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Papers must be closely scrutinized for typographical and grammatical errors. If English is not author's first language then the paper should be proof-read by a native English-speaking person, preferably one with experience of writing for academic use. Spelling should follow the Oxford English Dictionary.
Tables, graphs and illustrations should be drawn using a suitable drawing package. Colour may be used. Place all diagrams and tables where you wish them to appear in the paper. Ensure your diagrams fit within the margins and are resizable without distortion.

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Following Editorial recommendation, papers are submitted to a double-blind peer review process before publication. Commentary by reviewers will be summarized and sent by email to authors, who can choose to revise their papers in line with these remarks. Re-submitted papers should be accompanied by the description of the changes and other responses to reviewers' comments (see above), so that the desk-editor can easily see where changes have been made.

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The submission of a paper will imply that, if accepted for publication, it will not be published elsewhere in the same form, in any language, without the consent of the Publisher. Before publication, authors will be asked to complete a copyright release, giving the publisher permission to publish the paper in a specific issue of this Journal. Overall copyright ownership of the paper, however, remains with the author/s. It is the authors' responsibility to obtain written permission to quote material that has appeared in another publication.

With this last issue (Vol. 15, No. 4) of 2022, it is time to summarise the ending year. We are more than pleased that ERIES Journal has strengthened its position in Scimago Journal & Country (SJR) ranking, with significant growth in all metrics. For example, the SJR growth to 0.251 (+23%), +53% of total citations, and +16% of citations per document. Similarly, our presence on social networks shows a pleasant growth. For example, ERIES Journal gained 109 new followers at LinkedIn during the last year. Currently, we have 294 followers, which represents an increase of 59%. We are about the celebrate our 300th follower before the end of the year. Higher interest in the journal can also be expressed by +690.5% of page views, +770% of page visitors and +1,250% reactions to our published content.

For the next year, two special issues are prepared: "Practitioner Inquiry: Towards Efficiency and Responsibility in Teaching and Teacher Education" and "Education as a Factor of Regional, Economic, and Social Development: The Data Envelopment Analysis Approach". We are sure that the published articles from both special issues will catch the significant attention of the journal readers and the scientific community.

The above-mentioned achievements set new commitments to enhance the journal's quality. As a response to the higher researchers' interest in the journal, we have extended the Editorial team, welcoming PhDr. Michaela Cocca from the Czech University of Life Sciences, Czech Republic. Michaela Cocca has a strong publication history in top international journals and excellent editorial records.

The last volume of 2022 includes six articles. The first article, "Exploring the Key Predictors of Instructional Quality" by Mohamad Arief Rafsanjani, Heni Purwa Pamungkas, Muhammad Abdul Ghofur and Dhiah Fitrayati explores key predictors of instructional quality. The analysis was conducted on 283 economics teachers from senior high schools in East Java, Indonesia. The authors used partial least squares structural equation modeling to examine the relationship between the selected variables. The results revealed that teacher competencies, including cognitive and motivational aspects, positively affected instructional quality.

In the second article, "Developing Awareness and Attitude Towards Sustainability Through an Activity-Based Intervention", the authors Jagpreet Kaur and Khushgeet Kaur examined the impact of an activity-based intervention on adolescents' attitude and awareness towards sustainability. For this purpose, a quasi-experimental research design was used with a cluster sample of 99 students from government schools located in Patiala District of Punjab. The results revealed a significant impact of the activity-based intervention for sustainable development on the attitude and awareness of school students towards environmental sustainability. Therefore, students should be oriented towards pro-environmental attitudes by reinforcing the environmental aspects, such as living in harmony with biodiversity, consuming and conserving resources responsibly, and having a sustainable lifestyle.

The third article, "Effect of 8-Week Circuit Training on the Development of Different Forms of Muscle Strength in Physical Education" by Dejan Milenković aimed to determine the effect of an 8-week circuit training program on explosive strength and strength endurance in physical education classes intended for high school students. The analyzed sample consisted of 60 students from two second-grade high school classes. Five strength tests were used in the study: squat jump, countermovement jump, squats, push-ups, and sit-ups. The results showed that the 8-week strength development program organized as circuit training contributed significantly to strength improvement. So, it has been determined that short-term circuit training in physical education classes is an effective way to develop students' physical performance.

In the fourth article, "How do Studies at the University Help Prospective Physical Education Teachers form Their Professional Identity?", Sniegina Poteliūnienė, Diana Karanauskienė, Vytė Kontautienė and Lauras Grajauskas investigated the expression of self-efficacy, academic motivation, and study the satisfaction of prospective physical education teachers. A questionnaire survey was administered to 783 1st to 4th year undergraduate physical education students from four Lithuanian universities. The analysis discovered that the year of the study did not affect changes in students' self-efficacy expectations and intrinsic academic motivation. This may suggest that such professional identity indicators are less affected by contextual factors. The correlations among the analyzed variables also showed that the quality of teaching, clear goals and the maintenance of autonomy are essential components of the academic environment to strengthen the prospective teacher's professional identity.

In the fifth article, "Employee Training and Development and Competency-Based Approach: Any Relationship?", the authors Martina Fejfarová and Jiří Fejfar analyzed the use of the competency-based approach in employee training and development in organizations in the Czech Republic. For this, the authors conducted long-term research of 1,360 organizations, 75.7% private and 24.3% public, since 2013. The results confirmed that organizations that use the competency-based approach place more emphasis on their employees' training and development than those that do not.

The last article, "Over Three Decades of Data Envelopment Analysis Applied to the Measurement of Efficiency in Higher Education: A Bibliometric Analysis" by Thuan Pham Van, Trung Tran, Trinh Thi Phuong Thao, Anh Hoang Ngoc, Thanh Nghiem Thi and Thuy La Phuong uses bibliometric analysis on publications extracted from the Scopus database to provide a comprehensive overview of research publications on the measurement of higher education efficiency based on data envelopment analysis. The analysis included a total of 169 related publications published between 1988 and 2021. The analysis revealed that research trends using Data Envelopment Analysis to measure higher education performance have recently received more attention. The main keywords reflecting the recent research are efficiency measurements, resource allocation, performance evaluation and benchmarking.

We hope that all our readers will find this last issue of the year 2022 interesting. We also hope that ERIES Journal will contribute to the field of efficiency and responsibility in education and science as it has contributed during recent years. With the end of the year 2022, we would like to thank all the authors who have submitted their manuscripts to ERIES Journal, to all reviewers who carefully reviewed all these manuscripts, as well as to all members of the Editorial board who contributed to increase the ERIES Journal quality. Their ongoing work is a huge responsibility for the Executive Editors to keep improving the journal quality.

We wish you Merry Christmas and a Happy New Year 2023.

Sincerely

Martin Flégl
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CONTENT

Full research paper

EXPLORING THE KEY PREDICTORS OF INSTRUCTIONAL QUALITY

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ABSTRACT

Classroom instruction became a popular topic due to its crucial role in teaching and learning activities. The teacher plays an essential role in providing quality classroom instruction. This study tries to explore the key predictors of instructional quality. This study was conducted on 283 teachers taken randomly. We used an online questionnaire to reach the research participants in east java, Indonesia. Structural equation modelling (SEM) was utilized to examine the relationship between the variables. The findings revealed that the teacher competencies, including cognitive and motivational aspects, positively affected instructional quality. This study also revealed that teachers' cognitive aspect is not the only predictor of instructional quality. The motivational aspect also plays a crucial role in predicting instructional quality. This study provides several insights for related stakeholders (such as teachers, policymakers, and universities) in making efforts or policies to improve teacher instructional quality.

KEYWORDS

Instructional quality, teacher competence, senior high school

HOW TO CITE

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Highlights

- *Teacher competence consists of cognitive aspects (pedagogical content knowledge and constructivist beliefs) and motivational aspects (self-efficacy and enthusiasm).*
- *Teacher competence positively predicts instructional quality.*
- *This study revealed that instructional quality is not only determined by the teacher's cognitive aspects but also by the teacher's motivational aspects.*
- *To promote teacher instructional quality, the stakeholders must pay attention not only to teacher cognitive aspects but also to teacher motivational aspects.*

INTRODUCTION

Millions of students received instruction daily and spent most of their school time in the classroom. The classroom activities were dominated by the instructional practices set up by teachers. Instructional quality describes as a specific teacher action related to the teaching strategies and practices during classroom learning activities (Baier et al., 2019). Furthermore, instructional quality refers to teachers' observable behavior and interactions between teachers and students during classroom activities (Blömeke et al., 2022, Rimm-Kaufman and Hamre, 2010, Fauth et al., 2019). The teacher plays a key role in setting up instructional practices (Baumert and Kunter, 2013a, Fauth et al., 2019) and essential sources during class activities (Fauth et al., 2019, Hattie, 2009). Therefore, teachers are responsible for providing a high-quality learning environment.

The study of instructional quality has become a popular topic in educational research due to its crucial role in learning activities (Nilsen and Gustafsson, 2016). However, most previous studies emphasize the effect on students learning outcomes (Kleickmann et al., 2016, Fauth et al., 2019, Praetorius et al., 2018, König et al., 2021). Empirically, instructional quality among teachers varies. Many researchers and policymakers are interested in increasing teachers' instructional quality (Baier et al., 2019). Therefore, finding the predictor of teachers' instructional quality became essential to improving low-performing instruction.

The current study provides two main contributions. First, most previous studies emphasized the relationship between instructional quality and students' learning outcomes. This study examines the antecedent variable of instructional quality to fill the gap. Hence, this study contributes to the body of knowledge regarding the key predictor of

teachers' instructional quality. Second, this study provides scientific understanding and directions to policymakers and practitioners in improving teachers' instructional quality.

THEORETICAL FRAMEWORK AND HYPOTHESES

Instructional quality

Instructional quality is conceptualized as teachers' observable behavior and teacher-student interaction during classroom activities (Blömeke et al., 2022, Rimm-Kaufman and Hamre, 2010, Fauth et al., 2019). Furthermore, instructional quality covers three dimensions of a specific teaching domain: cognitive activation, student support (supportive climate), and classroom management (Praetorius et al., 2018, Blömeke et al., 2022, Fauth et al., 2019).

Cognitive activation refers to challenging learning activities that stimulate students' high-order thinking skills through selected instructional strategies and tasks. Cognitive activation also covers the teacher's ways of exploring concepts, ideas, and students' prior knowledge (Praetorius et al., 2018, Fauth et al., 2019). For example, when trying to find out the solution to a specific problem, teachers can apply classroom discussions to enhance student engagement during learning activities rather than direct questions with "right" or "wrong" answers (Baumert and Kunter, 2013b). These practices could promote the students' ability to re-construct, elaborate, and integrate information, leading to a deeper understanding. Cognitive activation practices also enhance students' conceptual understanding through more engagement in classroom participation, such as communicating concepts and ideas during classroom discussions (Praetorius et al., 2018).

The second dimension of instructional quality is student support (also called supportive climate). The studies revealed that a challenging environment is not enough to promote students' engagement, but they need to be fully supported during learning activities (Baumert and Kunter, 2013b, Stefanou et al., 2004). Student support is conceptualized as quality interactions between teacher and student during learning activities (Praetorius et al., 2018). Another study refers to student support as positive and constructive feedback during teacher-student interactions (Lazarides, Gaspard and Dicke, 2019). It also covers how teachers treat their students positively (with respect, interest, and support) during learning activities. For example, the teacher positively approaches students who make mistakes or misconceptions. The teacher also allows students to express different ideas, choices, needs, and interests.

Classroom management refers to the teacher's ability to allocate classroom time efficiently and prevent the classroom from interpersonal conflicts and disruptions (König et al., 2021, Evertson and Weinstein, 2013). The other study conceptualized classroom management as a teacher's rules and procedures in the classroom to ensure smooth transitions during teaching activities (Fauth et al., 2019). Thus, classroom management covers the teachers' ability to allocate time efficiently through clear rules and procedures to minimize interpersonal conflicts and distractions during teaching activities.

Professional competence of the teacher

In the last decades, the study of instructional quality predictors used qualifications and the number of courses taken by the teacher as proxy measures (Boyd et al., 2009, Darling-Hammond, 2000, König et al., 2021). However, the study about instructional quality predictors has recently shifted to teacher competence (König et al., 2021, König and Pflanzl, 2016, Lenske et al., 2016, Voss et al., 2014). Some scholars see competence as knowledge, skills, characteristics, motivation, and attitudes to act effectively and efficiently in specific situations and conditions (Zhu et al., 2013, Koster et al., 2005). Furthermore, teacher competence refers to the specific abilities to fulfill the need of their profession (Fauth et al., 2019), such as knowledge and motivation (Baumert and Kunter, 2013a). The concept of teacher competence distinguishes between cognitive aspects (knowledge and beliefs) and motivational aspects (self-efficacy and enthusiasm) (Fauth et al., 2019, Kunter et al., 2013, Blomeke and Kaiser, 2017, Blömeke et al., 2022, Fives and Buehl, 2012, Fives and Gill, 2015). A brief overview of each aspect and the link to the instructional quality will explain as follows.

Cognitive aspect: Knowledge. The domain-specific knowledge is divided into content knowledge and pedagogical content knowledge (Blömeke et al., 2022, Fauth et al., 2019). Content knowledge refers to the teachers' comprehensive understanding of subject matters (Shulman, 1986, Fauth et al., 2019). Meanwhile, pedagogical content knowledge refers to understanding how to teach the subject matter (Loewenberg Ball, Thames and Phelps, 2008, Shulman, 1986). Therefore, PCK plays a role to bridges the subject matters and the teaching practice.

The previous study revealed that PCK is closely related to instructional strategies, classroom management, and the relationships between teacher and student (König and Pflanzl, 2016). In more detail, the role of PCK on instructional quality through the following pathways. Teachers with good PCK will be able to create a challenging learning environment to activate a high cognitive level (Förtsch et al., 2016, Fauth et al., 2019, Kunter et al., 2013). This practice enhances students' cognitive engagement during learning activities, which in turn positively affects students learning outcomes (Fauth et al., 2019, Klieme, Pauli and Reusser 2009). The challenging learning activities foster students' engagement during learning activities, which helps the students to understand the topics easier (Fauth et al., 2019, Leuchter, Saalbach and Hardy, 2014).

Teachers with good PCK mostly provide better individual learning support for students (Baumert et al., 2010, Kunter et al., 2013). Positive teacher-student interaction will establish a supportive climate during learning activities, which is helpful for the student during knowledge construction and sense-making (Fauth et al., 2019, Fauth et

al., 2014). This practice provides a supportive environment for students to understand specific topics or courses easier. Last, teacher competence contributes to excellent teaching effectiveness (Liakopoulou, 2011) and classroom management (Voss et al., 2014). Teachers with higher PCK are better at allocating time efficiently and preventing the learning activities from being distracted. They know when to intervene in learning activities if needed (Praetorius et al., 2018). The teacher's ability to minimize classroom disruptions offers ideal environments for learning activities, making students more focused during learning activities. Therefore, teachers' PCK became crucial for teachers to run effective teaching.

Cognitive aspect: Beliefs. The concept of beliefs refers to the subjective assumptions that are held to be true (Kleickmann et al., 2016). Regarding teacher beliefs, scholars divide into two orientations, transmission and constructivist (Voss et al., 2013, Mansour, 2009). Transmission orientation sees that teaching as a direct transmission activity from the teacher to the student. Hence, students are considered knowledge recipients. Meanwhile, the constructivist orientation believes that students should actively construct new knowledge by themselves during learning activities. This orientation conceptualized students as active knowledge constructors (Dubberke et al., 2008, Fauth et al., 2019). Therefore, teacher beliefs refer to the teachers' ways of treating students in learning activities, whether as knowledge recipients or knowledge constructors.

Previous studies revealed that teachers with strong constructivist beliefs often give selected tasks to activate students' cognitive during teaching activities (Staub and Stern, 2002, Fauth et al., 2019, Voss et al., 2013, Kunter et al., 2013). In addition, the teacher has more concern regarding students' conceptual understanding by providing individual support (Dubberke et al., 2008, Kunter et al., 2013). Teachers with constructivist beliefs will provide individual support, keep an eye on the student learning process, and be aware of students' difficulties (Kunter et al., 2013, Cornelius-White, 2007).

Motivational aspects: Self-efficacy. The study of self-efficacy is popular, particularly in the psychology field. Self-efficacy is conceptualized as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, Freeman and Lightsey, 1999). Similarly, the other studies also defined self-efficacy as a teacher's belief in their capacity to influence student performance (Berman, 1977, Tschannen-Moran, Hoy and Hoy, 1998, Zee and Koomen, 2016, Guo et al., 2014), although unmotivated student (Guskey and Passaro, 1994, Tschannen-Moran, Hoy and Hoy, 1998), and how to deal effectively with student misbehavior (Zee and Koomen, 2016, Chacón, 2005).

Some scholars have revealed the relationship between teacher self-efficacy and instructional quality. Teachers with high self-efficacy could better deal with the demand of classroom instruction, such as stimulating students' high-order thinking skills, providing a supportive environment, and minimizing interpersonal conflicts and classroom distractions (Zee and Koomen, 2016, Fauth et al., 2019). In addition, teacher instructional behavior is determined by self-efficacy (Tschannen-Moran and Johnson, 2011, Guo et al., 2012). The other studies also revealed that teachers with high self-efficacy consider implementing new instructional methods to avoid student boredom (Zee and Koomen, 2016). Teachers with high self-efficacy also reported better coping with student misbehavior (Lambert et al., 2009) and using positive strategies during teaching activities (Lambert et al., 2009, Emmer and Hickman, 1991).

Motivational aspects: Enthusiasm. Enthusiasm is a form of intrinsic motivation that encourages the active involvement of teachers in their work and play as a key to high-quality instruction (Kunter et al., 2008, Long and Hoy, 2006). Based on motivation theories such as interest theory (Krapp, 2002) and self-determination theory (Deci and Ryan, 2002), the teacher enthusiasm concept is described as teacher enjoyment and excitement during engagement in teaching activities (Kunter et al., 2008).

