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Isabelle Cabot and Annie Bradette

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Article abstract

There are numerous instruments in the literature to measure motivation in physical activity and sport achieved in physical education context. However, tools for assessing motivation in physical and health education (PHE) courses are rare. To promote physical activity, PHE teachers are developing various teaching and assessment strategies. In this context, an instrument that measures motivation in PHE would help to assess the effectiveness of the strategies put in place. This study reports on the process of developing and validating such an instrument with French-speaking postsecondary students, including a pre-intervention version and a post-intervention version. Results indicate good psychometric properties for the instrument. These results are discussed in the light of the instrument's foresights and the needs that justified its conduct.

Process for Developing and Validating the Physical Education and Health Motivation Scale (PEHMS) with Post-Secondary Students[1]

Isabelle Cabot
ORCID : 0000-0003-1713-0015
Cégep Édouard-Montpetit
Université de Sherbrooke

Annie Bradette
Cégep Édouard-Montpetit
Université de Sherbrooke

Key words: motivation, physical education, postsecondary, validation process, measurement instrument

There are numerous instruments in the literature to measure motivation in physical activity and sport achieved in physical education context. However, tools for assessing motivation in physical and health education (PHE) courses are rare. To promote physical activity, PHE teachers are developing various teaching and assessment strategies. In this context, an instrument that measures motivation in PHE would help to assess the effectiveness of the strategies put in place. This study reports on the process of developing and validating such an instrument with French-speaking postsecondary students, including a pre-intervention version and a post-intervention version. Results indicate good psychometric properties for the instrument. These results are discussed in the light of the instrument's foresights and the needs that justified its conduct.

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Mots-clés : motivation, éducation physique, postsecondaire, processus de validation, instrument de mesure

La littérature compte de nombreux instruments permettant de mesurer la motivation à l'égard des activités physiques et des sports pratiqués dans le cadre des cours d'éducation physique et à la santé (ÉPS). Toutefois, rares sont ceux qui visent la motivation à l'égard des cours d'ÉPS. Pour lutter contre les effets indésirables de l'inactivité physique, des enseignants d'ÉPS mettent sur pied diverses stratégies d'enseignement et d'évaluation. Dans ce contexte, un instrument mesurant la motivation en ÉPS pourrait contribuer à évaluer l'efficacité des stratégies mises en place. La présente étude rapporte le processus d'élaboration et de validation d'un tel instrument auprès d'étudiants francophones du postsecondaire, incluant une version préintervention et une version postintervention. Les résultats indiquent de bonnes qualités psychométriques pour l'instrument élaboré. Ils sont analysés en fonction des prospectives de l'instrument et des besoins qui ont justifié sa conduite.

Palavras-chave: motivação, educação física, pós-secundário, processo de validação, instrumento de medida.

A literatura conta com inúmeros instrumentos para medir a motivação em relação às atividades físicas e desportivas praticadas no contexto dos cursos de educação física e da saúde (EFS). No entanto, poucos são os que almejam a motivação em relação aos cursos de EFS. Para combater os efeitos indesejáveis da inatividade física, os professores de EFS implementam diversas estratégias de ensino e avaliação. Neste contexto, um instrumento de medida da motivação em EFS poderia contribuir para avaliar a eficácia das estratégias implementadas. Este estudo relata o processo de elaboração e validação de tal instrumento com estudantes francófonos do pós-secundário, incluindo uma versão pré-intervenção e uma versão pós-intervenção. Os resultados indicam boas qualidades psicométricas para o instrumento elaborado. Eles são analisados em função das prospetivas do instrumento e das necessidades que justificaram sua conduta.

Authors' note: Correspondence related to this article may be addressed to isabelle.cabot@cegepmontpetit.ca

Introduction

Scientific, political, and public media widely report that too few people engage in regular physical activity (PA). For example, according to Clarke et al. (2019), 16% were inactive and the annual healthcare cost of physical inactivity in Canada was estimated at $6.8 billion. The fact that physical inactivity is linked to an increased risk of chronic disease and premature death has led to the development of interventions aimed at solving this problem in various social spheres, including education (Guthold et al., 2020; Ministère de l'Éducation et de l'Enseignement Supérieur [MEES], 2019a; the World Health Organization [WHO], 2019a, 2019b; Roure et al., 2016). The school environment is ideal for pedagogical interventions for PA practice due to the favorable environment and supervision (Gadais, 2015) and because PA practice curbs social inequalities, among other things. The 2019-2023 MEES strategic plan (2019b) includes the regular practice of PA in sports, recreational, and outdoor activities as a leading indicator and "an intrinsic part of the ministerial vision" (p. 2).

