



The relationship between physical literacy and quality of life among university students: The role of motivation as a mediator

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ABSTRACT

Background/objective: The literature has discussed the potential for nurturing, integrating, and optimizing physical literacy to thereby enhance quality of life. Progression could be made through the disposition of acquiring movements and engaging in physical activity, but data supporting such an argument remains limited. This cross-sectional study attempted to empirically investigate these two variables by assessing the levels of motivation and satisfaction among university students in Taiwan. The hypothesis posited a positive correlation between physical literacy and quality of life, with the mediating effects of motivation and satisfaction taken into consideration.

Methods: By applying the time segregation method, participants were asked to complete a set of questionnaires at the beginning and the end of the first semester during the 2021 – 2022 academic year. The initial phase involved gathering demographic information and assessing the perceived physical literacy score. The scores for motivation, satisfaction, and quality of life were measured in the subsequent phase. SmartPLS version 3.3 was used to conduct data analysis. After ratifying the model's goodness-of-fit, partial least squares structural equation modeling was used to test the hypotheses in the research model.

Results: A total of 388 students (male $n = 320$, female $n = 68$; mean age: 18.5 years) participated in this study. Moderate explanatory power was found in the relationships of perceived physical literacy to physical education satisfaction ($\beta_{PPLI \rightarrow PES} = 0.137$, $t = 6.439$, $R^2 = 0.642$) and motivation ($\beta_{PPLIA \rightarrow SIMS} = 0.511$, $t = 32.701$, $R^2 = 0.607$). Results then indicated that motivation is the mediator of the relationship between physical literacy and physical education satisfaction ($\beta_{PPLI \rightarrow SIMS \rightarrow PES} = 0.373$, $t = 4.015$). Furthermore, this satisfaction mediated the relationship between physical literacy and quality of life ($\beta_{PPLI \rightarrow PES \rightarrow QoLS} = 0.070$, $t = 4.47$).

Conclusion: This study connected theoretical knowledge regarding physical literacy with practice, suggesting that ongoing physical education may nurture the habit of lifelong participation in physical activity, thus further improving quality of life.

1. Introduction

1.1. Physical literacy

Physical literacy originates from the philosophical foundations of monism, existentialism, and phenomenology.¹ Whitehead revised the definition of physical literacy to “as appropriate to each individual, physical literacy can be described as the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engaging in physical activities for life”.² The philosophically defined domains and attributes of physical literacy

facilitate managing quality physical education programs by practitioners to nurture students' progress.³ The ideology has also been embedded in the curricula of several other countries.⁴ However, physical educators have criticized that the already established approach of promoting physical literacy and delivering high-quality physical education would still be used,² and have characterized the controversial concept as “old wine in new bottles”.^{5,6} This points to the prominent arguments relating to the measurement and assessment methods of physical literacy.⁷ Notably, it has been discussed among scholars and practitioners of the International Physical Literacy Association (IPLA) that a more holistic approach should be considered to determine the

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progress of students' physical literacy aspirations and values throughout their lives.⁸

Following the significant number of research studies focusing on children and adolescents,^{8,9} this is now a timely opportunity to expand the scope of the investigation to include physical literacy among young adults, adults, and the aging population in diverse environments. Specifically, the conclusion of mandatory secondary education could be considered a transitory phase from adolescence to young adulthood.¹⁰ Individuals of this age group soon become independent in their physical activity habits, and these habits vary depending on their demographic backgrounds, such as age, marital status, education level, occupation, living conditions, family income, etc. Over the course of its two-decade development, it has expanded from the physical education context to encompass elements of public health.^{11–13} One viable way for future physical literacy research might be to investigate its attributes through student satisfaction with physical education lessons and their overall quality of life. Accordingly, this study took into account the philosophical domains, attributes, and principles that govern the measurement of physical literacy.

1.2. Associations between physical literacy and quality of life

Quality of life is a comprehensive and complex concept defined as “an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns” (p. 43).¹⁴ It encompasses a wide range of aspects of physical health, psychological health, independence, social relationships, environment, and beliefs.¹⁵ These non-cognitive outcomes can be perceived not only as prerequisites of learning but may also be regarded as goals of education.¹⁶ After all, the efficacy of an education system is questionable if its students concentrate only on achieving academically, even at the cost of their quality of life. Yet, how do we ‘educate’ students to have a better quality of life? Based on the conceptual discussions in Western studies, a recent review of reviews has indicated that physical literacy has the capacity to enhance well-being, improve health, and elevate quality of life.¹⁷ Specifically, a 12-factor virtuous model of physical literacy development aimed to establish connections between movement sciences, psychology and social science. This model provides insights into how individuals can enhance their quality of life progressively by acquiring movement skills and knowledge, and actively participating in physical activities.¹⁸ Expanding on this further, examining an individual's physical literacy can serve as a disposition indicator to explore new activities and these active engagements have the potential to enhance their overall quality of life.