Previous studies show that enthusiastic teachers positively affect learning support and classroom management (Kunter et al., 2013). The higher the teacher's enthusiasm, the higher the instructional quality (Kunter et al., 2008, Kunter et al., 2013, Fauth et al., 2019). The teacher's enthusiasm created a warm and supportive atmosphere during learning activities (Fauth et al., 2019). Teachers can create a supportive atmosphere more easily if they teach with more fun (Roth et al., 2007). Furthermore, the enthusiastic teacher will focus on classroom mastery goal orientation (Lazarides, Buchholz and Rubach, 2018). Teachers must allocate instructional time efficiently through good classroom management to achieve the goal. Teacher enthusiasm also correlates with positive classroom behavior (Zhang, 2014).

In conclusion, based on the literature and previous findings, we hypothesized that teacher competence positively predicts instructional quality.

Ha. ***Teacher competence positively affects instructional quality.***

Current study

The current study examines the relationship between teacher competencies and instructional quality. Based on the literature and previous findings, teacher competence as an antecedent consists of four dimensions (PCK, constructivist beliefs, self-efficacy, and enthusiasm). Furthermore, instructional quality as an outcome construct consists of three dimensions (cognitive activation, student support, and classroom management). Besides, we also performed the confirmatory factor analysis while examining the relationship between teacher competence and instructional quality.

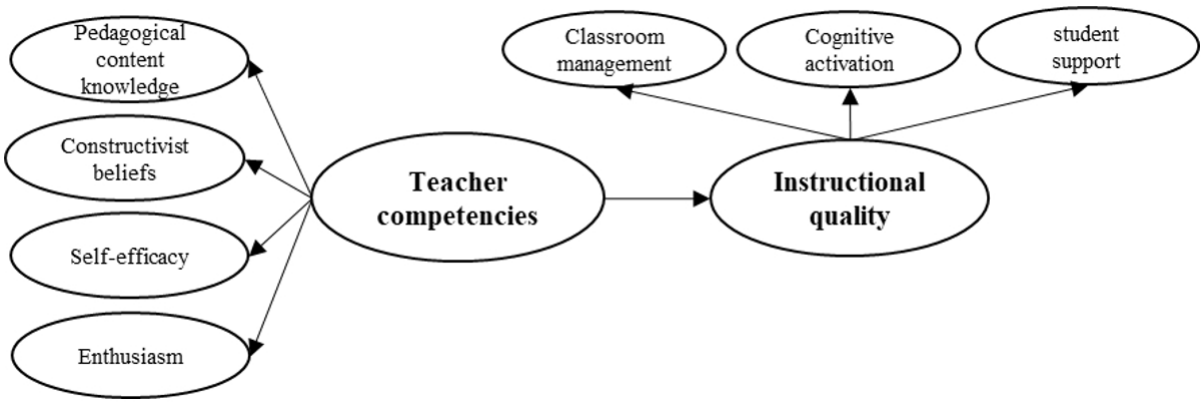

Figure 1: Conceptual model

METHOD

Participants

The current study use economics teacher from senior high school (public and private) in East Java, Indonesia. The teachers were invited to become research participants through professional teacher networks (high school economics teacher forum). The research participants were 283 teachers. On average, the teachers' age was 38.7 years old (*SD* = 11.2), and teaching experience was 12.6 years (*SD* = 10.8). Fifty-eight percent of teacher participants were female. All the research participants are voluntary.

Instruments

Pedagogical content knowledge (PCK). Teachers' PCK was measured by a twenty-three item based on the PCK scale by Aksu, Metin and Konyalıoğlu (2014). The PCK scale is developed by combining the intersection between pedagogical knowledge and content knowledge. A sample item is: "I know the critical points of my lessons." The items were rated on a 5-point Likert scale from 1 (*strongly disagree*) to 5 (*strongly disagree*).

Constructivist beliefs (CB). Teachers' constructivist beliefs were measured using the Teacher Belief Survey (TBS) developed by Woolley, Benjamin and Woolley (2004). We adopted a part of TBS, especially the constructivist section, which consists of eleven items. The scale captures teacher philosophies about the teaching profession covering seven main themes (classroom learning environment, behavior management, curriculum, assessment, teaching strategies, student roles, and working with parents). A sample item is "I believe that expanding on students' ideas is an effective way to build my curriculum." The items were rated on a 6-point Likert scale from 1 (*strongly disagree*) to 6 (*strongly disagree*).

Self-efficacy (SE). Teachers' self-efficacy was measured by ten items scale developed by Schwarzer and Schmitz (1999). The scale has been broadly validated (Schmitz and Schwarzer, 2000). The scale covers relevant aspects of teaching activities, such as interacting with students, parents, and colleagues. The scale captures teacher conviction in dealing with various situations, particularly in classroom instruction (sample item "I am convinced that I am able to successfully teach all relevant subject content"). The items were rated on a 4-point Likert scale from 1 (*strongly disagree*) to 4 (*strongly disagree*).

Enthusiasm (Enth). Teachers' enthusiasm was measured by four items developed by Kunter et al. (2008). The items focus on subject-related enthusiasm and teaching-related enthusiasm (a sample item is: "I am still enthusiastic about the subject"). The scale showed good predictive validity (Kunter et al., 2011, Lazarides, Gaspard and Dicke, 2019).

Instructional quality. Teachers' instructional quality was measured using the instrument developed by Schlesinger et al. (2018). The instrument consists of eighteen items covering three instructional quality dimensions (cognitive activation, student support, and classroom management). A sample item is: "The lesson starts and ends on time". The items were rated on a 5-point Likert scale from 1 (*strongly disagree*) to 5 (*strongly disagree*).

Data Analysis

We used partial least squares structural equation modeling (PLS-SEM) in SmartPLS 3.0 software to examine the research model. We adopted a multi-stage process that involves the model specification, outer model evaluation, and inner model evaluation (Hair et al., 2014). First, we draw the model specification according to the literature review (figure 1). Second, we evaluate the outer model through confirmatory factor analysis (CFA), including the validity and reliability of the measurement model. Third, we evaluate the inner model through the coefficient of determination (R^2), cross-validated redundancy (Q^2), path coefficients, and the effect size ($f2$).

RESULTS

First-order measurement model

After the model specification was established based on the literature and previous studies (figure 1), we evaluated the outer model through confirmatory factor analysis (CFA). We performed a first-order stage to examine the convergent validity (factor loadings and AVE), discriminant validity, and composite reliability of all constructs. During the analysis, we drop three items due to the factor loadings being less than 0.6 (PCK1, CA1, and CM5). The result (table 1) shows that the convergent validity of the measurement was established. It is evidenced by the factor loadings of the items for all constructs, which are higher than 0.6, and the AVE of each dimension is higher than 0.5 (Hair et al., 2017). The composite reliability of all constructs was higher than 0.7.

Construct	Item	Factor Loading	AVE	Composite Reliability
Pedagogical content knowledge (PCK)	PCK2	0.888	0.733	0.984
	PCK3	0.802		
	PCK4	0.87		
	PCK5	0.846		
	PCK6	0.851		
	PCK7	0.89		
	PCK8	0.876		
	PCK9	0.897		
	PCK10	0.864		
	PCK11	0.86		
	PCK12	0.745		
	PCK13	0.885		
	PCK14	0.82		
	PCK15	0.89		
	PCK16	0.812		
	PCK17	0.884		
	PCK18	0.878		
	PCK19	0.897		
	PCK20	0.854		
	PCK21	0.824		
	PCK22	0.812		
	PCK23	0.895		
	PCK24	0.833		
Constructivist beliefs (CB)	CB1	0.939	0.906	0.991
	CB2	0.967		
	CB3	0.947		
	CB4	0.901		
	CB5	0.965		
	CB6	0.961		
	CB7	0.959		
	CB8	0.937		
	CB9	0.963		
	CB10	0.954		
	CB11	0.974		
Self-efficacy (SE)	SE1	0.832	0.786	0.973
	SE2	0.855		
	SE3	0.856		
	SE4	0.897		
	SE5	0.845		
	SE6	0.876		
	SE7	0.938		
	SE8	0.931		
	SE9	0.928		
	SE10	0.901		

Construct	Item	Factor Loading	AVE	Composite Reliability
Enthusiasm (ENTH)	Enth1	0.867	0.78	0.934
	Enth2	0.865		
	Enth3	0.915		
	Enth4	0.886		
Cognitive activation (CA)	CA2	0.666	0.741	0.918
	CA3	0.915		
	CA4	0.923		
	CA5	0.911		
Student support (SS)	SS1	0.925	0.798	0.965
	SS2	0.925		
	SS3	0.938		
	SS4	0.934		
	SS5	0.913		
	SS6	0.827		
	SS7	0.776		
Classroom management (CM)	CM1	0.943	0.876	0.973
	CM2	0.936		
	CM3	0.949		
	CM4	0.926		
	CM6	0.926		

Table 1: First-order construct loadings, AVE, and composite reliability

Second-order measurement model

We performed the second-order stage due to the multidimensional construct of teacher competence as antecedent and instructional quality as the outcome variable. The teacher competence consists of four dimensions (pedagogical content knowledge/PCK, constructivist beliefs/CB, enthusiasm/ENTH, and self-efficacy/SE), while the instructional quality consists of three dimensions (cognitive activation/CA, student support/SS, and classroom management/CM). The result shows that factor loadings of all dimensions are acceptable (higher than 0.6) with t-values > 1.96 and p-values < 0.001. Furthermore, table 3 shows the AVE and composite reliability of all dimensions are higher than 0.5 and 0.8. Additionally, This study used Fornell and Larcker method (1981) to examine the discriminant validity. Table 4 shows that the discriminant validity of this study was established.

Constructs	Dimensions	Factor Loadings	t-Values	AVE	Composite Reliability
Teacher competence	Pedagogical content knowledge (PCK)	0.878	51.509**	0.512	0.977
	Constructivist beliefs (CB)	0.761	28.364**		
	Self-efficacy (SE)	0.619	13.905**		
	Enthusiasm (Enth)	0.633	14.381**		
Instructional quality	Cognitive activation (CA)	0.984	548.373**	0.794	0.984
	Student support (SS)	0.995	1111.639**		
	Classroom management (CM)	0.992	863.401**		

*Note. **significant at the level of 0.001*

Table 2: Second-order construct loadings, t-values of dimensions

Dimensions	AVE	Composite Reliability
Pedagogical content knowledge (PCK)	0.733	0.984
Constructivist beliefs (CB)	0.906	0.991
Self-efficacy (SE)	0.786	0.973
Enthusiasm (Enth)	0.78	0.934
Cognitive activation (CA)	0.741	0.918
Student support (SS)	0.798	0.965
Classroom management (CM)	0.876	0.973

Table 3: AVE and composite reliability of the second order constructs

	PCK	CB	SE	ENTH	CA	SS	CM
PCK	0.856						
CB	0.457	0.952					
SE	0.343	0.376	0.887				
ENTH	0.43	0.484	0.509	0.883			
CA	0.442	0.463	0.439	0.507	0.861		
SS	0.432	0.466	0.417	0.52	0.773	0.893	
CM	0.447	0.447	0.418	0.509	0.766	0.862	0.936

Note: PCK = Pedagogical content knowledge; CB = Constructivist beliefs; SE = Self-efficacy; Enth: Enthusiasm; CA = Cognitive activation; SS = Student support; CM = Classroom management.

Table 4: Discriminant validity

Next, we evaluate the inner model through the coefficient of determination (R^2), cross-validated redundancy (Q^2), path coefficients, and the effect size (f^2). The result (table 5) shows 0.338 for R^2 and 0.266 for Q^2. That means the predictive accuracy of the research model is weak to moderate, while the predictive relevance is medium to large (Hair et al., 2017). Additionally, the path coefficient of teacher competence on instructional quality is 0.582 (p-value < 0.001), meaning teacher competence positively predicts instructional quality. Last, the effect size (f^2) shows 0.512, which means the teacher competence has a large effect on explaining the instructional quality (Cohen, 1988, Hair et al., 2014, Hair et al., 2017). In other words, the teacher's competence strongly contributes to explaining the instructional quality.

Relationship	β-value	S.E.	p-value	R^2	Q^2	f^2
Teacher competence → Instructional quality	0.582	0.040	< 0.001	0.338	0.266	0.512

Table 5: Inner model evaluation

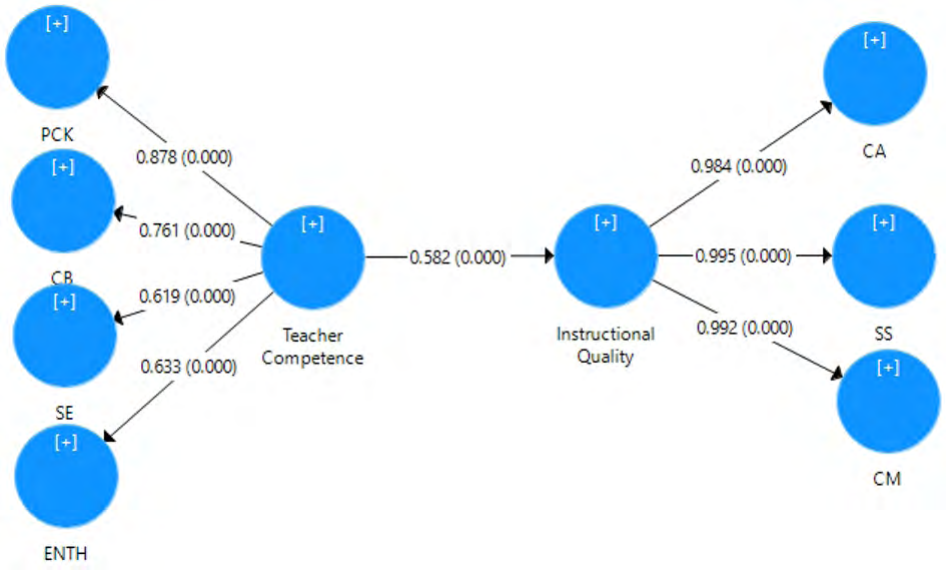

Figure 2: Result of the structural model analysis

DISCUSSION

The result shows that teacher competence, including cognitive aspects (PCK and beliefs) and motivational aspects (self-efficacy and enthusiasm), positively affected instructional quality. This finding indicates the higher the teacher's competence, the higher the instructional quality. In other words, cognitive aspects (PCK and beliefs) and motivational aspects (self-efficacy and enthusiasm) are identified as relevant predictors of classroom instructional quality.

In more detail, this study revealed the underlying mechanism of the relationship between teacher competence and instructional quality, particularly on how each teacher competence dimension affects instructional quality. The first dimension of teacher competence is pedagogical content knowledge (PCK). This study denotes that teachers with good PCK will be able to provide better instructional quality. Teachers with good PCK understand how to organize, adapt, and deliver learning material to the diverse abilities of learners. In other words, the teacher with good PCK will be able to represent and formulate the subject matter and make it easy to understand for students. In short, PCK is a teacher's competence in teaching the subject matters and plays a role in bridging the subject matters and the teaching practice.

The previous studies revealed the role of PCK on instructional quality in the following ways. A good PCK will allow a teacher to provide a challenging learning environment to enable students' cognitive level (Förtsch et al., 2016, Fauth et al., 2019, Kunter et al., 2013). The challenging environment will promote students' cognitive engagement and help them comprehend the subject matter (Fauth et al., 2019, Leuchter, Saalbach and Hardy, 2014, Klieme, Pauli and Reusser, 2009). Furthermore, a teacher with good PCK will provide better individual learning support (Baumert et al., 2010, Kunter et al., 2013), which will establish a positive relationship between teacher and student. The supportive climate will promote knowledge construction and sense-making of the student (Fauth et al., 2019, Fauth et al., 2014). Last, good PCK also enables the teacher to create lesson plans and efficiently use time allocation. In addition, teachers also have the ability to minimize classroom distractions during learning activities. Teachers know when to intervene in the learning activities (Praetorius et al., 2018). These practices offer students an ideal learning environment and help them focus on the subject during learning activities. Therefore, the current finding strengthens the previous study that PCK is positively related to instructional quality dimensions, including cognitive activation, student support, and classroom management.

Second, constructivist beliefs. This study revealed that teachers with constructivist beliefs treat students to construct knowledge by themselves. In other words, the teacher believes that the student is a knowledge constructor instead knowledge recipient. Furthermore, teachers with constructivist beliefs will encourage students to construct knowledge by establishing a challenging learning environment through selected tasks and strategies, which could activate students' cognition. In addition, to encourage the student to self-construct knowledge, teachers with constructivist beliefs will keep an eye on the student learning process and be aware of students' difficulties by providing individual support. This finding is in line with the previous studies that proposed teacher with strong constructivist beliefs will more be successful in activating students' cognitive (Staub and Stern, 2002, Fauth et al., 2019, Voss et al., 2013, Kunter et al., 2013) and provide better student support (Dubberke et al., 2008, Kunter et al., 2013, Cornelius-White, 2007).

Third self-efficacy. As conceptualized, self-efficacy is the teacher's belief in their capabilities to organize and execute the required learning process to achieve the learning goal. Therefore, teachers with high self-efficacy have confidence in promoting student performance and dealing effectively with student misbehavior. This study revealed that teachers with high self-efficacy would be more confident in making decisions to deal with classroom demand during instruction, such as considering the new instructional methods to stimulate students' high-order thinking skills. Furthermore, high self-efficacy makes it easier for teachers to minimize classroom distractions, develop a supportive environment, and encourage students' motivation. The current findings are in line with the previous studies that reported that teachers with high self-efficacy had a better ability to utilize an appropriate learning strategy (Lambert et al., 2009, Emmer and Hickman, 1991) and cope with student misbehavior (Lambert et al., 2009, Zee and Koomen, 2016).