From elementary to post-secondary education, physical education (PE) teachers try to positively influence students' lifestyle habits with their PA pedagogical strategies, and in some cases, their evaluation methods. In Cegep – the first level of post-secondary education in Quebec – students must successfully complete three physical education and health (PEH) courses during their program to obtain their Diploma of College Studies. These PEH classes are the last compulsory courses in a school setting supervised by teachers. They follow a logical sequence leading students to (a) analyze their PA practice in relation to lifestyle habits that promote health; (b) improve their effectiveness in practising PA; and, ultimately, (c) demonstrate their ability to manage their PA practice to promote health (MEES, 2016, pp. 27-30). Many teachers and researchers develop PEH teaching and evaluation practices to include an impact on students' sustained management of their PA practice (e.g., Caplette-Charette & Grenier, 2014; Lemoyne & Valois, 2014; Leriche & Walczak, 2016; Thibault, 2017). Evaluation of such implemented strategies is only partial or non-existent to date (Lalime, 2016; Messier, 2016).

The measurement instruments available in this field consist mainly of questionnaires aiming to measure multiple aspects of PA practice, including the motivation to practice PA (André & Laurencelle, 2010; Observatoire national de l'activité physique et de la sédentarité, 2015). However, few instruments measure students' motivation for PEH courses. In this article, we describe the development process and the first step in the validation of such an instrument in French that could possibly contribute to the evaluation of PEH pedagogical strategies. First, we present the conceptual framework. Next, the process of developing and validating the Physical Education and Health Motivation Scale (PEHMS) is explained. Finally, the results are analyzed based on the needs leading to the development of the PEHMS and its potential contribution to the development of the PEH teaching profession.

The Issue

After high school in Quebec, regular schooling continues at the post-secondary level, with college and university studies. Colleges (called "Cegeps" in the public sector) are the entry level to post-secondary education, offering pre-university programs and technical programs, the latter leading directly to the labor market (MEES, 2020). There are no compulsory PEH courses in general university education, except for students enrolled in an undergraduate program in teaching PEH. College studies are therefore the last opportunity in the Quebec education system for developing competencies for an active lifestyle that promotes good health.

Given the global scourge of sedentary behavior, and the fact it is the last opportunity in the education system to have an impact, post-secondary PEH teachers are motivated to influence public health through their professional practice (Leriche & Walczak, 2016). They design and implement teaching and evaluation strategies to motivate students to develop competencies targeted by their PEH courses and to integrate this learning into their lifestyles. Few of these strategies are either formally identified or scientifically evaluated. The rare evaluations use measurements that do not directly address students' perceptions of their PEH courses. As a result, it is difficult to judge the teaching or evaluation strategy the teacher wants to test, or to compare these strategies with each other.

Studies on Post-Secondary PEH Courses

The literature review conducted as part of this study shows little formal research has been undertaken to evaluate students' perception of pedagogical aspects of Quebec post-secondary PEH courses. For example, research projects aimed at estimating the influence of PEH classes include measurements of PA practice duration and intensity based on WHO recommendations (2010). They showed that courses have a positive influence on PA practice while students are taking them (Lemoyne, 2012; Leriche & Walczak, 2014), but such influence was not seen outside the courses or after their completion. For example, Leriche and Walczak (2014) reported that nearly 40% of Cegep students do less than 10 minutes of PA per week.

To estimate the impact of PEH courses, research design can also include measurements of the motivation to practice PA. With effective control of confounding variables (such as the utility attributed to PA, prior to the start of a PEH course), it would be possible to examine the connections between various PEH pedagogical strategies and the motivation to practice PA. Many instruments of this kind, based on various theoretical models of motivation, are available in the specialized literature (see the directory compiled by André & Laurencelle, 2010). It would, however, be useful to add a measurement of motivation sparked by the course where a particular pedagogical strategy is applied. As a result, observed increases in motivation could be attributed to that specific strategy.

Pedagogical studies in PEH can also be planned to take into account the barriers to and determinants of PA practice (Cid et al., 2019; Lemoyne et al., 2015). For example, Lemoyne and Valois (2014) reported that physical self-concept (i.e., self-perception of body image and physical abilities) is an important predictor of PA practice. Pedagogical strategies could therefore be developed along these lines, within the framework of PEH courses, to try to influence this determining factor and, consequently, students' management of their PA practice. However, it would be worthwhile to include a measurement of student perception of the course to show the validity of any connection between the pedagogical strategy implemented and any change observed in the targeted determining factor.

In all the examples presented above, a measurement of the student's perception, specifically of the PEH course they are taking, would be valuable. Some instruments come close, for example, by asking respondents to comment on their self-image during a specific sports activity (Roure et

al., 2016) or the group climate (Biddle et al., 1995; Soini et al., 2014) in PEH courses (Girard et al., 2015; Nishida, 1988; Roure, 2020; Schiano-Lomoriello et al., 2005). For example, the Schiano-Lomoriello team (2005) developed and validated the Approach and Avoidance Questionnaire (*Questionnaire d'approche et d'évitement en éducation physique et sportive [QAE–EPS]*). This instrument provides a portrait of the achievement goals pursued by students in their PEH courses.