1.3. Mediators of motivation and satisfaction

When evaluating the connection between physical literacy and quality of life, it is important to consider the progress made in each factor and how it contributes to ensuring a meaningful and fulfilling experience. Particularly in the context of physical education, the characteristics of motivation and satisfaction are worth considering.^{19,20} Motivation is a disposition of physical literacy described as the ability “to capitalize on innate movement potential to make a significant contribution to the quality of life” (p. 12).²¹ When individuals demonstrate the motivation to make unique progress on their physical literacy journey, it pertains to their interest, enthusiasm, and perseverance in solving physical activity tasks in a challenging environment.² Although motivation has not been included in the perceived physical literacy framework, it is one of the attributes in the affective domain of physical literacy. Through effective curricula and pedagogy, physical education not only promotes students' physical activity levels but could also build perceived physical literacy and motivation.¹⁹ One's personal disposition could make a significant contribution to personal satisfaction and overall quality of life.²² Hence, motivation could be deemed a mediator

of physical literacy; however, less is known about whether the relationship between physical literacy and quality of life varies as a function of satisfaction with physical education and motivation.

Physical education provides a suitable context for students to learn and develop healthy habits to allow for lifelong participation in physical activity.²³ Students' satisfaction with physical education becomes one of the vital parts of appraising their overall learning outcomes, especially in relation to how their satisfaction was affected by confidence, communication, and knowledge. In the university context, the institutes provide leisure facilities and organize recreational activities, providing students greater freedom in choosing their physical activities and preferred level of intensity.¹⁰ University physical educators actively facilitate students to engage in physical activity through structured physical education lessons. Through a wide variety of activities, teachers may empower students to relate the lesson contents to the recreation and leisure context, thereby positively influencing students' quality of life.²⁴ A positive and reciprocal relationship between perceived physical literacy and the satisfaction of basic psychological needs was demonstrated in the Taiwan university context.²⁰ This result may further suggest the context of physical education in promoting quality of life.

1.4. Research gaps

In Taiwan, the 12-year literacy-oriented national foundational education curriculum was initiated by the Ministry of Education in 2015. Higher education institutions have started to promote physical literacy in physical education teacher education programs, and one university was commissioned to deliver a series of continuing professional development programs. Since then, the curricula for primary and secondary physical education programs have been designed around the concept of physical literacy. Nonetheless, mandatory physical education curricula are provided at the higher education level in Taiwan, which could be regarded as the last opportunity for undergraduate students to participate in structured physical activities.¹⁹ Assessment of their skills and knowledge would take place and a grade would be given, which would count as part of their graduation requirements. As an onset foundation, studies in the education context could avoid the discrepancy in its conceptual meaning. Given the unique nature of this study taking place in the university context, findings are expected to generate new physical literacy knowledge for physical education in Taiwan both across universities (horizontal) and across education levels (vertical), which could then be studied over an extended period of time from population censuses or longitudinal perspectives. For example, two studies in the Greater China Region have indicated that physical literacy is positively related to physical activity levels²⁵ and basic psychological needs satisfaction.²⁰ However, these methods may generate an interchangeable meaning between physical activity and physical literacy, causing the philosophical and conceptual meanings associated with the latter to vanish. Additionally, it remains unclear whether similar physical literacy research could yield benefits in terms of the quality of life among university students. Considering these findings, it is reasonable to expect that physical education experiences not only enhance physical literacy but also contribute to increased physical activity and overall well-being among young adults.