Last enthusiasm. This study revealed enthusiastic teachers could create a warm and positive relationship with students. In addition, the enthusiastic teacher shows a positive and constructive approach to students. These practices contribute to establishing a supportive environment during learning activities. This study also revealed that teacher enthusiasm is related to classroom management. Teachers with high enthusiasm show high motivation to achieve the learning goal through effective and efficient time allocation. The enthusiastic teacher also shows an excellent ability to minimize distraction and interpersonal conflicts during classroom instruction to achieve the learning goal. These findings are in line with the previous if enthusiastic teachers positively related to the ability to create a supportive atmosphere through a positive teacher-student relationship (Praetorius et al., 2018, Fauth et al., 2019, Lazarides, Buchholz, and Rubach, 2018, Roth et al., 2007) and good classroom management through efficient time allocation and minimizing classroom distraction (Zhang, 2014, Kunter et al., 2013). Therefore, the more enthusiastic the teacher is, the more student support and classroom management are provided.

CONCLUSION AND IMPLICATION

In conclusion, this study discloses that teacher competence, including cognitive aspects (PCK, constructivist beliefs) and motivational aspects (self-efficacy and enthusiasm), positively affected instructional quality. This study revealed that instructional quality is not only determined by the teacher's cognitive aspects but also by the teacher's motivational aspects. Therefore, to enhance instructional quality, this study suggests paying attention to the teachers' motivational aspects as well as teachers' cognitive aspects.

This study provides insights for all stakeholders, including the practitioners (teachers), policymakers, and universities as the

responsible institutions for preparing teacher competencies. First, practitioners (teachers) should increase the four competencies (PCK, constructivist beliefs, self-efficacy, and enthusiasm) through continuing professional development programs to ensure quality instruction. Second, policymakers should support teacher development programs in cognitive and motivational aspects. For the cognitive aspects, the support can be in the form of free professional development opportunities and research grants. Furthermore, the support to increase the motivational aspects can be from career paths, salary increases, and direct rewards for outstanding teachers. Through the actual support, the increases in the four teacher competencies could be expected, which in turn enforce the instructional quality. Last, the universities should not only focus on preparing the cognitive aspects of prospective teachers but should also pay more attention to the motivational aspects to ensure instructional quality.

LIMITATION

This study has several limitations. First, this research model ignores socio-demographics (age, gender) and teacher experience, although those variables, theoretically, affect the teacher's instructional quality. Second, the research was conducted on high school teachers as participants. This study can not be generalized to other levels of education, such as elementary and higher education. At those education levels (elementary and higher education), the instructional quality may predict by different variables due to the different students and environment characteristics. Therefore, more research is needed to confirm and generalize our findings.

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DEVELOPING AWARENESS AND ATTITUDE TOWARDS SUSTAINABILITY THROUGH AN ACTIVITY-BASED INTERVENTION

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ABSTRACT

The present study intended to examine the impact of an activity-based intervention on the attitude and awareness of adolescents towards sustainability and its dimensions using a quasi-experimental research design. A cluster sample of 99 participants, experimental and control groups comprising of 50 and 49 school students, was selected for the present study. The investigators constructed and standardized an activity-based module for conducting the intervention, awareness test and attitude scale for sustainability. The module was used to teach the treatment group regarding concepts related to sustainability. However, the lecture method was used to teach the control group. Both groups were taught for a duration of four weeks. The results of the analysis of covariance revealed a positive and significant impact of the activity-based module for sustainable development on the awareness and attitude of school students towards sustainability and its dimensions. Implications of these results are discussed with regard to curricular and pedagogical concerns at the school level in India.

KEYWORDS

Activity-based module, attitude, awareness, economic, environmental, intervention, social, sustainability

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Highlights

- *The results revealed a significant impact of the activity-based intervention for sustainable development on the attitude and awareness of school students towards environmental sustainability.*
- *The results of the study revealed that the activity-based module for sustainable development has a significant and positive effect on attitude and awareness of school students towards economic sustainability.*
- *Further, the activity-based intervention for sustainable development led to an increase in favourableness and enhanced levels of attitude and awareness of sustainability, and its three dimensions among school students.*

INTRODUCTION

Whereas the 21st century has been an era of rapid industrialization, and technological advancements, its corollaries in the form of population explosion, poverty, deforestation, illiteracy, urbanization, etc. have resulted in the sustainability crisis assuming staggering proportions. A mass culture of consumerism is being promoted by capitalism at the global level, which in turn is depleting natural and human resources. The earth's carrying capacity is adversely affected due to the depletion of life-supporting resources. Thus, affluence and consumption-prone lifestyle will ultimately make the life of the future generation unsustainable (Chaudhari, 2013). Every day, two million tonnes of waste is poured into the water, while one litre of wastewater pollutes eight litres of fresh water (Gobar Times, 2003). There are several such wake-up calls about the harm that humans are inflicting upon the environment, but awareness about these remains wanting.

Adolescence is a crucial phase as from here the learners will enter the stage of adulthood. A review of previous researches revealed that adolescents tend to take less interest in the issues and concerns related to the environment, and a dearth

of studies on the consciousness of school students regarding sustainable development in the economic and social context was observed (Olsson and Gericke, 2016).

As the sustainable development concept evolved, the role of education as the main instrument became pertinent. First of all, education for sustainable development (ESD) got recognition and description in Chapter 36 under Agenda 21 for the promotion of education, awareness and training points to the duty of both formal as well as non-formal education system for developing appropriate attitudes in the population at large so as to enable them to actively participate in activities and matters concerning sustainable development (UNESCO, 1992). To make education effective, it should deal with biotic and abiotic components of the environment, including various facets of human development. These concepts should be integrated across all disciplines by using a variety of means of communication with the help of formal and non-formal methods. United Nations World Summit on Sustainable Development (WSSD) produced a resolution 57/254 at Johannesburg, South Africa in 2002 and declared the decade of 2005–2014 as a Decade of Education for Sustainable Development (DESD). UNESCO was assigned to be the main agency for promoting and integrating practices, values and principles of sustainability across different educational levels.

During the latter half of 1980s, education for sustainable development (ESD) emerged as a triad of three domains, namely social, economic and environmental sustainability. These three pillars together form the core of sustainable development. The basic premise is that economic systems, habitats and people coexist and are interrelated irrespective of the context. This interdependence can be ignored for a specific period of time, ultimately human race will be reminded of its dire consequences by means of a crisis or an unforeseen situation (Strange and Bayley, 2008). There is a dearth of such studies in India that embrace all three pillars of sustainability. The focus of earlier studies on sustainability is restricted to its one dimension i.e. environment, alone. Social, cultural and economic dynamics of sustainable development are generally ignored. The synchronization of these three pillars is the central concern of this new paradigm of sustainable development. It is a well-established fact that the targets of sustainable development cannot be achieved without considering all three components viz. environmental, social and economic factors in an integrated manner (Burgan and Sansom, 2006; George, 2007). Glavič (2020) suggested that the content of education for sustainable development should be holistic, focusing on all aspects of human experience, including social, emotional, physical as well as intellectual and should emphasize on a balanced relationship between man and the environment. The present study takes into consideration these tripartite aspects, as the remediation of social inequalities and environmental debasement is not possible without adhering to a sound economic edifice.

The related literature review indicated that most of the researches focussed on the environmental aspect of sustainable development. It was further observed that the awareness of students regarding sustainability and the related concerns was much less as compared to their awareness regarding environment-related concerns. In most of the researchers the concept of ESD was misrepresented as environmental education. Significant knowledge gaps concerning the social and economic dimensions were pointed out in a number of studies (Incekara and Tuna, 2011; Nicolaou and Conlon, 2012; Kilinc and Aydin, 2013; Walshe, 2017; Michael et al., 2020). However, experiential learning, instruction packages and intervention programmes were found to be effective in making the school students' attitude more favourable towards the economic, environmental and social aspects of ESD (Segalàs, Ferrer-Balas and Mulder, 2008; Sonwane, 2010; Kilinc and Aydin, 2013; Kalathaki, 2017) as well as enhancing their level of awareness towards education for sustainable development and its dimensions (Harjai, 2008; Uzunboylu, Cavus and Ercag, 2009; Walshe, 2017; Sarma, 2017). In a recent study, the use of educational aids was recommended for achieving the objectives of sustainable development (Krishna et al., 2022).

While reviewing the studies related to sustainability, it was seen that much research has not been done in the area of activity-based intervention for teaching the various aspects of sustainable development. Most of the studies remain descriptive in essence, relying on traditional modes of instruction. The activity-based learning package in ESD was developed for this study so as to rekindle inquisitiveness, stir the acquisition process, bringing effectiveness in teaching-learning process by replacing the monotonous classroom teaching with vigorous instruction, thereby raising awareness and knowledge of students about sustainable choices. Hence, to find out how far an activity-based learning package for education for ESD is effective in developing the awareness and attitude of school students in terms of environment, social and economic sustainability, the present study becomes imperative.

Experiential learning, instruction packages and intervention programmes have been found to be effective in enhancing the students' attitudes as well as their awareness levels towards education for sustainable development (Burek and Bonwic, 2010; Walshe, 2017; Sims and Falkenberg, 2013; Walshe, 2017; Kalathaki, 2017). Walshe (2016) argued that an interdisciplinary approach to ESD encourages students to engage more critically and affectively with the concept of sustainable development. It has also been suggested that innovative pedagogies and integrated approaches must be adopted for developing sustainable attitudes (Wamsler, 2020). In a recent study considering the developmental concerns, it was emphasized that ESD must be strengthened through all types of education channels i.e. informal, formal as well as non-formal channels in view of global development (Yuan et al., 2022). Hence, a need was felt to develop attitude and awareness of adolescents regarding sustainability in terms of its social, economic and environmental dimensions. So, it was thought worthwhile to construct and standardize an activity-based module for sustainable development to test its effectiveness on the attitude and awareness of school students regarding sustainability.

OBJECTIVES OF THE STUDY

- To study the impact of an activity-based module on the attitude of adolescents towards environmental, social and economic sustainability.
- To study the impact of an activity-based module on the awareness of adolescents towards environmental, economic and social sustainability.

METHOD AND PROCEDURE

The present research was conducted using a quasi-experimental research design in two phases: (1) Module and tool development (2) conduct of the experiment.

Module and Tool Development

An activity-based learning module for sustainable development along with an attitude scale and awareness test of sustainability was developed for the school students for the present study as described hereunder:

Activity-based Learning Package for Sustainable Development

The researchers prepared and standardised an activity-based learning package for sustainable development, including the thrust areas and activities based on environmental, economic and social sustainability. The development of the learning package involved selection and specification of the content (environmental sustainability, social sustainability and economic sustainability) based on the class 9th social science textbook prescribed by Punjab School Education Board and modules for sustainable development, formulation of instructional objectives in terms of Bloom's Taxonomy, followed by the development of activities for the learning package. The validity of this activity-based module was established through content validation. The content validity of the module was determined by matching the behavioural outcomes of the learners with the conditions specified in the instructional objectives of the activities covered in the package. Further, experts, educationalists and subject teachers with credentials and expertise in the Social Sciences and sustainability orientation from different fields were also consulted for standardization of activity-based module for sustainable development through content validation.

Attitude towards Sustainability Scale

The attitude towards Sustainability Scale was developed by the investigators. The development of the scale involved the selection and specification of the content (environmental, social and economic sustainability) for the preliminary draft, preparation of the preliminary draft consisting of 123 items, followed by item analysis and preparation of final draft of attitude towards sustainability scale containing 38 items pertaining to its three dimensions, namely, social, economic and environmental sustainability. These were selected based on a field tryout of 100 ninth-grade students (Mean age = 15.25 years). This scale has Likert type items to be responded on a five-point continuum. The scale was found to have satisfactory reliability and validity. The test-retest reliability was calculated and found out to be 0.97, with internal consistency reliability using Spearman and Brown Formula, Guttman Split-half Coefficient, and Cronbach's Alpha found out to be 0.95, 0.95 and 0.94, respectively.

Awareness Test for Sustainability

The test for awareness of sustainability was also constructed and standardized by the investigators, which involved the selection and specification of the content (environmental, social and economic sustainability) for the preliminary draft, formulation and classification of instructional objectives on the basis of Bloom's Taxonomy, preparation of the preliminary draft consisting of 103 items, followed by item analysis to determine the difficulty and discrimination index of the questions on the test, and preparation of the final draft of awareness test containing 56 items pertaining to the three dimensions viz. social, economic and environmental sustainability based on a field tryout on 102 ninth grade school students (Mean age = 15.56 years). Each question was followed by four options, out of which only one was correct, while the other three were distracters. The respondent was awarded one mark if he/she selected the correct option and a score of zero was awarded for every incorrect response. The test was found to have satisfactory reliability and validity. The reliability of the Education for Sustainable Development Awareness Test was calculated by Kuder-Richardson Reliability Coefficient, which came out to be 0.87.

Conduct of the Experiment

The population for this study was ninth-grade students from government schools located in Patiala District of Punjab. A cluster sample of 99 school students (mean age = 15.85) studying in 9th grade of Govt. Senior Secondary School, Bahadurgarh from Patiala district was selected to conduct the study. The 9th class had four sections (Sections A, B, C, and D). As the nature of the present study was quasi-experimental, all four intact classes were matched based on intelligence and academic achievement in terms of marks obtained in 8th grade. Two sections that did not differ significantly on the above-mentioned criteria were selected and further matched on the basis of pre-test scores and socio-economic status, followed by a random procedure for selecting the experimental and control groups. These groups comprised of 50 students (28 boys and 22 girls) and 49 students (27 boys, and 22 girls) respectively. There were three phases in this study:

Pre-experimental Testing

This was the initial stage of the experiment. Prior to the commencement of experimentation, the necessary permission was sought from the District Education Officer and the school authorities where the experimentation was to be conducted. In this phase, pre-testing was done on the variables namely awareness and attitude towards sustainability. Before administering pre-tests, the investigator held an informal session with the students of both groups. The doubts of the students regarding the tests were cleared. The tests were administered to respondents who were assured that the information they gave would be confidential and meant only for research purposes.

After the pre-testing was complete, the response sheets were collected from the students and were scored with the help of pre-determined scoring keys to be used for further analysis.

Experiment/Treatment

The sessions were carried out among school students in 9th grade of Govt. Senior Secondary School, Bahadurgarh in Patiala district of Punjab. The activity-based learning package for Sustainable Development was executed in fifty working days for one period of thirty-five minutes for each working day. The sessions were carried out with the school students within the school premises. For the experimental group, the sessions were participative and activity-based. The main techniques for imparting education for sustainable development were small group activities, role-playing, story-telling, group discussions, brainstorming, hands on experiments, and audio-visual presentations, etc. Similar content was taught simultaneously to the control group through the traditional method of teaching. The students in the control group were given awareness regarding sustainable development. However, they were not given any exposure to the activities.

Post-experimental Testing

Post-experimental testing was done with both the groups immediately after the completion of the administration of the activity-based learning package for sustainable development. The investigators administered the attitude scale and awareness test for sustainability during the post-testing.

RESULTS & DISCUSSION

The present study intended to find out the impact of an activity-based module on the attitude and awareness of school students towards sustainability and its different dimensions. The data analysis was done using the technique of analysis of covariance to investigate the impact of treatment on the awareness and attitude of school students towards different dimensions of sustainability.

Effect of Activity-based Module on Attitude of Adolescents towards Sustainability

The mean scores and SDs of the attitude of school students towards sustainability and its dimensions at different stages are shown in table 1.

Variable	Stage	Experiment Group			Control Group		
		N	Mean	SD	*N*	Mean	SD
Attitude towards Environmental Sustainability	Pre-test	50	50.92	6.98	49	50.53	5.82
	Post-test	50	62.90	6.97	49	57.65	6.73
Attitude towards Social Sustainability	Pre-test	50	50.06	8.37	49	52.55	7.70
	Post-test	50	65.64	5.97	49	60.65	6.88
Attitude towards Economic Sustainability	Pre-test	50	26.96	4.77	49	26.04	4.92
	Post-test	50	33.92	3.83	49	31.29	4.82
Attitude towards Sustainability	Pre-test	50	127.94	15.65	49	129.12	14.83
	Post-test	50	162.46	13.81	49	149.59	14.97

Table 1: Means and SDs of Attitude of School students towards Sustainability and its dimensions in Experiment and Control Groups

In order to see whether the activity-based learning package in education for sustainable development had any significant effect on the attitude of school students towards sustainability and its dimensions, ANCOVA was applied on mean attitude scores of school students towards sustainability and its dimensions, keeping pre-test attitude towards sustainability scores as a covariate. The results of the analysis of covariance for the impact of the activity-based intervention on the attitude of school students towards sustainability and its dimensions are shown in table 2.

Variable	Source of Variation	*SS*	*df*	*MS*	*F*-value
Attitude towards Environmental Sustainability	Among Means	618.46	1	618.46	20.08**
	Within Groups	2956.60	96	30.80	
	Total	3575.06	97		
Attitude towards Social Sustainability	Among Means	940.13	1	940.13	37.04**
	Within Groups	2436.88	96	25.38	
	Total	3377.01	97		
Attitude towards Economic Sustainability	Among Means	137.96	1	137.96	8.04**
	Within Groups	1648.04	96	17.17	
	Total	1786.00	97		
Attitude towards Sustainability	Among Means	4645.74	1	4645.74	51.77**
	Within Groups	8614.20	96	89.73	
	Total	13259.94	97		

*** p ≤ 0.01*

Table 2: Summary of Analysis of Covariance on Attitude towards Sustainability and its dimensions of School students for Two Groups: Experimental vs Control

Table 2 shows that the *F*-values for the impact of the activity-based intervention on adjusted mean attitude scores towards environmental, social, economic and overall sustainability came out to be significant (F = 20.02, 37.04, 8.04, 51.77; $p \leq 0.01$). This implies that there is a significant impact of the activity-based intervention in developing positive attitude towards economic, social and environmental dimensions as well as overall attitude towards sustainability among school students. The activity-based intervention significantly improved the attitude towards sustainability and its dimensions among school students in the experimental group compared to their control group counterparts.