For measuring students' direct motivational perception of their PEH course, certain items and subscales included in questionnaires are found in the literature (Biddle et al., 1995; Soini et al., 2014). For example, the scales to measure the perceived climate of a physical education class, by Biddle et al. (1995), includes four items measuring the perception of choice (e.g., "In this PEH course, students can plan their own activities."). This scale is used to assess the degree of control perceived by the student during the course. In this conceptualization, perceived control contributes to student motivation (Viau, 2009) and promotes attainment of the need for autonomy (Deci & Ryan, 1985). However, an instrument specifically addressing the motivational perceptions of French-speaking post-secondary students for their PEH courses was not found. In this study, we aim to develop such an instrument and to perform an initial evaluation.

Conceptual Framework

A study of teachers' practices to motivate students was conducted with 74 post-secondary PEH teachers (Leriche & Walczak, 2016), using self-determination theory (Deci & Ryan, 1985; Ryan & Deci, 2000). Among other things, the results revealed that all the participating teachers expressed their desire to organize their pedagogy to make students experience more enjoyment, and ultimately to contribute to their motivation to practice PA. Post-secondary teachers develop new teaching and evaluation strategies to lead students to better appreciate and value the learning achieved in PEH classes (Leriche & Walczak, 2018; Ratté, 2020; Thibault, 2017), hoping in this way to have a positive influence on the long-term pursuit of healthy lifestyle habits after graduation.

Other authors studied PEH evaluations (Bradette, 2020; Lalime, 2016; Lopez-Pastor et al., 2012; Messier, 2016). For example, some questioned the authenticity of PA practice data provided by students to their teacher for evaluation purposes (Surprenant, 2019). In another example, an issue

of injustice was recently brought before the Superior Court of Québec by two students who failed the fitness test imposed by the physical education department of their institution of higher learning (2012 QCCS 647). The purpose of this evaluation was to assess and grade the students' cardiorespiratory capacity. The judgment denounced this evaluation practice, stating that this type of "test is unfair and even discriminatory" for a minority of the population who are unable to increase their maximal aerobic power. Furthermore, "the Court [was] also of the opinion that a student's physical abilities should not be confused with their ability to manage their physical activity practice." (paragraph 96 of the judgment). Researchers are exploring new PEH evaluation strategies (Bradette, 2020; Surprenant, 2019) to resolve unfairness and contribute to the motivation underlying the purpose of PEH courses. An instrument estimating the control students perceive to have over PEH evaluations would help to assess the effectiveness of evaluation.

Enjoyment and Value Attributed to PEH Courses

Theoretical models of motivation consider value to be a concept composed of the interest and utility attributed to an activity or course (e.g., Viau's (2009) motivational dynamics model and the expectancy-value theory of Wigfield and Eccles (2000)). However, as the literature has shown that interest and perceived utility are two empirically distinct constructs that do not always vary together (Cabot, 2017; Eccles & Wigfield, 1995), we consider these two variables separately in this study.

Perceived Utility

A task is considered useful when the individual perceives its contribution to the attainment of their goals (Jacobs & Eccles, 2000). Perceived utility thus derives from an evaluative judgment by the individual about the compatibility between the task and the goals pursued (Bouffard et al., 2006). When the task is considered useful, the individual's motivation to engage in it to realize their goals increases (Dubeau et al., 2015).

Hulleman and colleagues (2010, 2017) studied perceived utility as a motivational construct in students struggling to succeed. In the case of these students, the authors explained that the perceived compatibility between the learning task and the goal pursued must involve a goal that is meaningful to the individual student. In other words, arguments or examples of situations provided by the teacher in an attempt to trigger the utility attributed to a learning task by students are ineffective in the case of struggling students.

In these instances, when a student cannot identify with proof of the utility of a learning task, they suffer from increased anxiety and their interest in the task drops. A student's perception of utility must be based on their own goals or on goals with which they identify. This contributes to the relevance of formulating measurement items that capture the student's own perceptions of the learning to be achieved in their PEH course.

Interest Felt

Interest is a motivational construct that combines emotions and cognitions (Hidi et al., 2004; Renninger & Hidi, 2019). The literature differentiates between two types of interest: situational interest and individual interest (Schiefele, 2009). Situational interest is context-dependent, short-lived, and comprises more emotions than cognitions. Individual interest can be felt regardless of context and is more stable. During interest development, situational interest must first be triggered, then maintained sufficiently for individual interest to emerge and deepen (Hidi & Renninger, 2006). The power of interest for engagement is now recognized in the literature (Ainley, 2012; Renninger & Hidi, 2016). In education, it is possible to conceptualize situational interest as the interest felt for a specific learning situation or for a course, whereas individual interest is defined as the interest felt for the discipline itself, independently of the context of the course (Cabot and Chouinard, 2014; Linnenbrink-Garcia et al., 2010).

In this case, the need for intervention is connected to value given to learning in PEH courses and how it is appreciated. The instrument to be developed should therefore include items relating to the interest specifically felt for the PEH course, as well as those relating to the utility attributed to the learning from the course. No French-language measurement tool adapted to the target context was found in the literature.