1.5. Hypotheses

Although it is widely accepted that physical activities may benefit quality of life, the magnitude of this effect and its relationship with important attributes are less clear. Consequently, the purpose of this study was to investigate the mediation effect of motivation and satisfaction in the relationship between physical literacy and quality of life. We focused on the following questions: 1) How strong is the effect of perceived physical literacy on motivation, satisfaction with physical education, and quality of life among Taiwan university students? 2) Are these effects mediated by motivation and satisfaction? We hypothesized

that physical literacy has positive impacts on physical education satisfaction (H1) and situational intrinsic motivation (H2). The mediation analyses hypothesized that situational intrinsic motivation mediates the relationship between physical literacy and physical education satisfaction (H3), and that satisfaction may mediate the relationship between physical literacy and quality of life (H4). A detailed hypothesized mediation model is shown in Fig. 1.

2. Methods

2.1. Procedures

The relationship between physical literacy and quality of life was investigated through a mediation analysis of motivation and satisfaction. Before inviting participants, ethical approval was obtained from the first author's institution. This study took place in universities in Taiwan that provided various kinds of mandatory 16-lesson physical education courses each semester. Specifically, within the framework of university education policy in Taiwan, it is mandatory for university students to enroll in physical education courses. Additionally, universities in Taiwan follow a two-semester academic year system, with each semester spanning a duration of 16 weeks. Furthermore, during the initial week of the course, the physical education instructors provided an overview of the study and enlisted student participants. Subsequently, they detailed the test administration process and obtained informed consent from the students before proceeding with data collection via paper questionnaires. Permission to conduct the survey and informed consent were received from the universities and students respectively. Students were informed that their responses would remain confidential and would be used for research purposes only.

This study used the time segregation method to collect data on different variables in order to confirm the sequential relationships of the measured variables across an interval of 16 lessons. In the 2021–2022 academic year, students were asked to complete the same set of questionnaires twice - before and after the first semester, i.e., August 2021 and February 2022. The survey items were allocated randomly in the design of the measurement tool to avoid psychological interference in participants' responses. On average, a participant took around 15 min to complete the questionnaire. The first phase collected demographic information from the participants and independent variable scores of perceived physical literacy. The second phase measured the mediator score of motivation and satisfaction with physical education and the dependent variable score of quality of life. The researchers were responsible for inputting the anonymized data into a Microsoft Excel Worksheet (Microsoft Corporation, Redmond, WA) for further analysis. A paired comparison of demographic variables was also performed to eliminate confounding factors before the data collection procedures.

2.2. Sample

A total of 400 valid responses were collected for initial data screening. After the paired comparison of demographic information and the exclusion of 12 multivariate outliers, as identified by Mahalanobis

distance analysis,²⁶ data from the remaining 388 participants who completed both phases were available for further analysis. Precisely, to ensure the completeness of the data, it was imperative that students who completed the questionnaire had participated in a full 16-week physical education program. Furthermore, this study scrutinized the data's integrity by cross-referencing the students' identification numbers. Of the remaining participants (mean age = 18.5 years, SD = 1.38 years), most were male (male $n = 320$, 82.5 %; female $n = 68$, 17.5 %). 294 (75.8 %) participants chose a mandatory physical education course, while 94 (24.2 %) participants took part in elective courses. They also engaged in an average of 2.2 hours of moderate to vigorous physical activity per week (see Table 1).

2.3. Instruments

2.3.1. Perceived physical literacy

The nine-item perceived physical literacy instrument (PPLI) is a survey that can measure the attributes of sense of self and self-confidence, self-expression and communication with others, and knowledge and understanding of sports benefits.²⁷ Participants responded to each item on a Likert scale ranging from one (*strongly disagree*) to five (*strongly agree*). Example items included: (a) I am physically fit, in accordance with my age (*sense of self and self-confidence*); (b) I have strong social skills (*self-expression and communication with others*); (c) I am aware of the benefits of sports in relation to health (*knowledge and understanding*). Among test groups of physical education teachers,²⁷ adolescents,²⁸ and undergraduates,²⁹ this instrument was internally consistent (Cronbach's $\alpha = 0.73 - 0.76$) and valid,

Table 1

Descriptive statistics analysis and correlations among study variables.

	Number	%					
Gender							
Male	320	82.5					
Female	68	17.5					
Physical activity per week							
One time	116	29.9					
Two times	150	38.7					
Three times	72	18.6					
Four times	27	7.0					
Five times	23	5.9					
Variables	Mean	SD	1	2	3	4	5
1. Physical activity per week	2.20	1.12	–				
2. Perceived physical literacy	3.92	0.76	0.30**	–			
3. Motivation	5.18	0.96	0.19**	0.71**	–		
4. Physical education satisfaction	3.82	0.79	0.26**	0.72**	0.62**	–	
5. Quality of life satisfaction	4.12	0.83	0.29**	0.74**	0.67**	0.61**	–

Note. $n = 388$, ** $p < 0.01$.