A post-hoc analysis was carried out to study the significance of mean differences in adjusted mean attitude towards economic, social, environmental and overall sustainability scores. Table 3 reveals the results of post-hoc analysis.

Variable	Group	*N*	Pre-test Mean (M_x)	Post-test Mean (M_y)	Adjusted Mean ($M_{y.x}$)	*t*-value
Attitude towards Environmental Sustainability	Experimental	50	50.92	62.90	62.78	4.50**
	Control	49	50.53	57.65	57.78	
	General Means		50.73	60.30	60.28	
Attitude towards Social Sustainability	Experimental	50	50.06	65.64	66.18	6.02**
	Control	49	52.55	60.65	60.10	
	General Means		51.29	63.17	63.14	
Attitude towards Economic Sustainability	Experimental	50	26.96	33.92	33.78	2.83**
	Control	49	26.04	31.29	31.43	
	General Means		26.51	32.62	32.61	
Attitude towards Sustainability	Experimental	50	127.94	162.46	162.87	7.23**
	Control	49	129.12	149.59	149.17	
	General Means		128.53	156.09	156.02	

*** p ≤ 0.01*

Table 3: Adjusted Mean Scores of Attitude towards Sustainability and its dimensions Experimental and Control Groups of School students

As per Table 3, the calculated *t*-values for checking the significance of mean differences in adjusted mean attitude towards environmental, social, economic and overall sustainability scores between the control and experimental group came out to be significant (t = 4.50, 6.02, 2.83, 7.23; $p \leq 0.01$). This indicates the more favourable attitude of school students towards the environmental, social, economic and overall sustainability of the experimental group than their control group counterparts. Thereby meaning that the treatment given to the experimental group has a significant and positive effect on the attitude of adolescents towards sustainability and its dimensions.

Effect of Activity-based Module on Awareness of Adolescents towards Sustainability

The means and SDs of school students' awareness of sustainability and its dimensions at different stages of the intervention are given in table 4.

Variable	Stage	Experiment Group			Control Group		
		N	Mean	*SD*	*N*	Mean	*SD*
Awareness of Environmental Sustainability	Pre-test	50	9.46	2.70	49	9.45	2.96
	Post-test	50	20.62	1.95	49	17.08	2.73
Awareness of Social Sustainability	Pre-test	50	5.80	1.85	49	5.55	2.14
	Post-test	50	13.16	1.28	49	10.67	2.14
Awareness of Economic Sustainability	Pre-test	50	6.76	2.10	49	6.45	2.31
	Post-test	50	13.20	1.80	49	11.94	1.96
Overall Awareness of Sustainability	Pre-test	50	22.02	4.79	49	21.45	5.52
	Post-test	50	46.98	3.32	49	39.69	5.37

Table 4: Means and SDs of Awareness of School students towards different dimensions of Sustainability at different stages

In order to test whether the activity-based learning package in education for sustainable development had any significant effect on awareness of sustainability and its dimensions among school students, ANCOVA was applied on awareness scores of sustainability and its dimensions among school students, keeping pre-test awareness scores as a covariate. Table 5 shows the summary of the analysis of covariance for the effect of treatment on awareness of sustainability and its different dimensions among experimental and control groups of school students.

Variable	Source of Variation	*SS*	*df*	*MS*	*F*-value
Awareness of Environmental Sustainability	Among Means	309.03	1	309.03	72.66**
	Within Groups	408.32	96	4.25	
	Total	717.35	97		
Awareness of Social Sustainability	Among Means	142.71	1	142.71	52.50**
	Within Groups	260.97	96	2.72	
	Total	403.68	97		
Awareness of Economic Sustainability	Among Means	34.64	1	34.64	10.55**
	Within Groups	315.36	96	3.29	
	Total	350.00	97		
Overall Awareness of Sustainability	Among Means	1184.76	1	1184.76	124.32**
	Within Groups	915.25	96	9.53	
	Total	2100.01	97		

*** p ≤ 0.01*

Table 5: Summary of Analysis of Covariance for the Impact of Activity-based Intervention on Awareness of School students regarding Sustainability and its dimensions

Table 5 shows that the *F*-values, testing the significance of the impact of the activity-based intervention for sustainable development on mean awareness scores of environmental, social, economic and overall sustainability of school students came out to be significant (F = 72.66, 52.50, 10.55, 124.32; $p \leq 0.01$). This indicates that an activity-based package for sustainable development has a significant impact on the awareness of school students towards sustainability and its dimensions. The activity-based intervention resulted into a significant improvement in the awareness of school students in the experimental group regarding sustainability and its dimensions as compared to their control group counterparts.

The adjusted mean awareness scores of school students towards environmental, social, economic and overall sustainability and the *t*-values for checking the significance of mean differences in adjusted mean scores of awareness of environmental, social, economic and overall sustainability, post-hoc analysis was used. The results of post-hoc analysis are presented in table 6.

Variable	Group	*N*	Pre-test Mean (M_x)	Post-test Mean (M_y)	Adjusted Mean ($M_{y.x}$)	*t*-value
Awareness of Environmental Sustainability	Experimental	50	9.46	20.62	20.62	8.63**
	Control	49	9.45	17.08	17.08	
	General Means		9.45	18.87	18.85	
Awareness of Social Sustainability	Experimental	50	5.80	13.16	13.12	7.27**
	Control	49	5.55	10.67	10.72	
	General Means		5.68	11.93	11.92	
Awareness of Economic Sustainability	Experimental	50	6.76	13.20	13.16	3.28**
	Control	49	6.45	11.94	11.98	
	General Means		6.61	12.58	12.57	
Overall Awareness of Sustainability	Experimental	50	22.02	46.98	46.79	11.15**
	Control	49	21.45	39.69	39.88	
	General Means		21.74	43.37	43.34	

*** p ≤ 0.01*

Table 6: Adjusted Mean Awareness Scores of School students regarding Environmental, Social and Economic Sustainability

As per table 6, the *t*-values for the significance of mean differences in adjusted mean awareness scores of environmental, social, economic and overall sustainability between treatment and control groups are significant (t = 8.63, 7.27, 3.28, 11.15; $p \leq 0.01$). This indicates the significantly higher level of environmental, social and economic sustainability awareness scores for the treatment group than their control counterparts. It shows the significantly positive impact of the activity-based intervention for sustainable development on awareness regarding sustainability and its dimensions among school students.

The results of the present study highlighted that it is important to engage students by means of a variety of student-centered activities. The students must be given ample opportunities to engage with the subject-matter, thereby developing their own understanding and constructing their own knowledge in an educational context for getting mastery over the content. These results are being supported by a number of researches. For example, Uzunboylu, Cavus and Ercag (2009) found a mobile-based multimedia program to be effective in enhancing participants' awareness regarding environmental concerns. In another study, Walshe (2016) observed that integrating poetry in a geography lesson helps develop the appreciation of economic and social sustainability among Geography students. However, the significant focus of the students was on the environmental dimension of sustainability. Also, Sarma (2017) found a significant effect of active strategies for environmental education for sustainable development on the knowledge,

attitude and skills of school students regarding environment compared to the control group. Paul and Mehera (2016) in a study on the households of Burdwan district in West Bengal observed a significant and positive impact of education on sustainable development. Also, Olsson, Gericke and Chang Rundgren (2016) recommended that teachers should design the sustainability education as per the age and level of students. Further, due attention should be given to striking a balance of various sustainability dimensions. In another study, Nousheen et al. (2020) stressed upon integration of education for sustainable development in teacher education in Pakistan as it has the potential to develop a favourable attitude of prospective teachers towards sustainable development. Similarly, Badea et al. (2020) observed that integrating sustainable development content along with the involvement of teaching staff involvement emerged as important strategies for developing sustainable behavior among Romanian Economics and Business students. In a recent study, Birdman, Wiek and Lang (2022) found that individual activities, relationships and their interactions to be the formative and mutually influential elements for developing sustainability competence in a graduate sustainability program. Also, Olsson, Gericke and Boeve-de Pauw (2022) concluded that ESD has an effect on the action competence of students for sustainability. In a similar vein, Corazza, Cottafava and Torchia (2022) observed that a transformative training activity for business students helps them choose a career in the field of sustainability. These results emphasize that study of sustainability-related disciplines influences the long-term career orientation of students in sustainability-oriented areas. Hence, it may be concluded that the results of the present study have both theoretical as well as empirical support from the earlier research and these results are worthwhile to explain the development of sustainability perspective among school students.

IMPLICATIONS

Following are the implications of these results:

1. The results revealed a significant impact of the activity-based package for sustainable development on the attitude and awareness of school students towards environmental sustainability. Therefore, students should be oriented towards pro-environmental attitudes by reinforcing the environmental aspects such as living in harmony with biodiversity, consuming and conserving resources responsibly, having a sustainable lifestyle, purchasing only what we need, participation in non-threatening environmental activities, etc.
2. The results of the study revealed that the activity-based learning package for sustainable development has a significant and positive effect on the attitude and awareness of school students towards economic sustainability. In this context, it has been rightly remarked that there is a dire need to raise awareness and reorient attitudes towards preferential consumption of those that have been made locally and under the least environment threatening conditions, encouraging fair commercial practices, thereby reducing the adverse impact of commercialization on the environment (Estrada-Vidal and Tójar-Hurtado, 2017).
3. Further, the activity-based package for sustainable development led to an increase in favourableness and enhanced levels of attitude and awareness of sustainability, and its three dimensions among school students. Therefore, teachers should incorporate activity-based teaching strategies in their everyday classroom teaching transaction and approach education for sustainable development content holistically. Hence, rather than teaching through conventional methods, the lessons should be taught with the help of activities involving small group activities, role-playing, story-telling, group discussions, brainstorming, hands on experiments, and presentation of video tutorials.
4. Learning is life-long process and learning of concepts through activity-based learning package for sustainable development provides a solid edifice for concept formation in students. The concepts learnt through experiential learning are ever-lasting and bound to leave impressions on the students' minds forever. Therefore, experiential learning must be given due importance in teaching-learning transactions.
5. Activity-based intervention for sustainable development was found to have a significant and positive effect on the attitude and awareness of school students towards sustainability. Therefore, through experiential teaching, teachers must emphasize the social responsibilities and roles that the students have to play as members of society by participating in democratic activities, respecting other cultures and believing in gender equity through means of non-environmental threatening approaches.
6. The results also suggest that innovative pedagogies must be adopted in schools in order to facilitate and develop uniformities regarding the attitude and awareness of various issues and concerns related to sustainable development (Patra and Panda, 2017). It is further recommended that sustainable environment programmes must be designed to ensure the involvement of students and the community at large. Environmental activists should try to generate mass awareness with the help of various environmental programmes.
7. Courses on sustainable development must be integrated into the pre-service teacher education curriculum (Aydın and Keles, 2021). Teachers' professional development initiatives can develop ESD teaching over time. Hence, the teachers must be supported during the process of transformation of their teaching towards education for sustainable development, to develop students' competencies to enable them to contribute to sustainable development (Olsson, Gericke and Boeve-de Pauw, 2022).
8. Educational institutions must have a clear vision for achieving the sustainable development goals through curricular and pedagogical approaches (Moganadas et al., 2020). It has been rightly pointed out that the ESD curricula and courses should be designed per human society's needs (Glavič, 2020). It is recommended that the issues and concerns regarding sustainability should be incorporated into the curriculum of different educational programs to enhance students' consciousness and knowledge regarding these pertinent issues (Msengi et al., 2019).

9. Finally, curricular adjustment is needed across all levels (Novieastari et al., 2022). Further, concepts related to sustainable development should be integrated into the curricula of all institutions, and special emphasis must be given to the training and empowerment of the public and stakeholders in a rigorous manner.

In a nutshell, it may be concluded that it is the need of the hour to integrate ESD across all disciplines and levels of education. Moreover, the impetus must be given to the continuous professional development of teachers so that ESD policy may be implemented in letter and spirit. Also, adopting ESD management practices will help support and promote ESD globally (Laurie et al., 2016). Sustainability based curricula and organizational culture must be developed in educational institutions, which may prove to be the key driver for bringing about desirable mindset transformation. The sustainability principles must be the core agenda of institutional strategy (Žalėnienė and Pereira, 2021). It is a well-known fact that the road to sustainability is paved by education since education plays a pivotal role (Kioupi and Voulvoulis, 2019). It is high time we must invest into it, else we would not be able to achieve the sustainable development goals by 2030.

LIMITATIONS

Following were the limitations of the present research:

1. The present study was quasi-experimental. A similar study may be undertaken using true experimental designs to validate the results of the present study more rigorously at different stages of education, i.e., from school to university level.
2. The qualitative and experimental approaches may be combined to replicate the same study to fill the existing lacunae in the theory and practice of sustainability and its tripartite aspects.
3. The social science textbooks of PSEB may be analyzed with regard to content coverage regarding sustainable development by carrying out its content analysis. Further, comparisons may be drawn between PSEB social science textbooks and those published by NCERT.
4. Descriptive studies may be conducted to assess students' attitude and awareness of sustainable development at different stages of education.

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EFFECT OF 8-WEEK CIRCUIT TRAINING ON THE DEVELOPMENT OF DIFFERENT FORMS OF MUSCLE STRENGTH IN PHYSICAL EDUCATION

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ABSTRACT

The aim of the research was to determine the effect of an 8-week circuit training program on explosive strength and strength endurance in physical education classes intended for high school students. The research included 60 students of two second-grade high school classes. Both classes attended regular physical education classes, where, within the main part of the class, one class had a special program for developing strength through circuit training (circuit group), while the other one had no modifications to the regular physical education program (control group). The classes were randomly marked as circuit group (n = 28) and control group (n = 32). Five strength tests were used in the study: squat jump, countermovement jump, squats, push-ups, and sit-ups. The results showed that the 8-week strength development program organized as circuit training contributed to a significant improvement in strength. The results of all tests showed a significant effect of training on students' strength. It has been determined that short-term circuit training in physical education classes is an effective way to develop students' physical performanc.

KEYWORDS

Explosive strength, strength endurance, students, physical activity, physical exercise

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Highlights

- *Changes in explosive strength and strength endurance after eight weeks of circuit training program in physical education classes.*
- *8-week strength development program contributed to a significant improvement.*
- *Short-term circuit training in physical education classes is an effective way of developing students' physical performance.*

INTRODUCTION

The global threat of a sedentary lifestyle arises the necessity for physical activity, which becomes a key factor in determining the proper physical, social, and mental development of children and adolescents (Görner and Reineke, 2020). Modern technological progress facilitates everyday life on one side, while on the other, it causes a radical reduction in physical activity in people, which further conditions a lower level of muscle strength and cardiovascular endurance (Kudryavtsev et al., 2018). Optimal levels of physical activity stimulate children's development and ensure motor needs (Gao and Wang, 2019), improve the functioning of the cardiovascular system and prevent risk factors (Andersen et al., 2011), build up muscle strength (Landry and Driscoll, 2012) and bones (Tan et al., 2014) and increase flexibility (Mikkelsson et al., 2006).

In children and adolescents, it is very important to maintain an optimal level of physical activity that is advised to be at least 60 minutes per day (Pate and O'Neill, 2008). However, there are also negative effects of decreasing physical activity that begins in childhood and culminates in adolescence (Caspersen, Pereira and Curran, 2000; Farooq et al., 2020; Harding et al., 2015; Kelder et al., 2003), which happens for a number of reasons, starting with obesity (Muhajarine et al., 2015), to a low level of motor competence and physical fitness (McIntyre et al., 2015).

The programs that promote the development of physical fitness significantly improve the complete motor status of children and adolescents (Brusseau et al., 2018). The most commonly used physical development programs for adolescents are strength development programs because of their popularity among students, as well as because of the speed due to which they give results (8–12 weeks) (Granacher et al., 2011). Raising the level of strength in

physical education teaching affects the development of internal organs, hormonal, and locomotor systems, which affects the optimal growth, development, and health of each student (Hollmann and Strüder, 2009). Therefore, a difference is spotted in relation to the aim of strength development in a sport in which the best possible results are achieved. Improvement of physical ability being one of the most important occupies a significant position in the annual curriculum of physical education (Milenković, 2021). Strength training has a positive effect on the development of children and adolescents. In addition to logically increasing strength levels (Faigenbaum and Myer, 2010; McKinlay et al., 2018), strength programs contribute to the prevention of sports-related injuries (Faigenbaum and Schram, 2004; Myers, Beam and Fakhoury, 2017), as well as the improvement of general health (Smith et al., 2020). The positive effects of strength training can also be seen in the improvement of self-confidence, self-esteem, and mental health (Faigenbaum, 2007). There is no evidence to support the view that it negatively affects growth or a higher risk of injury (dos Santos Duarte Junior et al., 2022).

Among others, explosive strength and strength endurance stand out as two components of strength that partially cover both the area of speed and endurance. Explosive strength is the ability to manifest maximum strength in the shortest possible time, while strength endurance refers to the ability to repeat an exercise that requires great muscle strength, thereby gaining muscle mass, while developing both strength and endurance (Milenković, 2021). It is known that improvements in general strength development in children and adolescents are possible after controlled short-term endurance strength training programs two to three times per week (Stenevi-Lundgren, Daly and Karlsson, 2010). Therefore, strength training in various forms is implemented in teaching physical education. The benefit of such programs can be seen in the development of explosive strength and strength endurance (Faigenbaum et al., 2015). In physical education classes, it is recommended to perform dynamic exercises of moderate to high intensity to improve core muscular endurance, as another element of general strength (Allen et al., 2014). Likewise, programs for developing muscle capacity through resistance training are used (Kennedy et al., 2018), as well as 15-minute circuit strength training (Martins et al., 2020).