Controllability

The literature offers more than one conceptualization of controllability. For Viau (2009), controllability represents the perception of being able to influence how a learning activity will unfold. It is possible that learning contexts enabling students to feel power over the framework of the learning or evaluation tasks to be performed trigger increased motivation to engage in learning (Viau et al., 2004). From the point of view of self-determination theory, the perception of controllability contributes to fulfilling a fundamental human need for autonomy (Ryan & Deci, 2000). This could explain its positive influence on motivation.

The educational literature on pedagogical strategies that enable students to make choices offers an interesting perspective on the concept of controllability. When students can choose from both available options and the actions themselves (Reeve et al., 2003), they can adjust their learning experience to their own goals. This fulfills their need for autonomy, which in turn motivates them to engage in learning (Evans & Boucher, 2015; Katz & Assor, 2007). Achievement goal theory (Ames, 1992) suggests that a learning context offering choices in academic tasks, pedagogical materials, or learning methods leads students to pursue learning goals focused on developing their competencies, rather than performance goals focused on social comparison (Patall & Yang Hooper, 2019).

Given that the educational literature includes theoretical models of motivation that contain items measuring these three constructs, it makes sense to use them to adapt them specifically to post-secondary PEH courses in this study. We resisted the temptation to opt for a generic formulation of the items which would allow for varied use of the instrument. DeVellis (2017) warned against this apparent advantage: "A tool may be valid in one context but invalid in another or when put to a different use. […] So, an instrument's content validity will depend on how well the items comprising the scale map onto the construct of interest for the population and context of the specific investigation." (pp. 86-87)

The instrument developed must therefore include items about the perceived utility of the learning objectives of the PEH course, interest felt towards the PEH course, and controllability over the PEH evaluation. Since the objective is to assess the impact of teaching and evaluation interventions on the motivation triggered by a PEH course, the questionnaire is needed in both preintervention and postintervention versions, with items formulated accordingly. In this study, we aim to develop such an instrument and prove its validity.

Methodology

The following paragraphs outline the process followed to form and then accumulate evidence of the validity of the physical education and health motivation scale (PEHMS), drawing on DeVellis's (2017) eight-step procedure: (a) determine what you want to measure; (b) generate an item pool; (c) determine the format of the measurement instrument; (d)

have the initial item pool reviewed by experts; (e) consider adding items; (f) administer the items; (g) evaluate the items; and (h) verify the factor structure.

The first step proposed by DeVellis is to clearly define what needs to be measured. As presented in the preceding paragraphs, the instrument developed must measure interest in the PEH course, the utility attributed to the learning achieved in the course, and perceived controllability of how the course is evaluated. Also, evidence of the validity of the instrument must be collected. Items should be formulated to provide both a preintervention and a postintervention version of the instrument. Students starting a new course i.e. a course they have never taken before, cannot express their opinion of the course during measurement taken at the beginning. Consequently, the same instrument cannot be administered in a conventional repeated measures design. Items must be formulated differently to match the two contexts. The two versions of the PEHMS must be considered as two separate questionnaires, which must both be subjected to the validation process.

The second step was to create a pool of items. The review of questionnaires conducted as part of this study led to the identification of five existing instruments that could be applied in a pedagogical context, and that contained items close to those required to form the three subscales of the PEHMS. From the original French study comprising 23 possible items, 11 were chosen, representing the three targeted dimensions of motivation. Seven of them are the result of a process of translation [into French] of items originally formulated in English. The items in the French version were then precisely adapted to the context targeted by the present study to support the instrument's content validity (DeVellis, 2017). Table 1 shows the adapted items and their individual primary source.

The PEHMS takes the form of 5-point Likert-type agreement items, ranging from 1 (strongly disagree) to 5 (strongly agree). We chose this scale (Step 3) to be consistent with the original questionnaire formats from where the items originate. We then selected the items, already evaluated by experts (Step 4), pertinent to the context of this study and adjusted them to the target population. In Step 5, DeVellis suggests considering adding items that could contribute to the instrument validation process. This suggestion was not followed to reduce the risk of missing data (Gaudreau

et al., 2015) and ensure very rapid administration of the questionnaire. However, at the end of the process, the discriminating power of the items in the three subscales was examined to contribute to the validation process.

The sample consisted of 104 students (aged 18 to 20) from two Cegeps[2] enrolled in the last PEH college course (Step 6: administer the items). They responded to the preintervention items during the first week of the fall 2019 semester, and then to the postintervention items (n=98) in the last week of the same semester. Each time, a few minutes were set aside for administering the questionnaire. First, a printed consent form and the questionnaire were distributed by the teacher. Then a four-minute video clip, prepared by the principal researcher, presented the study and the various sections of the consent form to the students in class, asking them to sign the form and complete the questionnaire if they agreed to participate . To guarantee anonymity, all the documents were placed in a sealed envelope by the last student to use them.