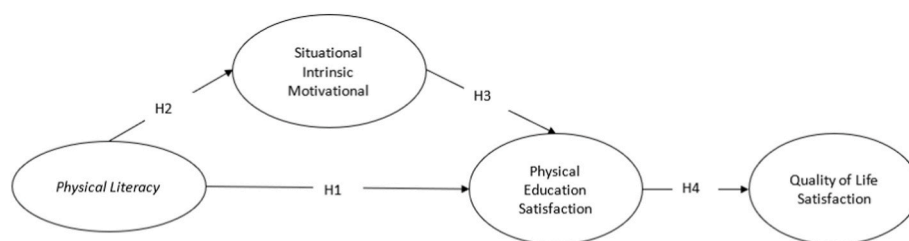


Fig. 1. The hypothesized mediation model of physical education satisfaction and situational intrinsic motivation in the relationship between physical literacy and quality of life.

with comparative fit index (CFI) > 0.95, root mean square error approximation (RMSEA) < 0.08, and standardized root mean square residual (SRMR) < 0.05.

2.3.2. Motivation

The 16-item situational intrinsic motivation scale (SIMS) was designed to measure intrinsic motivation, identified regulation, external regulation, and amotivation when engaging in physical activity.³⁰ Participants responded to items on a Likert scale ranging from one (*not at all true*) to seven (*very true*). Example statements included: (a) this activity is fun (intrinsic motivation); (b) I believe this activity is important for me (*identified regulation*); (c) I don't have any choice (*external regulation*); and (d) I do this activity, but I am not sure if it is a good thing to pursue (*amotivation*). This scale is reliable, with Cronbach's α ranging from 0.78 to 0.93, and valid, with CFI, Tucker Lewis Index (TLI), RMSEA, and SRMR of 0.99, 0.99, 0.05, and 0.06, respectively.³¹

2.3.3. Physical education satisfaction

This study adopted the modified version of a five-item sport satisfaction subscale^{32,33} to measure students' satisfaction in the contexts of physical education and physical activity. Participants responded on a Likert scale ranging from one (*strongly disagree*) to five (*strongly agree*). Sample items relating to physical education and physical activity included "I usually have fun doing physical education activities" and "In general, outside of physical education, I find time flies when I am doing physical activities". This subscale was theoretically hypothesized and statistically established with good reliability ($\alpha = 0.71$) and compatible correlations.³³

2.3.4. Quality of life satisfaction

Originating from the Flanagan scale,³⁴ the modified quality of life scale was adopted for the appraisal of health outcomes.^{35,36} This scale considered the holistic conceptual domains of a participant's life. In relation to the context of physical activity, only five out of 16 statements were selected in this study. Participants answered on a Likert scale of one (*terrible*) to seven (*delighted*). Examples statements included: (a) "Health – being physically fit and vigorous"; (b) "Independence, doing for yourself"; and (c) "Understanding yourself – knowing your assets and limitations – knowing what life is about". Additionally, additional elaborations were provided to clarify the meaning of each item. For example, the instructors specified some physical education scenarios to assist participants in better understanding the intended meaning of each item. This scale is validated and reliable with internal consistency ($\alpha = 0.82 - 0.92$) and had a 3-week test-retest reliability in those with chronic illness ($r = 0.78 - 0.84$).³⁵

2.4. Data analysis

The data analyses were conducted with SmartPLS version 3.3 (SmartPLS GmbH, Germany). In the first stage of the mediation analysis, the model's goodness-of-fit was assessed by using chi-squared testing, CFI, the goodness-of-fit index (GFI), the incremental fit index (IFI), the normal fit index (NFI), RMSEA, and SRMR. A model can be considered to be a good fit when the cut-off values of CFI > 0.9, GFI > 0.9, IFI > 0.9, NFI > 0.9, RMSEA < 0.08, and SRMR < 0.05 were achieved.³⁷ In the second stage, the validity and reliability tests of each instrument were performed to evaluate each first-order factor. A value of each factor loading, Cronbach's alpha, and convergent reliability (CR) of at least 0.7 is recommended to accept the reliability for the subscale items.²⁶ For the validity, a value of average variance extracted (AVE) greater than 0.5 in each construct indicated convergent validity, while the discriminant validity compared AVE to the squared inter-construct correlations, where the AVEs should be greater than the other constructs.³⁸ In addition, if the variance inflation factor (VIF) surpasses 3.3, it suggests the potential influence of common method bias within a model.³⁹ To assess the VIF values, a comprehensive collinearity test was undertaken,

revealing that all VIF values at the factor level ranged from 1.247 to 1.860, remaining below the critical threshold of 3.3. This outcome instills assurance in the absence of any common method bias.⁴⁰