It would be ideal to pay more attention to certain content of the teaching because it is known that the best way to successfully improve a certain physical component is that more time is spent on it (Camhi, Phillips and Young, 2011; Donnelly et al., 2009). However, as there are many other contents in the physical education program that have to be implemented, it is useful to find and use programs that will ensure faster progress. In order to achieve rapid effects on the motor status of adolescents, it is necessary to use short-term programs that will be effective in raising the level of physical fitness, including strength. Circuit training is one of the ways that effectively reduces the time required for practicing, and allows an optimal scope of training (Alcaraz, Sánchez-Lorente and Blazevich, 2008). Circuit training consists of a series of simple and well-known exercises united in a single whole in order to develop and improve basic physical fitness along with proper taking turns of loading and relieving not only between exercises but also between the exercise series (Milenković, 2021). This type of exercise allows a greater amount of time spent on motor engagement (Lozano et al., 2009) and has multilevel effects on physical fitness, especially in beginners (Dorgo et al., 2009; Wong et al., 2008). Therefore, circuit training used in this research was intended to confirm the allegations that indicate the effectiveness of this program and the speed of changes in the level of physical fitness in physical education classes.

The aim of the research was to determine the effect of an 8-week circuit training program on explosive strength and strength endurance in physical education classes intended for high school students. In that context, the research starts from the null hypothesis:

- H_0: *It is expected that after eight weeks, the effect of a circuit training on the development of explosive strength and strength endurance in physical education classes of second-grade high school students will be higher than that of regular physical education classes*.

MATERIAL AND METHODS

Participants

The research included 60 students of two high school second-grade classes. Both classes attended regular physical education program. One of those classes had a special program for the development of strength by using circuit training within the main part of the class (circuit group – CIR), while the other class did not have any modifications of a regular physical education program (control group – CON), but the strength of the control group of students was developed by the usual teaching contents. The classes were randomly marked as CIR group (n = 28) and CON group (n = 32). The classes were held by the same physical education teacher. There were no chronic diseases or major injuries in the students' health records. The parents' permission for the students to take part in the research was obtained, as well as the consent of the children themselves. Before the beginning of the program, the initial and after the end the final testing of both groups was carried out. The research was organized according to the recommendations for clinical research issued by the World Medical Association (2013).

Testing procedure

The testing was performed in the gym during the physical education classes with the students wearing adequate sports equipment. A week before the initial testing, the students went with their teacher through all the tests that were going to be used later to ensure the accuracy of the testing procedure. Furthermore, a trial test was organized to prepare the students for the entire procedure to which they were going to be subjected during the experimental testing. Two days later, the initial testing was done, and 8 weeks later the final one was carried out. 15-minute warm-up was performed before each testing. Each of the tests was repeated three times, so the best

value was taken for further analysis. After the completion of each test and before moving on to the next one, a rest of 5–8 minutes was allowed in order to avoid negative effects on testing caused by fatigue. The study used five tests for strength assessment. A closer look at the procedures and the scoring systems can be found on the Topend Sports website (Wood, 2008):

1. *Squat Jump* – a subject is in a starting position with his knees being bent at 90 degrees; hands are placed on the hips; the trunk is positioned as vertically as possible; feet are at hip width. From the starting position, the subject performs an explosive high jump, keeping the hands on the hips and extending the hips and knees.
2. *Countermovement Jump* – a subject is in an upright standing position; hands are placed on the hips; feet are at hip width. From the starting position, the subject squats down to 90-degree leg bent position and then performs an explosive high jump, keeping the hands on the hips and extending the hips and knees.

Both jumps (squat and countermovement) were performed using Optojump photocell system (Microgate, Bolzano, Italy) with force plate measurements for estimating vertical jump height which calculate jump height using the following formula: jump height = 9.81 x (flight time)^2 / 8 (Glatthorn et al., 2011). Both jump tests are reliable and valid for assessing explosive strength (Marković et al., 2004).

3. *Squats* – a subject is in a standing position with his feet apart at shoulder's width and hands on his hips. He squats until his knees are at right angles, then he returns to a standing position. The number of squats in 30 seconds is recorded.
4. *Push-ups* – a subject begins his push-up with the hands and toes touching the floor, the body, and legs in a straight line, feet slightly apart, the arms apart at shoulder-width, extended, and at a right angle to the body. Keeping the back and knees straight, the subject lowers the body to touch the ground or some other object, or until a 90° angle at the elbows, then returns back to the starting position with the arms extended. The number of push-ups in 30 seconds is recorded.
5. *Sit-ups* – a subject is lying on his back with his knees bent at a 90° angle. Fingers must be interlocked behind his head. The other person holds the subject's ankles with their hands only. From this position, the subject starts the sit-up by raising his upper body forward to the vertical position and then lowers his body until the bottom of his shoulder blades and the backs of his hands touch the ground. The number of sit-ups in 30 seconds is recorded.

All strength endurance tests are reliable and valid for assessing this fitness component (Blazevich, Gill and Newton, 2002; Ojeda, Maliqueo and Barahona-Fuentes, 2020).

Training procedure

Students of both groups (CIR and CON) had two classes of physical education per week, which is a total of 16 lessons in eight weeks. The teaching content of physical education included the regular program for the second grade of secondary school. They consisted of sport-specific skills (in that period of the school year basketball and gymnastics were taught) and exercises for the development of physical fitness in which, among other things, exercises for the development of strength were done.

However, in the CIR group, within the main part of each class, 15 minutes were used for the application of a specialized program of strength development organized as circuit training. This way, within the class itself, a modification was made which reinforced the development of strength by emphasizing the use of circuit training. The training program was focused on two dimensions of strength – explosive strength and strength endurance.

Two types of circuit training were used – training with a certain number of repetitions (characteristic for the development of strength endurance) and with limited training time (characteristic for the development of explosive strength).

Circuit training (number of repetitions) – before starting the circuit training, the students were tested using the maximum test to determine the initial number of repetitions for each student and the degree of load increase from cycle to cycle of the circuit training. Then, individual load assessment was performed at each exercise spot with an initial value of 50% of the maximum test for the first training cycle (Tmax/2). Later, from cycle to cycle (week after week), the number of repetitions was gradually increased depending on the progress of each individual student.

I week – Tmax/2	V week – Tmax/2+8
II week – Tmax/2+2	VI week – Tmax/2+10
III week – Tmax/2+4	VII week – Tmax/2+12
IV week – Tmax/2+6	VIII week – Tmax/2+14

Table 1: Load assessment of circuit training with number of repetitions

Circuit training (limited training time) – at scheduled training time (30 seconds – Tmax test) the exercise is repeated as many times as possible at maximum speed. The load assessment was done as shown in Table 2 (break time was extended up to 60 seconds).

I week – Tmax/2 (break – 45")	V week – Tmax test/2+13" (break – 32")
II week – Tmax test/2+3" (break – 42")	VI week – Tmax test/2+15" (break– 30")
III week – Tmax test/2+5" (break – 40")	VII week – Tmax test/2+18" (break – 27")
IV week – Tmax test/2+10" (break – 35")	VIII week – Tmax test/2+20" (break– 25")

Table 2: Load assessment of circuit training with limited training time

explosive strength	strength endurance
jumps in place	forward lunges
jumps on one leg in motion	squats with a medicine ball with arms raised
jumps on one leg forward/backward and left/right	stand up from a lying to a sitting position
jumps over hurdles	pull-ups
depth jumps	push-ups

Table 3: Exercises used in circuit training

Statistical analysis

Descriptive parameters (Mean ± St.Dev) were calculated for all variables. For differences in initial testing, a *t*-test for independent samples was used, while for changes within each group, a *t*-test for dependent samples was used. Covariance analysis (ANCOVA) was used to determine the effect. Statistical significance was established at the level of $p \leq .05$. The statistical package SPSS v. was used for data processing 20.0 (IBM SPSS Statistics).

RESULTS

The following chapter presents the obtained results in anthropometric measures and strength tests (Tables 4 and 5). The students successfully completed the experimental treatment without any injuries. Both groups of respondents had a high attendance rate (more than 95%). The testing carried out prior to experimental treatment, showed no significant differences between groups in any of the variables ($p > .05$).

Characteristics (total of 60)	CIR group (*N*=28)	CON group (*N*=32)
Age (*y*)	16.66 ± 0.7	16.54 ± 0.8
Body height (*cm*)	171.6 ± 6.6	172.3 ± 6.8
Body mass (*kg*)	58.8 ± 8.3	59.3 ± 8.5
BMI (kg/m^2)	21.9 ± 3.5	22.2 ± 3.7
CIR – circuit training; **CON** – control; **BMI** – Body mass index.		

Table 4: Group characteristics (Mean±St.Dev)

Strength tests	CIR group			CON group		
	Pre-test	Post-test	*p*	Pre-test	Post-test	*p*
Squat jump (*cm*)	27.93 (±3.88)	30.67 (±3.54)	< .001	28.48 (±4.45)	29.13 (±4.4)	< .001
Countermovement jump (*cm*)	30.91 (±4.18)	33.54 (±4.3)	< .001	31.67 (±4.98)	32.34 (±4.87)	< .001
Squats (*n*)	21.18 (±1.76)	24.79 (±2.42)	< .001	20.5 (±2.08)	22.28 (±2.08)	< .001
Push-ups (*n*)	9.82 (±2.5)	14.61 (±2.13)	< .001	10.44 (±2.7)	13.19 (±2.33)	< .001
Sit-ups (*n*)	16.36 (±1.73)	18.32 (±1.83)	< .001	15.81 (±1.99)	16.28 (±2.25)	< .001
Note: Significance level is $p \leq .05$						

Table 5: Pre- and post-test results for strength in Mean (±Std. Dev) for both groups

Changes in both groups (Table 5) show the statistical significance and obvious improvement in the results of all tests ($p \leq .05$): Squat jump ($p < .001$), Countermovement jump ($p < .001$), squats ($p < .001$), push-ups ($p < .001$) and sit-ups ($p < .001$).

Strength tests	*F*-test	*p*
Squat jump	64.88	< .001
Countermovement jump	65.94	< .001
Squats	34.63	< .001
Push-ups	50.57	< .001
Sit-ups	35.89	< .001
Note: Significance level is $p \leq .05$		

Table 6: Effects of exercise (analysis of covariance)

Considering that statistically significant changes were recorded in both groups of students, the effects of exercise on the development of strength (explosive strength and strength endurance) were calculated using the analysis of covariance (Table 6). It was found that a higher effect of exercise was recorded in the CIR group, where circuit training was applied within the traditional physical education class. The results of all tests contributed to the effects of exercise: Squat jump ($p < .001$), Countermovement jump ($p < .001$), squats ($p < .001$), push-ups ($p < .001$), and sit-ups ($p < .001$).

DISCUSSION

The results of the research showed an improvement in the strength development of both groups of students after 8 weeks of physical education classes ($p \leq .05$). However, when the effects of exercise were analyzed, it was found that the CIR group was more successful than the CON group and that a modification within the main part of the class that enhanced strength development by introducing the circuit training produced better results. The greatest improvement was recorded in the tests of the explosive strength of the lower limbs: Squat jump ($F = 64.88$; $p < .001$)

and Countermovement jump ($F = 65.94$; $p < .001$). This can be explained by the amount of content that was implemented in circuit training, which included various types of jumps (basketball contents were dominant). The effect of circuit training was also established in other tests: squats ($F = 34.63$; $p < .001$), push-ups ($F = 50.57$; $p < .001$), and sit-ups ($F = 35.89$; $p < .001$). This way, the 8-week program for developing strength by using circuit training contributed to a significant improvement in the level of this fitness component.

Similar conclusions were reached in previous studies when a kind of short-term strength development program (8–12 weeks) was used. Granacher et al. (2011) found a significant improvement in maximal isometric force during leg extension after eight weeks of ballistic strength training. Using fundamental integrative training (FIT), Faigenbaum et al. (2015) found that such exercise was helpful for children with low levels of muscle strength and the quality in the development of motor skills. Since lower percentage of such children participate in physical activities, it is believed that there is a greater possibility of physical development during such exercise development programs. Other authors also agree with this very statement (Fransen et al., 2014; The Hague, 2009; Hands, 2008). Since it is possible to develop and maintain the level of muscle strength and cardiovascular endurance during short-term programs in physical education (Mayorga-Vega, Viciana and Cocca, 2013), it is considered that such programs are necessary for physical fitness training to be effective and feasible within the school curriculum. So, such programs could guarantee the maintenance of previously achieved training effects.

Circuit training can make the best use of the time available to a physical education teacher, as one of the main goals is to make students active for as long as possible during classes (Whitehead, 2020). Using circuit training, students can easily achieve a minimum time of motor engagement, while performing numerous exercises (Lozano et al., 2009). Physical education classes last for 45 minutes, however, there is a lot of content that has to be implemented, so circuit training is a good organizational form that makes the most of the available time. In this regard, Dorgo et al. (2009) found a statistically significant improvement in muscle strength and cardiovascular endurance levels using circuit training. Besides, circuit training with individualized intensity that ensures maximum effort in a short period of time is very useful for improving overall strength (Chtara et al., 2008).

CONCLUSION

This research included the second-grade high school students in an 8-week strength development program in physical education classes. The strength development program was organized as a 15-minute circuit training (CIR) as part of the main part of the physical education class. The program, which was adapted to the age of adolescents, proved to be suitable, safe, and effective for working on the immediate development of strength (explosive strength and strength endurance) and the indirect development of other fitness components in which strength is significantly correlated with. Along with being fun, the program provided a sufficient amount of physical activity that led to improved physical performance.

The research indicates that strength development programs are effective and safe for children and adolescents as well as some previous studies (Behringer et al., 2011; Lesinski et al., 2020; Stricker, Faigenbaum and McCambridge, 2020). The study showed that eight weeks of a specialized program resulted in significant improvements in the level of explosive strength and strength endurance. It was also found that short-term circuit method training in teaching physical education, as one of the strength development programs, is an effective and safe way of developing the physical performance of students. Therefore, it can be stated that the null hypothesis (H_0: *It is expected that after eight weeks, the effect of a circuit training on the development of explosive strength and strength endurance in physical education classes of second-grade high school students will be higher than that of regular physical education classes.*) was not rejected because it was found that the effect of circuit training on the development of explosive strength and strength endurance in physical education classes of second-grade high school students was higher than that of regular physical education classes.

In accordance with previous research indicating the effectiveness of short-term circuit training, the results obtained in this study indicate that such a program is a sustainable model of work in physical education and that together with the professional guidance of physical education teachers it contributes to the improvement of the physical skills needed for proper development of children. This experimental treatment can also be used to design and implement other physical education programs with longer-term effects on students' physical and health status.

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Full research paper

HOW DO STUDIES AT THE UNIVERSITY HELP PROSPECTIVE PHYSICAL EDUCATION TEACHERS FORM THEIR PROFESSIONAL IDENTITY?

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ABSTRACT

This study examines the expression of self-efficacy, academic motivation, study satisfaction of prospective physical education teachers in different years of study, their interrelationships and intends to explain how studies help prospective physical education teachers shape their professional identities. A questionnaire survey was administered to 783 1st to 4th year undergraduate physical education students from four Lithuanian universities. The year of study did not affect changes in students' self-efficacy expectations and intrinsic academic motivation, which may mean that such professional identity indicators are less affected by contextual factors. The correlations among the analysed variables showed that the quality of teaching, clear goals, and the maintenance of autonomy are essential components of the academic environment in order to strengthen the prospective PE teacher's professional identity. The results of the study may encourage physical education teacher educators' deeper analysis of the ongoing feedback on student satisfaction with their studies as an emotional PI indicator.

KEYWORDS

Academic motivation, professional identity, self-efficacy, Social Cognitive Career Theory, study satisfaction, teacher education

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Highlights

- *The study expands the existing knowledge about the formation of physical education teachers' professional identities in the first period of their professional careers – at university.*
- *It has revealed the importance of the teacher as a component of the academic environment for students' self-determination to pursue a professional career.*
- *Teacher educators have to carry out a much deeper analysis of students' satisfaction with their studies as an indicator of their emotional professional identity.*

INTRODUCTION

The current scientific literature shows that teacher identity is an essential part of the teaching profession (Pérez Gracia, Serrano Rodríguez and Pontes Pedrajas, 2022). Preparation for the professional activity of a teacher begins at university (Mäkelä and Whipp, 2015), although professional career development begins in childhood and lasts a lifetime. Research data has shown that the formation of PI in the first stage of the career in preparation for professional activities is considered an essential bridge between higher education and future employment and acts as an enabling and potentially empowering force (Tomlinson and Jackson, 2021). In this process, various personality traits, skills, experiences are shaped, which influences the individual's professional identity (PI).

Experience makes a significant contribution to PI formation (González-Calvo et al, 2021; Nickel and Zimmer, 2018). Individual biographies of would-be physical education (PE) teachers, their previous experiences are related to their beliefs about PE teaching (Davis, 2020; González-Calvo et al, 2021; Matanin and Collier, 2003) and self-confidence as well as perceived competence to teach PE (Barber et al, 2020). The school experience of PE can have a greater impact on shaping PE teachers' perceptions of their future

profession and PE practice than teacher education programs (Ferry, 2018; Haynes, Miller and Varea, 2016). Therefore, in modelling PE Teacher Education programs, it is important not only to identify and understand students' motives for physical education teacher education choices, their expectations, experiences, and perceptions of PE, but also to understand that prospective PE teachers' experiences and perceptions may need to be redesigned and supplemented with new activities and pedagogical experiences, thus meeting the current needs of today's school (Ferry, 2018). Studies analysing PE teacher identity issues (Amaral-Da-Cunha, Batista and Graça, 2014; González-Calvo et al, 2021; Keating et al, 2017) showed that there is scarce research on the PI of PE teachers. The above-mentioned authors reveal the importance of the PE teacher's identity for educational practice and acknowledge that a deeper analysis of these issues could help higher education institutions to teach higher-quality PE teachers.