The evaluation of the items took place in various stages, as described in the following paragraphs. A principal component analysis was then conducted on each of the two sets of items to verify whether they grouped together correctly according to the three concepts. The calculation of Guttman's lambda-6, the preferred estimator according to Bourque et al. (2019), measured the internal consistency of each subscale. As a result, it was possible to consider the number of items based on the results of the analyses (Step 8), and then verify their structure with confirmatory factorial analysis.

Results

Initial Item Description

Initial verification of the data involved looking for extremes and examining the descriptive statistics for each item. No anomalies were found. All degrees of skewness and kurtosis lie between 0.97 and 0.07 (preintervention), and between -1.03 and 0.90 (postintervention), within the limits specified by Brown (1997) and DeCarlo (1997). Table 1 shows the mean and standard deviation for each item.

2. This study was approved by the ethics committees of the two educational establishments where the instrument was administered.

Table 1

Mean, (Standard Deviations) and Item-scale Correlations of Items on the Physical Education and Health Motivation Questionnaire (PEHMQ)

Items	**M (*SD*)**	**item-scale *r***	**Primary source**
Subscale: interest in the physical education course			
I think I'm going to like attending this course. (intcourse_pre1)	3.82 *(0.88)*	0.81	Corbière et al. (2006)
I liked attending this course. (intcourse_post1)	3.87 *(1.02)*	0.83	
I think I'll enjoy taking this course. (intcourse_pre2)	3.87 *(0.90)*	0.85	Corbière et al. (2006)
I enjoyed taking this course. (intcourse_post2)	3.83 *(0.99)*	0.84	
I think I'll find the course interesting. (intcourse_pre3)	3.75 *(0.89)*	0.81	Harackiewicz et al. (2008)
I found the course interesting. (intcourse_post3)	3.84 *(0.97)*	0.80	
I'm really excited about taking this course. (intcourse_pre4)	3.52 *(0.96)*	0.75	Harackiewicz et al. (2008)
I was really excited to take this course. (intcourse_post4)	3.41 *(1.02)*	0.68	
Subscale: controllability of physical education course evaluation practices			
In this physical education course, I expect to be able to choose how I'm evaluated. (contcourse_pre1)	2.81 *(1.24)*	0.79	Reeve et al. (2003)
In this physical education course, I was able to choose how I was evaluated. (contcourse_post1)	3.32 *(1.24)*	0.74	
In this physical education course, I expect my opinion on the procedure for the end-of-semester evaluation to be taken into account. (contcourse_pre2)	3.21 *(1.18)*	0.69	Bédard & Viau (2001)
In this physical education course, my opinion on the procedure for the end-of-semester evaluation was taken into account. (contcourse_post2)	3.19 *(1.21)*	0.61	
In this physical education course, I expect to be able to decide on certain things in the way I'm evaluated. (contcourse_pre3)	3.17 *(1.15)*	0.65	Bédard & Viau (2001)
In this physical education course, I was able to decide on certain things in the way I was evaluated. (contcourse_post3)	3.57 *(1.15)*	0.77	

Items	M (*SD*)	item-scale *r*	Primary source
Scale: utility of learning in the physical education course			
I believe that this physical education course will help me develop competencies that will be useful in my everyday life. (uticourse_pre1)	3.79 *(0.82)*	0.79	Hulleman et al. (2017)
I found that this physical education course helped me develop competencies that are useful in my everyday life. (uticourse_post1)	3.80 *(1.04)*	0.76	
I believe that the course material in this physical education course will be relevant to my future career plans. (uticourse_pre2)	3.61 *(0.94)*	0.73	Hulleman et al. (2017)
I found that the course material in this physical education course was relevant to my future career plans. (uticourse_post2)	3.94 *(1.01)*	0.75	
I think what we'll learn in this physical education course will be worthwhile. (uticourse_pre3)	3.91 *(0.77)*	0.70	Harackiewicz et al. (2008)
I found that what we learned in this physical education course was worthwhile. (uticourse_post3)	4.09 *(0.86)*	0.82	
I believe that the competencies we're going to develop in this physical education course will be important to my future. (uticourse_pre4)	3.75 *(0.82)*	0.64	Hulleman et al. (2017)
I found that the competencies we developed in this physical education course are important to my future. (uticourse_post4)	4.02 *(0.93)*	0.76	

As DeVellis (2017) explained, the ideal is to ensure that the means and standard deviations of the data are not too close to the two extremes of the scale. As the PEHMS is a five-point scale, the descriptive data in Table 1 shows the items generally meet this data distribution criterion. Following the advice of DeVellis (2017), the correlation between each item and the rest of its scale was also examined. All these correlations (reported in Table 2) lie between 0.59 and 0.83, indicating the linearity and non-multicollinearity of the data. This is a very satisfactory result (Field, 2013) and contributed to the decision to retain the data for subsequent analysis.