After the assessment of the measurement model satisfied the thresholds, this study further adopted two-step partial least squares structural equation modeling (PLS-SEM) to test the mediating effect of situational intrinsic motivation on the relationship between physical literacy and physical education satisfaction, as well as whether or not that satisfaction mediates the relationship between physical literacy and quality of life. The PLS-SEM technique has been widely used as a useful tool for business research.⁴¹ In particular, sports management has been regarded as a particularly appropriate discipline for applying PLS-SEM to estimate complex interrelationships, such as direct, indirect, and moderating relationships. As the research model examines the mediating and moderating effects, the PLS-SEM technique is deemed suitable as it estimates the path coefficients with reduced error terms.⁴¹ Although a traditional three-step procedure provides useful insights into examining a mediating effect,⁴² more recent practical guidelines have been developed by using PLS-SEM.^{43,44} This analysis not only emphasizes the prediction in the proposed model but also provides a causal one.⁴⁵ Accordingly, the coefficient of determination (R^2), cross-validated redundancy (Q^2), and the significance and relevance of both measurement and structural model paths were assessed.²⁶ An R^2 value greater than 0.25, 0.50, and 0.75 indicated a small, medium, and large explanatory power, respectively, while a Q^2 value greater than 0, 0.25, and 0.5 referred to a small, medium, and large predictive relevance, respectively.⁴⁵ To evaluate the significance, a bootstrapping method of analyzing 5000 samples was implemented.

3. Results

3.1. Measurement model

Table 1 demonstrates the descriptive statistics and correlation analysis of each variable. Positive significant correlations ($r = 0.61 - 0.74$, $p < 0.01$) were found between perceived physical literacy (mean = 3.92, SD = 0.76), motivation (mean = 5.18, SD = 0.96), physical education satisfaction (mean = 3.82, SD = 0.79), and quality of life satisfaction (mean = 4.12, SD = 0.83) which could support further hypothesis testing. In addition, the student's weekly physical activity level (mean = 2.2, SD = 1.12) was significantly correlated ($p < .01$) with the variables of perceived physical literacy ($r = 0.30$), motivation ($r = 0.19$), physical education satisfaction ($r = 0.26$), and quality of life satisfaction ($r = 0.29$).

The instruments satisfied the goodness-of-fit requirements of the study sample through the PLS-SEM analysis. All indicators suggested adequate convergent validity and sufficient observed variables to represent the latent variables, as shown in Table 2. The PPLI yielded satisfactory values on fit indices: $\chi^2/df = 9.598$, $p < 0.001$, CFI = 0.95, GFI = 0.96, IFI = 0.97, NFI = 0.95, RMSEA = 0.08, and SRMR = 0.05. The factors were in a consistent direction with the loadings ranging from 0.899 to 0.931 representing an adequate convergent validity. The SIMS demonstrated adequate model fit: $\chi^2/df = 16.84$, $p < 0.001$, CFI = 0.89, GFI = 0.87, IFI = 0.89, NFI = 0.86, RMSEA = 0.11, and SRMR = 0.08.⁴¹ The observed variables sufficiently represented the latent variables with the loading ranging from 0.866 to 0.970. These items were also in a compatible direction indicating an adequate convergent validity. For the variables of physical education and quality of life, sufficient reliability ($\alpha = 0.93$) and correlation were shown in both instruments, indicating compatibility with hypothesized directions and magnitudes. The analysis suggested deleting item b011 because the factor loading was lower than 0.7. In conclusion, the values of Cronbach's alpha (0.892 – 0.975), CR (0.933 – 0.981), and AVEs (0.593 – 0.930) in each construct satisfied the thresholds. All factors satisfied the discriminant validity, and the square of AVEs was higher than other constructs, as shown in Table 3.

Table 2
Results of reliability and validity tests of each instrument (n = 388).