Although PI is defined differently by different authors, for most researchers, PI is self-awareness when performing professional roles. Teachers' PI is important for understanding their professional lives and career decisions, and this relates to teachers' self-perceptions, self-awareness, knowledge, values, confidence, and interactions with colleagues, students, and families (Pérez Gracia, Serrano Rodríguez and Pontes Pedrajas, 2022). PI formation is manifested by studying professional alternatives, commitment to the chosen alternative and reconsideration of commitments and professional alternatives (Porfeli and Lee, 2012). PI is dynamic and consists of several interrelated identities (Amaral-Da-Cunha, Batista and Graça, 2014; Keating et al, 2017). Learning to teach is a complex process in which an interaction between personal values and professional demands of teaching takes place, thus, tensions between personal and professional identities are often possible (Leeferink et al, 2019). Each person's PI development is individual and unique as a result of their different experiences and their negotiation for adaptations (García-Martínez and Tadeu, 2018). Pérez Gracia, Serrano Rodríguez and Pontes Pedrajas (2022) meta-analysis showed that during the period of initial education, while studying in a higher education institution, the construction and evolution of PI is influenced by a wide range of factors (personal, professional and contextual).

When analysing the concept of teacher identity, Beltman et al (2015) note that this concept, regardless of different authors and theories, has several common elements: identity develops under the influence of many personal and contextual factors; these factors are reciprocal and dynamic; thus, personal identity is constantly changing. Therefore, in order to understand identity, it is necessary to analyse it in a specific context and at a specific time. Thus, the analysis of teacher PI in the early stages of a professional career while studying at university can contribute to a better understanding of how young people's self-awareness as a teacher develops, revealing the links between personal and external factors that strengthen or inhibit their career choices. Students' satisfaction with their professional choice is very important as it is associated with a higher probability of not dropping out of studies and preparing to work in their speciality (Casanova et al, 2021; Castro-Lopez et al, 2022; Urbanavičiūtė, 2009). Satisfaction with studies (SS) is related to commitment to the profession, so it can have an impact on students' academic achievements, their creativity, and attitudes towards their future work (Ekin, Yetkin and Öztürk, 2021). Some authors tend to consider SS as one of the indicators of academic success (Guo et al, 2022; Naylor, Bird and Butler, 2021).

In this study, students' academic motivation (AcM), SS and self-efficacy (SE) are presented as PI indicators for prospective PE teachers. Although these indicators do not reflect the whole construct of PI, the analysis of their expression and interrelationships in different academic years can help to better understand the extent to which PI is affected by the study environment and students' experiences during the study period. At the beginning of the studies, the evaluation of the field of professional activity is based more on imagination, while in the last year – on experience (Nickel and Zimmer, 2019; Urbanavičiūtė, 2009). In addition, the quality of teaching has a positive and significant influence on students' satisfaction and intention to continue their studies in higher education (Amos and Hassan, 2017). Therefore, students' learning experiences, their satisfaction or dissatisfaction with their studies may encourage students to become more committed to the profession or to review their career goals. Research shows that students' AcM decreases during the study period (Arslantas, 2021; Brouse et al, 2010; Hakan and Münire, 2014) and their teaching motivation changes: intrinsic motivation increases, however, their altruistic type of motivation tends to decrease predominantly, e.g., motivation to work with children/adolescents (König et al, 2016). It has been established that higher intrinsic motivation (IM) of students studying in pedagogical study programs and those entering them is related not only to involvement in the study process and intention to work as a teacher, but also to career continuity (Rots and Aelterman, 2009). It is known that students who have graduated from higher education institutions and do not identify with the chosen professional field often leave it, do not even start working there, or do not realize their opportunities while working. This may be influenced by the absence of students' self-identification with the chosen field of study and future profession while studying in a higher education institution. It is necessary to consider whether students' vision of their future work is accurate and whether their expectations are adequate. The main reasons why students leave university without a degree are mostly related to their interests and expectations about the study programme and performance outcomes (Behr et al, 2021). Expectations can have a bearing on choosing a profession and exploring professional opportunities (Betz, 2007; Matanin and Collier, 2003), as well as the intention to continue the chosen professional activity and be satisfied with that (Casanova et al, 2021; Castro-Lopez et al, 2022). Therefore, a deeper analysis, revealing how the study period affects the PI of prospective teachers, can help to better understand the impact of individual and social environmental factors on

professional careers in different study periods as students engage in building their PI. In addition, PI development can be influenced by education (Hahl and Mikulec, 2018; Nickel and Zimmer, 2019), therefore, the results of this study can guide the educational process in higher education institutions to be supplemented with measures and conditions that strengthen the PI of prospective teachers, and this can affect teacher retention, teacher resilience and teacher effectiveness, especially in the first years of their profession (Mansfield, Beltman and Price, 2014).

Theoretical framework

Social Cognitive Career Theory (SCCT) (Lent, Brown and Hackett, 1994; Lent and Brown, 2006; Lent, 2013; Lent et al, 2019) was chosen as the theoretical basis of the study aiming to explain how professional interests are formed, how the choice of profession takes place and how professional goals are set. The SCCT emphasizes the relatively dynamic, situation-dependent, individual and environmental factors that are important both for an individual's choice of profession and for further career planning (Lent, Brown and Hackett, 1994; Lent, 2013). This approach foregrounds that the individual and the environment are changing, and those changes can sometimes be very significant. Therefore, this theory can help to explain how students' perceived academic environment in different study periods affects their self-determination for the chosen profession and helps to develop their PI.

The SCCT consists of models of academic and career interest, choice, performance, and satisfaction and involves three interacting cognitive-person variables that partly enable the exercise of agency in career development: SE beliefs, outcome expectations, and personal goals (Lent, 2013). The article briefly describes how these cognitive-person variables will be reflected in the results of the study.

Self-efficacy

SE is the belief in the extent that an individual has the ability to perform the actions necessary to achieve a particular goal (Bandura, 1977). The perceived SE construction reflects optimistic self-confidence (Schwarzer, 1993), it is the belief that a person can perform new or complex tasks and achieve the desired results. Tschannen-Moran, Woolfolk Hoy and Hoy (1998) adapted Bandura's SE concept to the teaching context, defining it as teachers' beliefs about their ability to successfully convey different teaching tasks through various actions, however, researchers such as Cocca and Cocca (2021) have taken into account the changes that educational systems experienced in recent years and adjusted the original measure to better reflect the current state of teaching and learning processes in the classroom. Perceived SE facilitates goal setting, investment of effort, perseverance in the face of obstacles and recovery from failures. Teacher self-efficacy is a strong predictor of early career teachers' commitment and decision to stay or leave the profession (Bandura, 1997; Kim, Youngs and Frank, 2017**).**

SE influences behaviour directly and through its effects on expected outcomes of the behaviour, the setting of relevant and challenging goals, and perceived barriers to and facilitators of the target behaviour (Bandura, 1997). SE has four sources (or types of learning experience): mastery experiences, vicarious learning, verbal persuasion and physiological and affective states at the time of the behavioural opportunity (Bandura, 1997; Lazarides and Warner, 2020). Both the sources of SE and the mechanisms through which it influences behaviour are specified and can be used to design behavioural interventions, thus strengthening the PI of prospective PE teachers.

The SCCT individual's beliefs about his/her SE are considered to be one of the main factors of professional development directly related to the setting and pursuit of professional goals (Lent, Brown and Hackett, 1994; Lent, 2013). Lazarides and Warner (2020) point out that teachers may have very different beliefs about their self-efficacy in different behavioural domains, their beliefs about their own efficacy are malleable, so they can be strengthened by educational interventions and social support. Research shows that SE changes during the period of studies (Bümen and Özaydin, 2013; Lazarides and Warner, 2020), and it is significantly influenced by direct teaching experience during their internship practice (Kuhn et al, 2020). SE is related to both extrinsic and intrinsic AcM of students (Chowdhury and Shahabuddin, 2007; Wu et al, 2020). Azila-Gbettor et al (2021) found a positively significant relationship between SE and autonomous motivation, which the authors identify with intrinsic motivation. A study performed by van Rooij, Fokkens-Bruinsma and Goedhart (2019) showed that undergraduate students' SE was positively related to commitment and negatively – to workload and stress.

In our study, we chose to analyse general SE. It is generally argued that the assessment of general SE is not expedient (Bandura, 2006; Betz, 2007) because SE is always focused on a specific field of activity and determines to what extent an individual is convinced that he/she is capable of performing. General SE was selected for the study because it may explain a wider range of human behaviours and experiences when the context is less specific. This can be useful when focusing on multiple behaviours at the same time (Luszczynska, Scholtz and Schwarzer, 2005). According to Pajares (2002), it is likely that if a person has successfully coped with a task in one area, then his/her confidence in his/her abilities in another area will be higher. SE affects essentially all areas of human life (Pajares, 2002), it develops throughout life as it accumulates successes and failures in performing various tasks in different fields. Thus, general SE captures individuals' perceived ability to perform a variety of tasks in a broad context, which we believe is important in the teaching profession.

Beliefs about SE play a key role in motivational processes (Bandura, 1997). Therefore, SE is often associated with behavioural changes precisely because of its influence on motivation. Based on these statements, the aim of this article was to reveal the links between general SE and AcM as well as SS, as it will depend on the SE whether the student will reach his/her full potential while studying. SE is directly related to the career adaptability of prospective teachers, which shows an individual's ability to cope with career planning, adapting to new challenges, and career optimism, which affects career satisfaction and outcomes (McLennan, Perera and McIlveen, 2017). This confirms the importance of SE for the independent management of students' careers and the construction of

their PI. We believe that general SE contributes positively to changes in the AcM of prospective PE teachers, which also affects students' self-determination for further professional careers, i.e., PI.

Academic motivation

Researchers apply the term *Academic Motivation* to study motivation in the context of education (Vallerand et al, 1992; Wilkesmann, Fischer and Virgilito, 2012). Self-determination Theory (SDT) sees motivation as an incentive, impulse, or energy to do something (Ryan and Deci, 2000), thus, AcM can be perceived as an incentive, impulse to learn or perform other activities related to the academic environment.

We selected a widely used Academic Motivation Scale (AMS) to research students' AcM (Vallerand et al, 1992) because it is designed to establish intrinsic and extrinsic AcM and amotivation. SDT (Ryan and Deci, 2000; 2017) maintains that different types of motivation reflect different levels of personal self-determination (*autonomous regulation and controlled regulation)*, i.e., the extent and degree of the behaviour that arises from the person himself/herself. Autonomous motivation is highly volitional, and it is characterized by engagement in activities out of a sense of interest, valuing, and volition (Ryan and Deci, 2017). Thus, students demonstrate autonomous regulation in the study process when they think that studies in higher education institutions meet their interests, are pleasant and interesting, and provide satisfaction (i.e., IM) or when they consciously identify the value of study activities, personally endorse them and therefore experience a relatively strong desire to act accordingly (i.e., identified regulation). Thus, with autonomous regulation, students' behaviours are more internalized and show greater determination to pursue a professional career.

In contrast, undergraduate students are characterized by controlled motivation (i.e., external regulation, introjected regulation), when their behaviours and activities during studies are initiated not by internal but by external factors, for example, in order to obtain reward, perceived approval from others or to avoid punishment or the feeling of guilt. Students who engage in activities for controlled reasons feel a sense of responsibility and pressure and are likely to continue the activity as long as the external contingency is present. Thus, controlled motivation suggests that students are less prone to behavioural self-regulation.

Students differ not only in the type of motivation they display, but also in the intensity of motivation. In SDT, the term *Amotivation* is used to describe the extent to which a person feels ineffective, without purpose, or internally resistant toward an action (Ryan and Deci, 2017). For students, amotivation can result from the lack of perceived competence to perform, or lack of value or interest. Amotivation can be a strong negative predictor of engagement, learning, and wellness (Ryan and Deci, 2020), therefore, in order to better understand students' PI, their professional expectations, it is important to analyse the changes in amotivation indicators during the study period.

SCCT distinguishes *outcome expectations* as one of the variables which refer to beliefs about the consequences or outcomes of performing particular behaviours (Lent, 2013; Lent et al, 2019). This variable can be measured indirectly by assessing the subject's value orientations and relating them to expectations (Lent, 2013). In the context of this study, professional expectations are revealed through the prism of AcM: why this profession is attractive or unattractive to the student and how they imagine the value of the result of the chosen profession.

SDT emphasizes the effect of social factors on different types of motivation and the influence of these factors in meeting certain psychological needs of a person (Ryan and Deci, 2020). According to SDT, the social context and the relationship between teachers and students in the educational process significantly contribute to the transformation of autonomous motivation into controlled motivation, or vice versa. It depends on the extent to which teachers support student autonomy and the extent to which a person's basic psychological needs (autonomy, competence and relatedness) are met (Ryan and Deci, 2000). For skills and knowledge to have an impact on motivation levels and learning outcomes, they should be developed in an environment that supports autonomy and allows people to communicate (Duchatelet and Donche, 2019; Wu et al, 2020). Thus, the autonomous motivation of PE undergraduate students and the academic environment that supports student autonomy are important factors in the development of students' academic achievements.

Study satisfaction

SS is considered an important indicator of PI in this study. The authors (Goegan and Daniels, 2021; Mäkelä and Whipp, 2015; Richardson and Watt, 2018), who analyze teachers' professional career, argue that it is influenced by factors of the personal environment and the organizational environment. Thus, the academic environment as a factor of the organizational environment can enhance or reduce students' self-determination in their chosen profession. Therefore, students' SS research can help reveal the most important components of the academic environment that increase or inhibit the decision to become a teacher, and highlight strategies that help meet students' expectations and strengthen their PI.

Some authors (Kim and Tanis, 2022; Sinclaire, 2014; van Rooij, Jansen and van de Grift, 2018) tend to consider SS as one of the indicators of academic success. Students' SS is associated with a commitment to the profession, especially an emotional commitment that can affect students' academic performance, creativity, and attitudes toward their future work (Conklin, Dahling and Garcia, 2013; Wilkins-Yel et al, 2018). SS, also known as academic satisfaction, includes personal conviction to act independently, expectations about the results, progress made towards achieving the goals, and perceived academic and social support (Guo et al, 2022).

The SCCT emphasizes that the ability to perform a particular activity, SE, the expectations of the consequences of the activity, and the personal goals are formed in a broader context, which may include a variety of variables that reflect the individual's social environment. The aim of this study was not to directly measure the influence of the contextual factor – *the academic environment* – on the PI of prospective teachers, but the indirect effect of the academic environment is highlighted

by revealing the links between AcM and SS. We believe that SS increases AcM, which may enhance students' professional expectations and PI.

Study aim

Experience makes a significant contribution to PI formation (González-Calvo et al, 2021; Nickel and Zimmer, 2018). Content of studies differs in different study periods, students accumulate some academic experience, which affects their professional expectations and allows them to assess the study process and their professional choice from a new perspective (Beltman et al, 2015; Horgan and Gardiner-Hyland, 2019; Urbanavičiūtė, 2009). The aim of this study was to reveal the manifestation of prospective PE teachers' SE, AcM, SS in different study periods, as well as their interrelationships, and to explain how studies help prospective PE teachers shape their PI.

MATERIALS AND METHODS

Participants

The sample included 1st-4th year full-time undergraduate students from four Lithuanian universities preparing PE teachers using stratified random sampling method. The sample was stratified on two characteristics: university and gender identity. The sample size for each year of studies was calculated assuming a 95% confidence level and ±5% confidence interval. The study sample consisted of 784 informants: 62% (n = 485) were males and 38% (n = 299) were females. According to the year of studies, the research sample was split in the following way: the first year n = 216, the second year n = 230, the third year n = 189 and the fourth year n = 149. Table 1 presents the demographic characteristics of prospective PE teachers included in the sample.

Variables		Year of studies				
		1	2	3	4	Total
Number		216	230	189	149	784
Age	Mean	19.19	20.93	22.10	22.91	21.31
	Std. Dev.	1.25	1.16	1.23	1.61	1.61
Average marks in the last exam session (points, 10-point system)	Mean	7.61	8.07	8.24	8.30	8.03
	Std. Dev.	0.95	1.05	0.97	1.15	1.06
Work during studies (%)	You are/have been working in a sport-related field	26.9	29.7	35.5	45.1	33.3
	You are/have been working in a field not related to sport	22.1	27.5	24.7	29.9	25.8
	You are not/have not been working	51.0	42.8	39.8	25.0	40.9
Attitudes towards the future profession during the study years (%)	Changed positively	46.8	38.9	36.7	44.5	41.6
	Did not change	47.2	48.9	37.8	32.9	42.7
	Changed negatively	6.0	12.2	25.5	22.6	15.7

Table 1: Demographic characteristics of participants (source: own calculation)

The average age of participants was 21.31 (*Std. Dev.* = 1.61, range 18–27) years. The average academic achievement grade of subjects in the last examination session was 8.03 (*Std. Dev.* = 1.06), 33.3% of students had worked or worked in sports-related areas during their studies, and 25.8% worked in areas not related to their studies. The attitudes of 42.7% of the respondents towards their future profession did not change during their studies, those of 41.6% changed positively, and those of 15.7% of respondents – negatively.

Measures and procedure

Prior to data collection, the Research Ethics Committee of the Lithuanian University of Educational Sciences approved the study. Cross-sectional study questionnaire survey design was used in this research. For data collection, group-administered anonymous paper-and-pencil questionnaires were used. The survey was conducted at the universities of the authors of this research article in 2017 and 2018 in the spring semester (in March) during the lectures having received a prior agreement from the university administration and the university teachers. The questionnaires took the participants on average 25 minutes to complete. Before handing out the surveys, the researchers explained the purposes of the study and informed that all data would be confidential. Students' participation was voluntary, and the participants could withdraw at any time. Twenty-eight incomplete responses were rejected owing to their failure to answer several key survey items. During the research period, the four Lithuanian universities where PE teachers were trained provided study programs accredited by an international expert team in 2014. This means that the study objectives, outcomes and content set in the study programs of all universities met the quality requirements of the Standards and Guidelines for Quality Assurance in the European Higher Education Area, as well as the Law of the Republic of Lithuania on Education and the Law on Higher Education and Research of the Republic of Lithuania and also the resources (human, material and methodological) and study quality management were adequate to achieve the intended learning outcomes provided in the study program. In Lithuania, the volume of the first cycle studies of the PE teachers is 240 study credits and the teaching practice of at least 30 study credits has to be performed. Teaching practice includes three practices: teaching assistant practice, teaching practice under the guidance of a mentor, and independent teaching practice. In all PE teacher training programs, the first teaching practice is provided in the 2nd year, the second in the third year, and the third in the fourth year of study.