Table 2
Pearson's Inter-item Correlation Matrix from the PEHMQ

Item code	ntcourse_ pre1	Intcourse_ pre2	Intcourse_ pre3	Intcourse_ pre4	Contcoursepre1	Contcoursepre2	Contcoursepre3	Uticourse_ pre1	Uticourse_ pre2	Uticourse_ pre3	Uticourse_ pre4
Intcourse_pre1		0.78***	0.76***	0.67***	0.14	0.15	0.10	0.34***	0.22*	0.37***	0.39***
Intcourse_pre2			0.78***	0.73***	0.14	0.07	0.13	0.39***	0.30**	0.40***	0.39***
Intcourse_pre3				0.66***	0.19*	0.17*	0.20*	0.38***	0.29**	0.54***	0.39***
Intcourse_pre4					0.21*	0.11	0.16*	0.35***	0.35***	0.39***	0.48***
Contcourse_pre1						0.71***	0.70***	0.21*	0.29**	0.17*	0.30**
Contcourse_pre2							0.56***	0.15	0.19*	0.12	0.22*
Contcourse_pre3								0.17*	0.23*	0.19*	0.21*
Uticourse_pre1									0.70***	0.71***	0.58***
Uticourse_pre2										0.59***	0.59***
Uticourse_pre3											0.52***
Uticourse_pre4											

	Intcours_ post1	Intcours_ post2	Intcours_ post3	Intcours_ post4	Contcours_ post1	Contcours_ post2	Contcours_ post3	Uticours_ post1	Uticours_ post2	Uticours_ post3	Uticours_ post4
Intcourse_post1		0.83***	0.73***	0.65***	0.40***	0.24*	0.32**	0.52***	0.44***	0.52***	0.50***
Intcourse_post2			0.78***	0.61***	0.43***	0.26**	0.43***	0.50***	0.42***	0.49***	0.50***
Intcourse_post3				0.63***	0.30**	0.34**	0.28**	0.54***	0.59***	0.57***	0.51***
Intcourse_post4					0.31**	0.26**	0.26**	0.57***	0.35***	0.49***	0.41***
Contcourse_post1						0.59***	0.74***	0.32**	0.18	0.25*	0.28**
Contcourse_post2							0.63***	0.23*	0.14	0.19	0.18
Contcourse_post3								0.24*	0.09	0.16	0.21*
Uticourse_post1									0.69***	0.73***	0.63***
Uticourse_post2										0.68***	0.65***
Uticourse_post3											0.77***
Uticourse_post4											

*$p < 0.05$. **$p < 0.01$. ***$p < 0.001$

Principal component analysis

In order to examine item groupings among the 11 items studied for each of the two versions of the PEHMS, a principal components analysis with an oblique (direct oblimin) rotation of the factors was conducted, enabling the factors to be correlated with each other. This choice is appropriate given the conceptual links between the three subscales studied (Field, 2013; Tabachnick & Fidell, 2007). The number of factors to be extracted was based on statistically generated eigenvalues to avoid introducing an element of subjectivity (by manually setting the number of factors) into the item study (DeVellis, 2017). The structure matrix was chosen because it presents the connection between each item and its factor without being affected by the connections between the factors.

The results of the analyses show that the 11 items are distinctly grouped under three factors that represent the three conceptually identified subscales, in both the preintervention and postintervention versions of the PEHMS. All eigenvalues are greater than one (K1 rule). Moreover, the two significant results ($p < 0.000$) from Bartlett's test of sphericity confirm the linear combinations of items for both versions of the PEHMS. Together, the three factors explain 76.46% (preintervention) and 77.64% (postintervention) of the variance in the data. Furthermore, the communalities threshold is greater than 0.6, confirming that sample sizes are appropriate for these analyses (Bourque et al., 2006). The Kaiser-Meyer-Olkin indicators (KMO; preintervention = 0.83 and postintervention = 0.84) reveal very good sampling quality, especially since all diagonal correlations of the two anti-image matrices were greater than 0.71, well above the 0.5 limit suggested by Field (2013). Table 3 shows item saturation (structure matrix), after rotation.

Internal Consistency

The three subscales of interest in the PEH course, utility attributed to learning in the PEH course, and controllability of evaluation practices in the PEH course all showed a very satisfactory degree of internal consistency (presented in Table 3), Guttman's lambda-6 (Bourque et al., 2019) between 0.80 and 0.89. The 11 items were chosen to form the PEHMS.

