptive statistics of manipulative skill competencies between 2 qualities of physical education teaching levels.

	Above average group		Below average group	
	<i>n</i>	Mean \pm SD	<i>n</i>	Mean \pm SD
Soccer skill	1286	9.73 \pm 2.09	1437	9.26 \pm 1.68
Throwing skill	1604	20.14 \pm 3.45	1816	18.89 \pm 3.38
Striking skill	1223	6.39 \pm 1.61	1486	5.60 \pm 1.45

boys. This study indicated QPET played more significant role in developing boys' soccer skills and striking skill competency, compared to girls. Conversely, the development of girls' throwing skill competency depended largely on the teachers' providing QPET in PE lessons.

Of the 4 essential dimensions of the QPET, task presentation and task design were most significant contributors to boys' soccer and throwing skill competencies, followed by class management which was a much less significant contributor to the 2 skill competencies. Task presentation and class management were significant contributors to boys' striking skill competencies, although class management contributed much less. On the contrary, task presentation and class management were significant contributors to girls' soccer and throwing skill competencies. However, task presentation alone was a significant contributor to girls' striking skill competency. The results indicated that task design and task presentation played a more significant role in contributing to soccer and throwing skill competency for boys. Task presentation and class management played more significant contributing roles in the development of manipulative skill competency for girls.

Although the significant contribution of the 4 essential dimensions to manipulative skill competency was gender specific, task presentation played the most significant role in contributing to all 3 manipulative skill competencies regardless of gender. This study indicated that to effectively help students demonstrate manipulative skill competency, it is critical for PE teachers to use high quality features of task presentation. When presenting a learning task, PE teachers should precisely and explicitly explain what it is about. To help students see how to perform a skill and/or a task clearly, PE teachers should demonstrate each key feature of a skill/task one at a time and demonstrate each phase of a skill/task performance in a sequential order. During the demonstration, PE teachers should present related learning cues that accurately capture the key features of the skill/task and are relevant to the focus of a skill/task. Likewise, researchers have noted that the teachers' use of partial and/or full demonstration accompanied with presenting learning cues was effective in helping the students understand the correct form of a skill.^{15–18} This study suggests that without knowing how to perform a skill/task correctly, even though the students have maximally participated in the task that is developmentally appropriate, the task itself will not help students gain a better understanding of the proper skill forms. Providing ample learning opportunities alone will not help students demonstrate proper forms of a skill/task. If students do not know the accurate learning cues of a skill/task prior to their task engagement, even though the teacher provides specific feedback related to their skill/task performance, students will not make any sense of what the specific feedback means to them. Therefore, high quality of task presentation is a key contributor to students' demonstration of manipulative skill competency.

It is important to note that in this study the highest number of students (74.5%) who demonstrated a competent level or above the competent level is soccer dribbling, passing, and receiving skills, followed by overhand throwing skill (71.5%).

However, the lowest number of students (60%) demonstrating a competent level is the striking skill. Striking skill is a basic specialized manipulative skill used in tennis, pickle ball, and badminton which are life-time sports. Mastery of striking skill in childhood lays a foundation for adolescents to effectively learn and master striking-related skills and to successfully play these life-time sports. Barnett et al.³ found that manipulative skill proficiency developed in childhood rather than locomotor skill proficiency seemed to be a significant determinant for adolescents to engage in moderate-to-vigorous activity and organized activity. Given the important role of motor skill competency in participation in organized sports and PA, this study suggests that PE teachers should focus more on helping elementary school students learn striking-related skills through providing high quality features of task-design and task presentation. PE teachers need to help students use striking-type skills in game-like and modified-game situations to reinforce their skill acquisition and improve their skill competency.

In conclusion, the 4 essential dimensions of QPET played a significant role in contributing to students' manipulative skill competency. QPET accounted for a relatively high percentage of the total variance in all 3 manipulative skills. The students in the high level of QPET group were more significantly likely to be skillfully competent than their counterparts in the low level of QPET group. Although the significant contribution of the four essential dimensions of QPET to manipulative skill competency was gender-specific, task presentation played the most significant contributing role in increasing manipulative skill competency regardless of gender.

Authors' contributions

WC designed the project, analyzed the data, and wrote the manuscript. WZ provided specific feedback for data analysis and wrote the manuscript and edited the manuscript. SM, AHB, and ACD searched and reviewed the literature on fitness and motor skills, input the data, and edited the manuscript. All authors have read and approved the final version of the manuscript and agreed with the order of the authorship for this manuscript.

Competing interests

None of the authors declare competing financial interests. There is no conflict of interests with this project regarding financial and/or no-financial aspects. We do not have any financial interest of the subject matter discussed in the manuscript.

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