A survey to measure the constructs relevant for prospective PE teachers' sense of their PI (SE, AcM, SS) was developed.

Self-efficacy. This was measured with the 10-item General Self-Efficacy (GSE) Scale (Schwarzer and Jerusalem, 1995; Luszczynska, Scholtz, and Schwarzer, 2005). Each item referred to successful coping and implied an internal-stable attribution of success. Possible responses were *not at all true* (1), *hardly true* (2), *moderately true* (3), and *exactly true* (4), yielding a total score between 10 and 40. A higher score indicated more SE of a person.

Academic motivation. AMS (Vallerand et al., 1992) was used to assess students' AcM. The AMS consists of 28 items related to seven different subscales (4 items per subscale) of motivation. Three subscales measure various types of IM (to know, toward accomplishment, to experience stimulation), three subscales measure various types of extrinsic (identified, introjected, external regulation) motivation (EM) and one measures amotivation. Participants were asked to indicate to what extent each question corresponded to the reason they were studying at the university. The students responded on a 7-point scale ranging from 1 (*does not correspond*) to 7 (*corresponds exactly*). The mean indicators for each subscale were calculated by summing the indicators for all items and dividing by the number of items, which were four in each subscale. An overall estimate of autonomous and controlled forms of motivation was calculated. Intrinsic motivation (to know, toward accomplishment, to experience stimulation) and identified motivation are classified as autonomous. Introjected motivation and external regulation motivation are classified as controlled motivation. Autonomous and controlled motivation indicators were obtained by summing the indicators of the respective AMS subscale items and dividing them by the number of items. AMS was adapted to the contexts of many countries, such as Croatia (Koludrović and Ercegovac, 2014), Greece (Barkoukis et al, 2008), Poland (Areńska et al, 2016), and elsewhere, as well as in Lithuania (Kairys et al, 2017).

Study satisfaction. The CEQ consisted of 24 items divided into 5 scales: *Quality of teaching* (6 items), *Clear goals and standards* (4 items), *Appropriate workload* (5 items), *Appropriate assessment* (4 items), *Autonomy* (5 items). *Quality of teaching* focuses on teachers' feedback, motivation, attention, understanding of problems and skills in explaining concepts. *Clear goals and standards* measure students' perceptions of the clarity with which teachers communicated expected academic standards and program goals. *Appropriate workload* scale measures students' perceptions of the appropriateness of their program workloads. *Appropriate assessment* scale measures students' perceptions about the extent to which assessment stresses the recall of information rather that other intellectual skills. *Autonomy* scale focuses on students' perceptions about the given opportunities to choose how to study and perform tasks, to choose and delve into areas of interest to them. Participants rated their agreement with items on a 5-point scale: *1 - strongly disagree (-100), 2 - disagree (-50), 3 - neither agree nor disagree (0), 4 - agree (+50), 5 - strongly agree (+100)*. Scores of less than 0 indicate that respondents have a negative perception of their program in the context of the general issue addressed by the item. A score above 0 indicates a positive response. For each scale, the mean score of all items were calculated. An overall assessment of SS in this study was also calculated: it was obtained by summing all the indicators of the CEQ items and dividing them by the number of items.

Data analysis

The statistical analysis was conducted using SPSS 22.0 software. Descriptive statistics was applied and arithmetic means (*M*), standard deviations (*Std. Dev.*) were calculated. Inferential statistics was used to compare data by exchange the years of study and to determine correlations between variables. Pursuing to determine the differences in students SE, AcM and SS of the year of studies, one-way ANOVA test was used, and Fisher's (*F*), Post Hoc criteria were applied. Pearson's correlation coefficients were calculated to examine the interrelationship between students' SE, AcM and SS variables. Cronbach's alpha coefficient was used to measure the internal consistency of GSE, AMS, CEQ scales, as well as the internal consistency of every AMS, CEQ subscale. In the present study, the internal consistencies of the scales were good: GES Cronbach's α =.826; AMS Cronbach's α =.878; CEQ Cronbach's α =.742.

RESULTS

General SE data are presented in Table 2. It was found that students' SE indicators did not differ statistically significantly in the aspect of the year of study. The data of students' AcM (Table 2) show that students' IM does not differ in terms of the year of study.

Variables	Current year level								*F*	*p*
	1st year (*n* = 216)		2nd year (*n* = 230)		3rd year (*n* = 189)		4th year (*n* = 149)			
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.		
IM - know	5.34	1.11	5.20	1.14	5.34	1.00	5.05	1.15	2.564	.054
IM - toward accomplishment	4.86	1.24	4.80	1.11	4.88	1.07	4.63	1.19	1.571	.195
IM - experience stimulation	4.31	1.32	4.52	1.47	4.45	1.31	4.51	1.29	1.092	.351
EM - identified	5.43	1.17	5.19	1.14	5.26	1.28	4.85	1.27	7.329	.001
EM - introjected	5.08	1.34	4.90	1.45	5.04	1.29	4.90	1.35	.925	.428
EM - external regulation	5.18	1.12	4.88	1.27	5.16	1.23	4.73	1.18	6.065	.001
Amotivation	2.17	1.39	2.66	1.62	2.83	1.63	2.82	1.52	8.064	.001
GSE	34.08	4.02	34.28	3.90	34.51	3.62	33.93	3.66	.759	.517

Table 2: Indicators of general self-efficacy and academic motivation of physical education students by the year of study (source: own calculation)

Significant differences were found according to the year of study in *EM – identified* and *EM – external regulation*. *EM – identified* of the 4th year students was statistically significantly lower compared to those of the 1st ($p < .001$), 2nd ($p = .034$) and 3rd ($p = .008$) year students. The *EM – external regulation* was significantly lower among the 4th year students compared to the 1st year ($p = .003$) and 3rd year ($p = .006$) students. A statistically significant difference was recorded in this subscale when comparing the data of 1st and 2nd year students, they were higher for the 1st year students ($p = .043$). Amotivation was the lowest among the 1st year students, the results differed statistically significantly from those recorded for the 2nd ($p = .004$), 3rd ($p < .001$) and 4th ($p < .001$) year students.

Table 3 presents student SS by the year of study. There were statistically significant differences of 1st year students in the *Quality of teaching* variables, they were statistically significantly higher compared to those of the 2nd ($p = .003$), 3rd ($p = .002$) and 4th ($p < .001$) year students. First-year students scored higher on the *Clear goals and standards* compared to 2nd ($p = .006$) and 4th ($p < .001$) year students. *Appropriate workload* variables of the 4th year students were statistically significantly lower compared to those of the 1st ($p = .022$), 2nd ($p = .008$) and 3rd ($p = .009$) year students. *Autonomy* was higher of the 1st year students compared to that of the 3rd ($p = .002$) and the 4th ($p = .001$) year students.

Variables	Current year level								*F*	*p*
	1st year (*n*=216)		2nd year (*n*=230)		3rd year (*n*=189)		4th year (*n*=149)			
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.		
Quality of teaching	29.70	31.27	17.98	36.60	17.15	37.63	9.35	34.45	10.642	.001
Clear goals and standards	22.55	26.83	13.15	32.53	15.83	31.35	8.30	29.59	7.197	.001
Appropriate workload	4.62	33.79	5.61	35.17	6.02	36.27	-5.97	32.92	4.387	.005
Appropriate assessment	2.26	29.28	1.79	34.64	3.77	30.04	3.02	29.77	.157	.925
Autonomy	16.51	28.99	11.00	31.25	5.93	28.88	4.35	29.42	6.502	.001

Table 3: Physical education students' satisfaction with study indicators by the year of study (source: own calculation)

Relationships between academic motivation, satisfaction with study and self-efficacy

As Table 4 illustrates, the IM and EM variables were correlated positively statistically significantly (r ranged between.309 and.741; $p < .01$), and correlations among *Amotivation* and other AMS variables were significantly adverse (r ranged between -.077($p < .05$) and -332; ($p < .01$)). The relationship was not statistically significant between *Amotivation* and *IM-experience stimulation.* Students' SE scores were directly significantly associated with all IM and EM subscales and inversely related to *Amotivation*.

Examining the correlations among the variables of SS, we can see (Table 4) that *Quality of teaching* is more strongly related to *Clear goals and standards* ($r = .602$; $p < .01$) and *Autonomy* ($r = .549$; $p < .01$) compared to *Appropriate assessment* and *Appropriate workload* variables. *Quality of teaching, Clear goals and standards* and *Autonomy* variables showed a weak direct statistically significant relationship with all IM and EM variables and a very weak correlation with SE. The interrelationships between derived variables of autonomous and controlled AcM as well as overall SS suggest that SS was more strongly associated with autonomous than with controlled AcM.SE were also more strongly positively related to autonomous than controlled AcM. A very weak statistically significant positive relationship was found among SE and SS variables.

DISCUSSION

The study aimed at revealing how studies helped the formation of PI of prospective PE teachers and explaining how students' perceived academic environment in different periods of studies was related to their decisions about their chosen profession. The results of the study can provide a better understanding of how the main academic and career interests of prospective PE teachers developed in the early stages of professional growth, how personal and contextual factors interact while seeking academic and career success, and how prospective teachers construct and redesign their PIs.

SCCT identifies the person's SE as one of the three important components of career development, so in the study we hypothesized that the person's SE positively contributes to changes in AcM, which also affects the person's PI. Research has shown that students' SE does not change during the study period, although some researchers (Bümen and Özaydin, 2013; Chan, 2008) established changes in SE during the study period. Such contradictory results demonstrate the importance of further research in this area. Nonetheless, SE beliefs are not intentions to behave or intentions to attain a particular goal. A SE belief is the belief that you can perform the behaviour or behaviours that produce the outcome (Maddux, 2017). Like Nickel and Zimmer (2018), we established sufficiently high SE scores for freshmen that did not change substantially during the study period. This allows us to assume about the career adaptability of prospective PE teachers (McLennan, Perera and McIlveen, 2017) so that they will be able to overcome emerging difficulties, better adapt when starting work at school and stay longer in their careers.

Still, according to SCCT, SE is seen as complementing, not substituting for, ability. SCCT does not assume that SE will compensate for inadequate task ability (Lent, 2013). It does, however, predict that the performance of individuals at the same ability level will be facilitated by stronger versus weaker SE beliefs. Van Rooij, Fokkens-Bruinsma and Goedhart (2019) found that highly self-efficacious students were more committed to the teaching profession, perceived a lower workload and less stress. However, a large overestimation

Variables	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. IM – know	.613**	.741**	.670**	.531**	.513**	-.323**	.892**	.567**	.387**	.294**	.121**	.066	.271**	.359**	.370**
2. IM – toward accomplishment	-	.566**	.604**	.638**	.544**	-.141**	.803**	.362**	.402**	.319**	.054	.057	.298**	.292**	.328**
3. IM – experience stimulation		-	.455**	.355**	.309**	-.037	.860**	.645**	.290**	.229**	.096**	.056	.262**	.354**	.232**
4. EM – identified			-	.584**	.653**	-.332**	.805**	.670**	.395**	.304**	.050	.099**	.310**	.362**	.264**
5. EM – introjected				-	.696**	-.077*	.621**	.930**	.295**	.208**	.024	.053	.245**	.258**	.244**
6. EM –external regulation					-	-.155**	.594**	.911**	.261**	.210**	-.009	.045	.206**	.222**	.199**
7. Amotivation						-	-.240**	-.124**	-.134**	-.094**	-.032	-.014	-.060	-.106**	-.142**
8. Autonomous motivation							-	.660**	.436**	.339**	.096**	.083*	.340**	.406**	.352**
9. Controlled motivation								-	.303**	.227**	.009	.053	.246**	.261**	.242**
10. Quality of teaching									-	.602**	.150**	-.028	.549**	.723**	.190**
11. Clear goals and standards										-	.183**	.067	.453**	.715**	.151**
12. Appropriate workload											-	.290**	.226**	.594**	.005
13. Appropriate assessment												-	.105**	.439**	-.022
14. Autonomy													-	.720**	.104**
15. Satisfaction with study														-	.135**
16. Self-efficacy															-

*IM- intrinsic motivation; EM – extrinsic motivation; * - p <.05; ** - p <.01*

Table 4: Pearson's correlations between all variables included in the study (source: own calculation)

of SE may be self-defeating because without a realistic evaluation of their abilities, students can set unrealistically high performance goals, which can lead to failure, loss of confidence and optimism, and cause motivational problems.

SE beliefs encourage motivation in several ways: they determine the goals people set for themselves, how much effort they expend, how long they persevere in the face of the difficulties, and their resilience to failures (Bandura, 1997). We found that IM and EM increase with increasing SE, indicating that these factors interact with each other. Thus, our data coincide with the findings of Chowdhury and Shahabuddin (2007) that SE is associated with both intrinsic and extrinsic AcM in students. Williams and Rhodes' (2016) founded that perceived SE and the satisfied need for competence are favourable factors for IM. Weak and moderate relationships between all IM and EM variables in our research suggest that students' intrinsic and extrinsic AcM do not conflict. These findings are consistent with previous researchers (Chowdhury and Shahabuddin, 2007; Duchatelet and Donche, 2019; Wilkesmann, Fischer and Virgilito, 2012). In addition, as shown in Chowdhury and Shahabuddin (2007), motivation and SE affect students' academic achievement, and students with the highest academic achievement have high SE and high IM and EM scores.

The involvement of individuals, their efforts and perseverance as well as their ultimate success are partly determined by both their beliefs about SE and the expectations of the outcomes (Lent, 2013). Our study showed that the year of study did not affect changes in students' intrinsic AcM, but it affected extrinsic AcM: the fourth-year students' EM, except for EM – introjected, decreased significantly compared to that of the first-year students. Sivrikaya (2019) also found that prospective PE teachers' internal AcM did not change during the study period, but some authors (Arslantas, 2021; Brouse et al, 2010; Hakan and Münire, 2014) established decreased fourth-year students' indicators of both IM and EM compared to the ones of the first-year students. However, EM-identified indicators are particularly important when analysing students' professional expectations, as they directly reflect how students perceive the value of higher education for their vocational choice. The type of identified motivation is particularly related to perseverance and future intentions (Howard et al, 2021). Our determined high EM-identified indices throughout the study period show that students' behaviours are internalized, which indicates their determination to pursue a professional career and satisfaction with their chosen career. The more internalized motivation, the more it becomes part of the learner's identity (Ryan and Deci, 2020).

According to SCCT, the goals set are strongly related to both the expectations of SE and the expectations of the outcome as people tend to set goals that are in line with their attitudes towards their personal abilities and the results they expect to achieve through certain activities (Lent, 2013). The IM-identified rates of our students were high, but this indicator decreased statistically significantly in the fourth-year students compared to the first-year students. This may have been influenced by the experience gained during the studies, which allows students to better assess their expectations about the future profession and their readiness just after entering higher education institutions. After starting their studies, prospective PE teachers build on their school experience of teaching and developed understanding of the work as a teacher, and for this reason, we observe links between their previous PE experience and the pedagogy they would like to implement (Davis, 2020; González-Calvo et al, 2021; Matanin and Collier, 2003). However, Barber et al (2020) showed that non-competitive, inclusive pedagogical approaches during the study period can have a positive effect on the self-confidence and competence growth of prospective PE teachers and help them review their previous experiences from new perspectives, which may prevent them from applying their negative experiences in teaching PE. Thus, upon graduation, students gain more knowledge about the future profession, and while practicing at school, they come across different practices and situations that may affect the change of their expectations and visions of themselves as a teacher.

It should be noted that the university where the teaching and academic environment start developing PI, provides the first contact with the professional field of PE. The study period, as a process of learning to teach, is very important because it is a time when teachers construct personal images of being a teacher, which are fundamental notions in PI (Castañeda, 2011; Tomlinson and Jackson, 2021). Teacher learning refers not only to subject content, pedagogical strategies or teaching and learning theories, but also to the process of identity formation (Schaafer and Clandinin, 2019). It is clear that teachers' PI develops at different stages of training, from the first steps, through their first experiences with the real practice in their placement periods and afterwards **(**Pérez Gracia, Serrano Rodríguez and Pontes Pedrajas, 2022). While researching how prospective teachers at the beginning of their careers imagined their identity as teachers and what they expected to become, Beltman et al. (2015) found that at the beginning of their studies, students positioned themselves as positive, confident, capable, and happy would be teachers. According to the researchers, first-year students seemed to be able to control their environment and there was no hint that in reality they may have to work in contexts where there will be differences between their own beliefs and the desired teaching realities. Thus, the available experience does not yet allow the first-year students to predict that tensions may arise between their personal and PI (Leeferink et al, 2019). Nickel and Zimmer (2018) also indicated that first-year students idealized portraits of the teachers they aspired to be, and the move from 'ideal self' to 'actual self' occurred primarily during the practicum experience. König et al (2016), studying preservice teachers in Austria, Germany, and Switzerland, found that students' intrinsic motivation to teach decreased during the first two years of study, and this was influenced by the opportunity to learn at school. Pérez Gracia, Serrano Rodríguez and Pontes Pedrajas (2022) meta-analysis has shown that researchers emphasize the need to pay more attention to the context of PI development, as well as mentoring relationships, since these factors give prospective teachers a more realistic approach that strengthens their self-esteem and decreases possible tensions in their future practices.

Research by Herold and Waring (2011) has shown that

prospective PE teachers' perceptions of their role change during their studies. When examining changes in Irish teachers' expectations of themselves as teachers, changes in teaching and learning over three years of study, Horgan and Gardiner-Hyland (2019) found that understanding of the role of the teacher, the value of reflective practice, different learners' needs and attitudes towards pedagogy were expanding.