Table 3
Results of Principal Components Analysis

	Factor loadings		
Items	**Interest**	**Controllability**	**Utility**
Intcourse_pre2	**0.92**	0.12	-0.42
Intcourse_pre1	**0.90**	0.14	-0.36
Intcourse_pre3	**0.90**	0.21	-0.45
Intcourse_pre4	**0.85**	0.19	-0.45
Contcourse_pre1	0.18	**0.92**	-0.28
Contcourse_pre2	0.14	**0.86**	-0.18
Contcourse_pre3	0.16	**0.85**	-0.24
Uticourse_pre1	0.40	0.19	**-0.90**
Uticourse_pre2	0.30	0.27	**-0.87**
Uticourse_pre3	0.48	0.16	**-0.83**
Uticourse_pre4	0.47	0.29	**-0.77**
Eigenvalues	***4.82***	***2.10***	***1.50***
λ	***0.89***	***0.80***	***0.84***
Interfactor r*			
Interest		***0.18***	***-0.46***
Controllability			***-0.26***
Intcourse_post1	***-0.92***	0.36	0.53
Intcourse_post2	***-0.92***	0.42	0.52
Intcourse_post3	***-0.87***	0.34	0.63
Intcourse_post4	***-0.81***	0.31	0.51
Contcourse_post1	-0.41	***0.89***	0.28
Contcourse_post2	-0.29	***0.84***	0.21
Contcourse_post3	-0.37	***0.91***	0.17
Uticourse_post1	-0.60	0.30	***0.85***
Uticourse_post2	-0.48	0.14	***0.87***
Uticourse_post3	-0.58	0.22	***0.91***
Uticourse_post4	-0.53	0.26	***0.86***
Eigenvalues	***1.05***	***1.91***	***5.59***
λ	***0.89***	***0.80***	***0.87***
Interfactor r*			
Interest		***-0.40***	***-0.61***
Controllability			***0.24***

Notes. Extraction method: principal component analysis
Rotation method: oblimin direct
Factor loadings within the expected dimensions are in bold.
*Interfactor correlations must be interpreted from their absolute values.

Confirmatory Factor Analysis

Data from the 11 PEHMS items were entered into confirmatory factor analyses using LISREL 10.30 software (Jöreskog & Sörbom, 2020). The maximum likelihood method was used to estimate the parameters applied to verify the models' suitability. For each of the two PEHMS versions, three models were tested. Their fit indices are presented in Table 4 for comparison purposes. The first factorial model submitted for analysis included the three latent variables (motivational constructs) representing the three scales the PEHMS measures. The second is composed of two latent variables, the utility and interest constructs having been merged for consistency with certain theoretical models that consider them together, forming the concept of perceived value (e.g., Viau's motivational dynamics model, 2009). The third model is unidimensional and may be representative of the vast concept of motivation.

The indices used to evaluate models are the root mean square error of approximation (RMSEA) and its confidence interval (CI), the comparative fit index (CFI), the non-normed fit index (NNFI), the weighted root mean square residual (SRMR), and the chi-square divided by the degrees of freedom (χ^2/df) (Baillargeon, 2006). The RMSEA verifies the agreement between the reproduced matrix and the observed matrix. Baillargeon (2006) specified that an RMSEA of less than 0.08 allows the model to be accepted. NNFI and CFI are relative fit indices that compare one model with another to assess its suitability. For a model to be accepted, their value must be greater than 0.95 (Schreiber et al., 2006). The goodness-of-fit index (GFI) is an absolute index of fit. It indicates the proportion of variance/covariance generated by the model. The index must be greater than 0.90 for the model to be considered suitable (Baillargeon, 2006). The standardized SRMR represents the average of the standardized residuals. A value below 0.05 indicates an acceptable fit. The χ^2 test is used to test the null hypothesis that the covariance matrix predicted by the model perfectly matches the covariance matrix observed in the sample. If it is significant, the model is considered imperfect, often leading to the rejection of good models. In other cases, it can lead to the acceptance of poor models (Miles & Shevlin, 2007). It is therefore advisable to judge the adequacy of the model on the basis of the coefficient itself, rather than its degree of significance: A high χ^2 indicates a poor model, while a low χ^2 indicates a good model. The degrees of freedom are used as a basis for standardization to

consider the χ^2 high or low (Diamantopoulos & Siguaw, 2000). A χ^2:df ratio of less than 3:1 indicates the model is adequate (Vieira, 2011). Table 4 shows the fit statistics for the models tested.

Table 4
Fit Indices of Models Tested

Models	RMSEA	NNFI	CFI	GFI	SRMR	χ^2/df
Preintervention						
Three-factor	0.056 (IC 90%: 0 - 0.09)	0.97	0.98	0.92	0.04	1.32
Two-factor	0.181 (IC 90%: 0.16 - 0.21)	0.72	0.78	0.71	0.10	4.39
Unidimensional	0.247 (IC 90%: 0.22 - 0.27)	0.48	0.58	0.61	0.21	7.35
Postintervention						
Three-factor	0.088 (IC 90%: 0.05 - 0.12	0.94	0.96	0.89	0.05	1.76
Two-factor	0.183 (IC 90%: 0.16 - 0.21)	0.75	0.81	0.70	0.09	4.28
Unidimensional	0.239 (IC 90%: 0.21 - 0.27)	0.58	0.66	0.62	0.17	6.59

The fit indices of the PEHMS (three-factor model) were globally satisfactory for both versions. Moreover, the strength of the regression coefficients from each latent variable to its observed variables was strong (> 0.61), and they were all significant (t > 1.96). The fit indices evaluating the model were consistent and led to confirmation that the three-factor model is a satisfactory representation of the data.