Construct	Items	Factor Loading	Cronbach's Alpha	CR	AVE
PL			0.946	0.954	0.698
SS	a001	0.899	0.901	0.938	0.835
	a002	0.931			
	a003	0.912			
SC	a004	0.899	0.892	0.933	0.822
	a005	0.922			
	a006	0.899			
KU	a007	0.917	0.905	0.940	0.840
	a008	0.927			
	a009	0.905			
SIMS			0.935	0.947	0.593
IM	b001	0.960	0.975	0.981	0.930
	b002	0.965			
	b003	0.970			
	b004	0.961			
IR	b005	0.920	0.932	0.951	0.831
	b006	0.937			
	b007	0.867			
	b008	0.920			
ER	b009	0.943	0.909	0.943	0.847
	b010	0.950			
	b012	0.866			
AM	b013	0.913	0.928	0.940	0.797
	b014	0.890			
	b015	0.876			
	b016	0.891			
PES			0.962	0.970	0.867
	c001	0.941			
	c002	0.941			
	c003	0.917			
	c004	0.957			
	c005	0.900			
QoLS			0.930	0.947	0.782
	e001	0.895			
	e002	0.907			
	e003	0.914			
	e004	0.920			
	e005	0.778			

PL = perceived physical literacy; SS = sense of self and self-confidence; SC = self-expression and communication with others; KU = knowledge and understanding; SIMS = situational intrinsic motivational scale; IM = intrinsic motivation; IR = identified regulation; ER = external regulation; AM = amotivation; SPA = physical education satisfaction; QoLS = quality of life satisfaction; CR = convergent reliability; AVE = average variance extracted.

Table 3
Fornell-Larcker criterion of each factor (n = 388).

	SS	SC	KU	IM	IR	ER	AM	PES	QoLS
SS	0.914								
SC	0.781	0.907							
KU	0.760	0.732	0.917						
IM	0.695	0.640	0.744	0.964					
IR	0.669	0.646	0.758	0.912	0.911				
ER	0.645	0.629	0.680	0.836	0.878	0.920			
AM	0.176	0.221	0.096	0.119	0.135	0.219	0.893		
PES	0.669	0.623	0.747	0.762	0.745	0.692	0.111	0.931	
QoLS	0.674	0.708	0.632	0.638	0.659	0.641	0.164	0.629	0.884

SS = sense of self and self-confidence; SC = self-expression and communication with others; KU = knowledge and understanding; IM = intrinsic motivation; IR = identified regulation; ER = external regulation; AM = motivation; PES = physical education satisfaction; QoLS = quality of life satisfaction.

Table 4
Path coefficients of perceived physical literacy to physical education satisfaction and motivation (n = 388).

Hypothesis	β	p	t	R ²	Q ²	LL	UL	Result
H1. PPLI → PES	0.137	0.000***	6.439	0.642	0.105	0.259	0.481	Supported
H2. PPLI → SIMS	0.511	0.000***	32.701	0.607	0.550	0.728	0.823	Supported

PL = perceived physical literacy instrument, SIMS = situational intrinsic motivational scale, PES = physical education satisfaction; ***p < 0.001; **p < 0.01; *p < 0.05.

3.2. Structural model and hypotheses test

The hypothetical model was examined through the PLS-SEM. The path coefficients were significant in the relationships of perceived physical literacy to physical education satisfaction (H1: $\beta_{PPLI \rightarrow PES} = 0.137, t = 6.439, R^2 = 0.642, p < 0.001$) and motivation (H2: $\beta_{PPLIA \rightarrow SIMS} = 0.511, t = 32.701, R^2 = 0.607, p < 0.001$), as shown in Table 4. Further, small and large model predictive relevances were indicated in H1 ($Q^2 = 0.105$) and H2 ($Q^2 = 0.550$), respectively. In the mediation analysis, the indirect effect (a × b) was first examined by applying bootstrapping procedures to 5000 resamples. If the indirect effect had a significant impact, the direct effect was used to determine the mediation type. As shown in Table 5, perceived physical literacy was positively related to situational intrinsic motivation and physical education satisfaction. The indirect effect of situational intrinsic motivation was significant (H3: $\beta_{PPLI \rightarrow SIMS \rightarrow PES} = 0.373, t = 4.015, p < 0.001$, 95% confidence level: 0.065 – 0.155), implying the existence of a mediating effect. In addition, the physical education satisfaction indirect effect was significant (H4: $\beta_{PPLI \rightarrow PES \rightarrow QoLS} = 0.070, t = 4.473, p < 0.05$, 95% confidence level: 0.049 – 0.132), implying the existence of the mediating effect.