The Discriminating Power of Latent Variables

In order to verify that only the construct specifically targeted by the subscale is measured by its group of items, Fornell and Larcker (1981) proposed to compare, for each pair of instrument subscales, the average variance extracted (AVE) of the item saturation indices of each latent variable with the variance shared between the two latent variables. The AVE of each of the two latent variables must exceed the shared variance of the tested pair. The data used for this verification are presented in Table 5 which shows that the three subscales measure three distinct constructs, despite being conceptually related.

Table 5
Variances Shared by Each Pair of PEHMS Subscales and Average Variance Extracted (AVE) of Saturation Indices for Each Subscale

Subscale pairs	r^2	*AVE*
Intcourse_pre – Uticourse_pre	0.21	Intcourse_pre: 0.80 Uticourse_pre: 0.71
Uticourse_pre – Contcourse_pre	0.07	Uticourse_pre: 0.71 Contcourse_pre: 0.77
Intcourse_pre – Contcourse_pre	0.03	Intcourse_pre: 0.80 Contcourse_pre: 0.77
Intcourse_post – Uticourse_post	0.37	Intcourse_post: 0.78 Uticourse_post: 0.76
Uticourse_post – Contcourse_post	0.06	Uticourse_post: 0.76 Contcourse_post: 0.78
Intcourse_post – Contcourse_post	0.16	Intcourse_post: 0.78 Contcourse_post: 0.78

Portrait of Respondents Revealed by the PEHMS

Table 6 presents a descriptive portrait of the respondents based on the PEHMS. The average score for course expectations (preintervention version of the scale) was slightly lower for the controllability dimension compared with the other two dimensions. At the end of the semester, interest in the PEH course was the same as initially expected, while the average utility and controllability scores were slightly higher than respondents had originally expected.

Table 6
Mean and (Standard Deviations) of PEHMS Scores

	Preintervention (*n* = 104)	**Postintervention (*n* = 98)**
Interest in the physical education course	3.74 (*0.81*)	3.73 (*0.88*)
Utility of learning in the physical education course	3.76 (*0.71*)	3.96 (*0.84*)
Controllability of physical education course evaluation practices	3.06 (*1.04*)	3.36 (*1.05*)

Discussion and Limitations

Based on the literature in the field of academic motivation, 11 items have been contextualized to develop two versions of the PEHMS: a preintervention version (n = 104) and a postintervention version (n = 98). They were administered to college students during the fall of 2019. The results of the scale validation process show a three-factor structure in line with the three target constructs: interest in the PEH course, the utility attributed to learning in the course, and the perceived controllability of evaluation practices in the course. The descriptive portrait of participants established taking into account the PEHMS (Table 6) also seems consistent. At the start of the semester, it is unlikely that students expect to have control over how they are assessed, given fitness assessments imposed in many of the PEH courses throughout the education program. However, the final evaluation of the last college PEH course requires each student to develop their own physical activity program, based on individual needs. In this context, it is possible students felt more autonomous and perceived the course activities as contributing more to achieving their personal goals, which could be reflected in the slightly higher controllability and utility scores at the end of the semester (Evans & Boucher, 2015; Jacobs & Eccles, 2000).

The main limitation of this study is the sample size. While the communalities are large enough to indicate sufficient sample sizes (Bourque et al., 2006), it was not possible to respect the rule, widespread in the literature, which prescribes a minimum of 10 participants per item to be tested (in this case, 11 items = at least 110 participants). Future research with a bigger sample is recommended to control the validity of the PEHMS again. Moreover, administration of the PEHMS in a quasi-experimental context, before and after a specific educational intervention, could help support evidence of validity. It would also be interesting to explore the scores obtained in the PEHMS for the different levels of PA (Surprenant et al., 2022) practiced by respondents or according to the various courses offered in college. Finally, the reaction of the PEHMS in an intervention evaluation situation can now be examined, for example, using concomitant measurements that have already been tried and tested.

Conclusion

Instruments used to measure motivation in PEH were historically designed to reflect a motivational response, for example, to a particular group climate or type of PA practice. The proposed PEHMS breaks new ground, partly because it specifically measures elements of student motivation for the course. How students perceive the teaching and evaluation strategy they experience in their course has been the subject of limited research in the fields of pedagogy and motivation in PEH. This PEHMS offers a solution to PEH teachers who plan courses to motivate their students to practice PA in a sustainable way.

Finally, awareness of students' perception of their interest in their PEH course, its utility and controllability can help develop courses more focused on students' current needs. PEH teachers can improve and update their practices by respecting their points of view and using them to shape their teaching and evaluation strategies, with the ultimate aim of exerting a positive influence on public health.

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