4. Discussion

The present study added to the existing literature in the physical education context by discovering mediators of motivation and satisfaction in influencing students' quality of life. We focused on the multifaceted attributes of charting physical literacy.⁷ Echoing the suggestion of identifying outcomes of physical literacy,⁹ findings reinforced the

Table 5
Tests of mediation effect in the structural model (n = 388).

Hypothesis	Indirect effect	Direct effect	Total effect	Result
H3. PPLI → SIMS → PES	0.373***	0.370***	0.743***	Supported
H4. PPLI → PES → QoLS	0.070*	0.592***	0.733***	Supported

PL = perceived physical literacy instrument; SIMS = situational intrinsic motivational scale; PES = physical education satisfaction; QoLS = quality of life satisfaction; ***p < 0.001; **p < 0.01; *p < 0.05.

conclusion of an outcome of lifelong participation in physical activity among young adults.^{8,9} In the university physical education context, our results agreed with the assumption that students' perceived physical literacy can positively influence several determinants, such as the mediating effect of motivation on satisfaction in physical education lessons. In particular, the value of participating in lifelong physical activity could translate into a better quality of life, given that students were satisfied with the progress of their physical education. Our findings may thus add further insights into the value of human capability in the field of physical literacy. It is important to exercise caution when generalizing the findings of this study to other emerging adults who are not enrolled in university. The scope of this study is limited to university students, and therefore, the applicability of the findings to other populations should be approached with attention.

Discussion about the contribution of physical literacy to quality of life has been present in the literature since about 2007.⁴⁶ The present cross-sectional study attempted to empirically test the theoretical implications of the hypothesized results. Regardless of whether the approaches were student- or teacher-oriented, teachers designed and delivered physical activities during the lessons.¹⁹ These activities required students to perform movement patterns in a progressively demanding environment.² Some of them were capable of doing so and were able to keep challenging themselves, while others took more time to tackle the obstacles. In the present study, the perception of physical literacy and its attributes were assumed to be the student's current level of progress, noting that it is a dynamic and individualized journey for each person.⁷ When students participate in the activities in a physical education course, those attributes and especially their motivation can be realized by capitalizing on their potential to accomplish the movements.²¹ Progress in physical literacy may fluctuate over the course of a person's lifespan as they encounter different experiences and challenges.⁴⁷ Correspondingly, satisfaction from physical education lessons may come from achieving goals that were set by teachers or by students. Thus, students' satisfaction with taking part in physical education lessons was affected by their perception of physical literacy and their motivation.

Satisfaction with physical education is also a mediator in shaping quality of life. The physical educators-participants in earlier studies proposed that some goals of general education could be cultivated in their lessons.⁴⁸ Taking the attributes of values, responsibility, and respect for self and others as examples, both educational goals and quality of life share the same set of attributes. To this extent, not only can physical literacy be nurtured through a satisfying physical education program, but it can also aim to incorporate some of the more "clichéd" ambitions of education.⁴⁹ This experience of satisfaction may also shift to life fulfillment by realizing the translation of psychological health from the context of physical education to life in general. This aligns with findings from prior research indicating that the achievement of broader physical literacy leads to the achievement of "better health, well-being, and quality of life for all".⁵⁰

To date, physical literacy research in the university context only investigated its positive relationship with physical activity levels²⁵ and basic psychological needs satisfaction in a cross-lagged longitudinal design.²⁰ More discussions on physical literacy and human flourishing have been connected to enhancing the quality of life.⁵¹ Although the present study could not investigate their direct relationship, we have integrated motivation and satisfaction with physical education as mediators that improve quality of life, with physical literacy at the foundation for each individual. Moreover, the present findings build upon previous mediation studies that examined the role of physical literacy in enhancing self-esteem⁵² as well as mental health and resilience,⁵³ providing additional support for these associations. While this study represents the first attempt to explore the relationship between physical literacy and quality of life, it is important to note that certain significant factors that could contribute to the mediation relationship, such as emotional, social, and psychological well-being, were not measured in

this study.

In higher education across the world, the number of universities offering physical education at the tertiary education level has been gradually decreasing over the past 150 years.⁵⁴ Although this has not occurred in Taiwan, more universities have envisaged eliminating physical education courses as part of students' graduation requirements. Accordingly, this study used the quality of life approach to deduce the importance of physical education. In terms of practical implications for the current results, physical educators should seek to better scrutinize students' satisfaction with their physical education lessons. Since a single sport is usually used in university physical education courses, this is similar to an environment of coaching a class of beginners. Nevertheless, the principles of nurturing physical literacy are similar in every physical activity context, that is, to design the lessons around the specific needs of the students, rather than around the lessons themselves.² As mentioned previously, teachers could establish a lesson environment that encourages students to set goals and to take responsibility for the activities.

With a deep-rooted teacher-oriented approach and huge classes (around 40 students per class) in Taiwan, the strategy behind the planning of student-oriented physical education lessons could be challenging. To motivate students with a satisfying course to improve their quality of life, the issues of holism, uniqueness, empowerment, and cooperation should be recognized. In engaging young adults to participate in physical activity, the practitioners should respect the holistic nature of students' previous experiences, current situations, support networks, etc.² This could facilitate the arrangement of future lesson content and intensity concerning students' academic activities.¹⁹ Since students may experience pressure from the demands of professional learning, the consideration of students' personal contexts may affect their engagement during physical education lessons. Furthermore, diverse levels of tasks could be prepared for students to develop their self-confidence in performing movements. In encouraging cooperation among students, teachers could delegate duties to them and let them finish the tasks with specific goals. Practically, the results of the present study suggest the need for a more student-oriented approach to delivering physical education programs. Motivating students to finish each group task through cooperation and empowerment may create an environment of greater satisfaction, thereby allowing the possibility of further life quality improvements.

Some limitations in this cross-sectional study should be recognized. The employment of a mediation analysis concentrates on predictive relationships - the results may not be indicative of causality between variables. Furthermore, the current analysis did not incorporate demographic information relating to gender, age, living area, academic and sports experience, etc. It should also be noted that no comparison between participants was carried out; this could be done in follow-up analyses using the same data. Additionally, the consideration of previous experiences of students may generate the next level of meaning regarding the quantitative analysis of physical literacy research. While the researchers acknowledge that the study was unable to assess satisfaction across various units of physical education, it relied solely on the assumption that the teachers were proficient in their teaching. Numerous physical literacy assessment methods have recently been developed, validated, and applied, and those tools may require participants to complete movement competency tests, questionnaires, interviews, etc.⁷ Although affective, physical, and cognitive domains were considered in the present study, the exclusive measurement of perceived physical literacy may limit the holistic nature of the concept. Future studies should also consider more deeply individual and focus group interviews where students can share their feelings, values, and experiences of participating in physical education courses that aim to nurture physical literacy and enhance their quality of life. The qualitative data could reaffirm the significance of those relationships and elucidate how university physical education reinforces the importance of lifelong physical activity. Upcoming studies should also recognize the

importance of considering the physiological states of students in educational assessments. By taking into account the diversity of student populations and their varying psychological and physiological levels, subsequent assessments can provide a more accurate and comprehensive understanding of student performance. Practically, the teachers can gain more information about students' levels and tailor instruction to meet their individual needs.

5. Conclusion

This study was motivated by the escalating attention to physical literacy in Taiwan's physical education. The current study design covered the domains and attributes of physical literacy in an attempt to investigate the relationship between physical literacy and quality of life. In particular, the variables of motivation and satisfaction were found to mediate the relationship between the two primary variables, in the context of university physical education. The results strengthened the assumption that physical literacy is an outcome of structured physical education,³ and also extended the theoretical link towards quality of life.⁵¹ As a practical implementation, physical education practitioners could nurture students to be physically literate, i.e., to take more self-responsibility for participating in lifelong physical activity by endorsing their holistic and unique experiences as well as creating a more empowering and cooperative environment. In employing the IPLA's proposed physical literacy questionnaire, we worked on the assumption that students could understand that participating in physical education opens up a world of opportunity for challenging themselves in worthwhile experiences that will contribute to their holistic health and enhance their quality of life.² We envisage that this research into physical literacy could open up future investigations into other population groups.

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Authors' contributions

FJ and SM conceived the study design and wrote the draft of the manuscript, SM revised the original manuscript, and YC was involved in data collection, data management, and data curation. All authors read and approved the final manuscript.

Declaration of competing interest

All authors declare that there is no competing interest.

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