Our research data confirmed the fact that students were constantly rethinking their professional choice. Although we found low indicators of first-year students' amotivation, which coincides with the data of other researchers (Arslantas, 2021; Hakan and Münire, 2014; Sivrikaya, 2019; Spittle, Jackson and Casey, 2009), amotivation increases significantly in the second year, it also increases in the third year, and remains similar in the fourth year. This change in amotivation may be related to unsatisfactory or different expectations and more experience gained. A higher level of amotivation in the third year compared to the first year was also determined by other researchers who studied prospective PE teachers (Spittle, Jackson and Casey, 2009; Spittle, and Spittle, 2014). Thus, this is in line with the SCCT theory maintaining that when a profession is chosen, it is subsequently "reviewed" and considered, as both the individual and the environment are dynamic and new professional alternatives, barriers, or difficulties may arise and individual priorities and values may change (Lent, 2013; Urbanavičiūtė, 2009). The direction these reviews may take – whether the commitment to the profession will strengthen or worsen, and PI at the same time – depends on both personal and contextual factors (Amaral-Da-Cunha, Batista and Graça, 2014; Castro-Lopez et al, 2022). Researchers analysing higher education students' professional identity formation (Tomlinson and Jackson, 2021) emphasize the importance of developing more general sets of identities related to professional life in general, and suggest the use of wider sets of resources, mainly related to social and cultural capital, to strengthen PI in higher education institutions In their view, this is beneficial because it engages students in early forms of professional socialization that can prepare them for the profession and its various ways of practicing it, and, in addition, it can help them navigate their options and create more dynamic connections with employment life.

In our study, we considered SS to be an important PI indicator. Stronger emotional commitment to the profession is more characteristic of those students who are satisfied with their choice and possible career, perceive their professional choice as suitable for them and consider themselves able to make successful career decisions (Casanova et al, 2021; Conklin, Dahling and Garcia, 2013). Our research shows that students' SS changes during the study period. It was found that the indicators of all SS variables in the fourth year, except for *Appropriate assessment*, were statistically significantly lower than the indicators of first-year students. This may be due to the fact that the expectations of students were not met, which may be caused not only by the unsatisfactory academic environment, the quality of studies, but also by the gained experience, which changes their perception of studies and the future profession.

Positive significant relationships between SS as an indicator of emotional PI and autonomous motivation and very weak significant relationships with students' SE show that the academic environment perceived by students as favourable may strengthen their PI. The statistically significant interrelationships between *Quality of teaching, Clear goals and standards,* and *Autonomy* and all IM and EM variables confirm the importance of the university teacher's role and for students' decision to pursue a teacher's professional career. Students' perceptions of the quality of their studies may have an increased likelihood of prospective PE teachers remaining in the profession after entering the profession, as there is a direct link between beginning teachers' perceptions of the quality of teacher education and their intention to remain in the first year of their professional activities *(*Kelly et al, 2019). Although the benefits of university study to employment is recognized by different generations, it is important for higher education institutions to focus on the expectations of different generations and the necessity of continuous development and implementation of improvements based on the changing preferences of generations (Šnýdrová, Depoo and Šnýdrová, 2021). However, people are most likely to develop interest in professional activities where they both feel efficacious and from which they expect positive outcomes (Lent, 2013). Therefore, in order to increase the PI of prospective PE teachers, it is very important that the university teacher helped to develop the interests of students and created a supportive environment in which they could feel competent and effective. It is then likely that the interests of students might turn into goals. SCCT maintains that goals are strongly related to SE and outcome expectations. This means that prospective PE teachers will be inclined to set goals that match their approach to their personal abilities and the results they hope to achieve through their studies.

Study limitations and future research directions

This study was not without limitations. One is that, although statistically significant relationships have been identified between many variables, they do not provide evidence of causality, thus explanations for the results may not be what they appear. Another limitation of the research would be that the research data and conclusions cannot be generalized to PE teachers trained in other social contexts, as well as to teachers of other fields of study or other subjects. Teacher identity development is a very personal journey and will not be the same for every prospective teacher (Hahl and Mikulec, 2018; Arvaja, 2016), therefore, in order to understand the PI transformations of prospective PE teachers during the study period and the interaction of personal and contextual factors in the development of PI, the study should be expanded to include more variables as well as a combination of quantitative and qualitative approaches to research. Further research could include a broader context explaining how interactions with members of the vocational learning community, i.e., other students studying together, and their sense of identity help them form PI during their studies.

Despite these limitations, research findings may provide an incentive to conduct research in other contexts. In addition, the findings of the study may be useful from a practical point of view and for further research.

CONCLUSIONS AND IMPLICATIONS

PI is a complex construct which has a double dimension – individual component and collective component; it is dynamic and is constantly being constructed and reconstructed. Research literature usually deals with the PI of teachers, but rarely with the PI of prospective teachers, including prospective PE teachers. In addition, the study of PIs often focuses on the components of SE and motivation, rarely focusing on SS as an emotional component of PIs, which is very important because identity is the product of the individual's interaction with the social context, their interaction with peers and their interpretation of these experiences. Therefore, our study based on SSCT, analysing PI variables such as SE, AcM and SS, and revealing the dynamics of these variables during the study period as well as their interrelationships, expands the existing knowledge about the formation of physical education teachers' PIs in the first period of their professional careers – at university. Besides, this research expands the concept of how the academic environment helps to form the professional interests and professional goals of would-be PE teachers.

The fact that the study period did not affect the change in students' SE expectations and intrinsic AcM may mean that these PI indicators, if they are at a certain level, are less affected by contextual factors, i.e., factors in the study environment, but this requires further research. However, the students' identified motivation, which directly reflected their perceived value of studies for their professional choice, changed, and in the fourth year it was significantly lower than in the first year. This may also be related to the experience gained, the independent pedagogical internship practice in the last year of study, when students could feel the reality of professional activity and the aspects that may not have met their expectations that they had just entering the teacher training programs. The development of PI in Lithuania's prospective PE teachers may have been influenced by the fact that a large proportion of students had already started their work activities in the first year, which was often related to the sports sector, and about two-thirds of students had work experience in the final year of study. From a practical point of view, research data can stimulate teacher educators to facilitate students' preparation for a teaching career, help them identify their career goals as early as possible, and form PI to become effective teachers. The interrelationships of the analysed PI variables show that the quality of teaching, the formulation of clear goals, and the maintenance of autonomy are essential components of the academic environment to strengthen the commitment of prospective PE teachers to the chosen profession, which increases their identification with the profession. Thus, in order to strengthen PI, student SS is important, encompassing the well-being and enjoyment that students experience in the academic process. However, it is important for university administrators where teachers are trained to understand that teacher identity development is dynamic and requires the constant input of all those involved in the process of becoming a teacher, not just teachers. The results of the study may encourage PE teacher educators' deeper analysis of the ongoing feedback on student SS as an emotional PI indicator.

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Full research paper

EMPLOYEE TRAINING AND DEVELOPMENT AND COMPETENCY-BASED APPROACH: ANY RELATIONSHIP?

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ABSTRACT

The article focuses on the relationship between the use of employee training and development and the competency-based approach. The objective of this article is to evaluate the use of the competency-based approach in employee training and development in organisations in the Czech Republic based on long-term research (n = 1,360) since the year 2013. The results showed that the competency-based approach in the management of organisations is utilized by only 21.8% of the organisations. An important finding is that 93.2% of organisations using the competency-based approach support employee training and development. The results confirmed that there is the relationship between the use of the competency-based approach and training and development in the organisation ($p < 0.001$, Cramer's $V = 0.178$) and also between the use of the competency-based approach and evaluation of training and development efficiency in the organisation ($p < 0.001$, Cramer's $V = 0.299$).

KEYWORDS

Competencies, competency-based approach, efficiency, employee training and development, job performance

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Highlights

- *The quantitative survey involving 1,360 organisations over a time horizon of more than 5 years.*
- *There is a relationship between training and development and the competency-based approach in organisations ($p < 0.001$, Cramer's $V = 0.178$).*
- *There is also a relationship between the evaluation of the training and development efficiency the competency-based approach in organisations.*
- *Organisations using the competency-based approach support employee training and development.*

INTRODUCTION

In the current dynamic business environment, an organisation's management must be aware of the importance of the training and development of its employees. Employee competencies thus play a key role in the strategic development of organisations. According to Mitchelmore and Rowley (2010), the concept of competency has many forms and applications. Research in the field of competencies and practical experience in organisations is driven by the aspiration to achieve superior performance at the individual and organisational levels. In the field of management, competencies essentially have two main meanings, from which the individual definitions of competencies are further based. The first characterises competencies as power and scope of authority relating to a particular person or body. In the second sense, competencies represent qualifications.

The concept of competencies in the second sense was first introduced by White (1959) when he emphasised the influence of competencies on motivation and performance in his work. McClelland (1973) then raised the question of why intelligence tests should be so important in selecting candidates for university or employment and considered the importance of competence testing. Later, Boyatzis (1982) emphasised the difference between a task that needs to be accomplished and the skills and other qualities that a person must have to accomplish it to the required standard. That is, he made a distinction between what is to be done (the intended result of activity) and which actions are required to complete the task excellently (Kubeš et al., 2004). It means, according to Boyatzis (1982), effective and/or superior job performance.

Based on the work of McClelland (1973) and other

colleagues, Spencer and Spencer (1993) summarised the knowledge in the field of competence over 20 years to clarify the development of this issue, which led to a shift in the perception of the concept of competence not only in terms of content but also formally. That is a move from the English word 'competence' to the introduction and definition of the term 'competency'. The importance of distinguishing between these two terms is confirmed, for example, by Woodruffe (1993), who emphasised the significant difference between the aspects of work in which a person is competent (competence) and the aspects of a person that allow them to be competent, i.e., competency. According to Teodorescu (2006), there are many differences and several similar features between the two terms in their definitions, areas of focus, and application. In order the organisation can support, train, and develop the right competencies of employees, first, the organisation has to define competences for each job position (Teodorescu, 2006). Sanghi (2016) saw the main difference in the fact that in one concept, we focus on what people can do, while in the other how they do it. Sanghi (2016) added that even in the plural of each word they do not have the same meaning – competences and competencies are not the same.

In this context, Moore et al. (2002) pointed out many confusions within the area of performance assessment about using terminology and differing interpretations regarding competence assessment. But, although the authors define competencies and their components differently, a closer examination involves different definitions with small differences, the common denomination is observable behaviour in the workplace (Sanghi, 2016). Distinguishing between the way you work, and the results allows you to manage performance much more effectively.

Competencies are closely linked to human resource management. In his work, Boyatzis (1982) addressed the idea that competencies can be used as a basis for the development of an integrated human resources management system. In the global competitive environment, the competency-based approach and the competencies that individuals need to acquire and develop should be the major focus (Lawler, 1994). The main feature of the competency-based approach in human resource management is the transition from staff-related operational issues to higher strategic importance tasks (Tymoshyk, 2020). According to Armstrong and Taylor (2014), this approach has a positive impact on personnel processes, especially those related to recruitment, training and development, performance management, remuneration, and succession planning (Wesselink et al., 2015). In the age of globalisation, human resource competencies are becoming essential for organisations (Serim et al., 2014). Competencies connect most human resource subsystems (Ashkezari and Mojtaba, 2012).

Competency-based training has become widely used terminology since the turn of the twenty-first century (Cate, 2017), although this approach is not new. According to Emerson and Berge (2018), competency-based training and development is an innovative approach and an asset to organisations focused on improving the performance of their employees and offering a more efficient way of training and development (Fejfarová and Fejfar, 2016). The competency-based approach to training and development emphasizes the specification and assessment of outcomes (competencies). This focus on outcomes is often contrasted with more traditional training and development programs (Bowden and Masters, 1993).

This article focuses on the use of the competency-based approach in employee training and development. The main objective of this article is to evaluate the use of the competency-based approach in employee training and development in organisations in the Czech Republic based on long-term research and to examine relationships between selected qualitative variables to verify the conclusions made. The article is structured as follows: First, the summary of the theoretical background is presented in the Introduction. The section Materials and Methods describes the research methods and statistical techniques. The gathered findings are evaluated in the Results. The results achieved and presented are then elaborated on and compared in the Discussion. This part also identifies the benefits and limitations of the article. The section Conclusion summarises the main findings. The section References contain a list of used sources.

MATERIALS AND METHODS

Data

The data were obtained through a questionnaire survey. First, preliminary research was carried out, which served to verify the accuracy and comprehensibility of individual questions, evaluate the appropriate categorisation of answers, and the ability verify partial null hypotheses and the technical processability of data. Research focusing on the use of the competency-based approach in organisations in the Czech Republic was conducted for a period of more than five years starting in 2013 and partial results were presented continuously (Fejfarová and Urbancová, 2015; Fejfarová and Fejfar; 2016; Fejfarová and Fejfar, 2017). The sample consisted of organisations operating in the Czech Republic. 1,477 selected organisations participated in the questionnaire survey. To enhance the quality of the questionnaire survey, it was required for the questionnaire to be completed by an HR specialist or an owner of the given organisation. As the survey lasted more than five years and some organisations participated repeatedly, it was necessary to cleanse the sample of duplicate data. Thus, adjusted, the final sample encompassed 1,360 organisations. The structure of the sample is shown in Table 1.

Research questions and hypotheses

We thought about the relationship between using employee training and development and the competency-based approach and formulated the following research questions:

- RQ1: Is there any relationship between employee training and development and the use of the competency-based approach in organisations?
- RQ2: Is there any relationship between employee training and development and the use of the competency-based approach in organisations?

Size of the organisation	1–49 employees	50–249 employees	More than 250 employees
	(607) 44.6%	(369) 27.2%	(384) 28.2%
Belonging to a larger group of organisations	Yes		No
	(623) 45.8%		(737) 54.2%
Area operated	Private		Public
	(1030) 75.7%		(330) 24.3%
Economic sector	Primary	Secondary	Tertiary
	(49) 3.6%	(382) 28.1%	(929) 68.3%
Size of the market	International	National	Regional
	(538) 39.6%	(332) 24.4%	(490) 36%
Use of the competency-based approach	Yes		No
	(296) 21.8%		(1,064) 78.2%

Table 1: Structure of the sample, 2013-2021 (source: own survey)

After clarification of the key-dependent and independent variables, we formulated 2 null hypotheses:

- H_{01}: There is no relationship between employee training and development and the use of the competency-based approach in organisations.
- H_{02}: There is no relationship between the evaluation of the employee training and development efficiency and the use of the competency-based approach in organisations.

The data have been processed using absolute and relative frequencies using IBM SPSS Statistics 26. The testing was done by Pearson's Chi-Square Test of Independence. The level of significance was set at 0.05. To interpret the strength of relationship coefficients (Cramer's *V*), a scale according to de Vaus (2014) was used. To identify a relationship between two initial variables (*X* and *Y*), it was necessary to identify another variable that might account for the relationship and conduct the analysis to see if this other (test) variable (*Z*) does explain the initial bivariate relationship (de Vaus, 2014). The testing of the test variable is based on maintaining it at a constant value. This compensates for the distorting effect of this test variable on the relationship between the initial two variables.

RESULTS

Use of the competency-based approach in organisations

The results of the survey showed that the competency-based approach in the management of organisations is utilised by only 21.8% of the organisations in question. The competency-based approach is most often utilised by large organisations (36.7% from addressed large organisations), followed by medium-sized organisations (20.1% from addressed medium-sized organisations), and the least by small organisations (13.3% from addressed small organisations).

Organisations utilising the competency-based approach do so mainly in the following areas: employee appraisal (224 organisations; 75.7%), employee training and development (209 organisations; 70.6%), employee selection (189 organisations; 63.9%), recruitment (160 organisations; 54.1%), job analysis (128 organisations; 43.2%), career planning and management (95 organisations; 32.1%), and team building (92 organisations; 31.1%). The results of the survey show that organisations do not utilise the competency-based approach in all areas equally. When searching for and selecting employees, and in their evaluation, training and development, it is always necessary to proceed from the established competency model for a given position. Although the key areas of use include the search for and selection of employees, and their evaluation, training and development, i.e., personnel activities that usually precede the management of employees' careers, organisations do not make much use of the competency-based approach in the field of career management.

The above results confirm the importance of using the competency-based approach in employee evaluation, training and development. In this sense, it is the use of individual competencies, which are defined as the individual characteristics necessary to achieve the required level of employee performance. The use of the competency-based approach in employee training and development is important, especially because it facilitates the correct definition of the content of employee training and development in accordance with the competencies that need to be applied in their jobs. Every job position requires that the employee has individual competencies that have been developed to the required level. The development of competencies then focuses on reducing and evening out the differences between the real and ideal state. For this reason, it is important to identify which competencies are to be developed in relation to the employee's specific position, i.e., respond to a specific need for training and development. Therefore, we further focused on employee training and development in organisations using the competency-based approach.

Employee training and development in organisations using the competency-based approach

The results of the survey showed that 93.2% of organisations using the competency-based approach support employee training and development. For comparison, the results from the original sample (n = 1,360; 79.7%) are presented. That means that we compared two samples – the sample of organisations using the competency-based approach (n = 296) and the sample of all organisations (n = 1,360). The results are shown in Table 2. For this reason, the relationships between selected variables were examined, i.e., training and development of employees and use of the competency-based approach in the organisation (H_{01}) and the evaluation of the training and development efficiency and use of the competency-based approach in the organisation (H_{02}).

			Training and development		Total
			Yes	No	
Use of the competency-based approach in the organisation	Yes	Count	276	20	296
		% within Use of the competency-based approach in the organisation	93.2%	6.8%	100%
	No	Count	808	256	1,064
		% within Use of the competency-based approach in the organisation	75.9%	24.1%	100%
Total		Count	1,084	276	1,360
		% within Use of the competency-based approach in the organisation	79.7%	20.3%	100%

Table 2: Contingency table 1, 2013–2021 (source: own survey)

Table 3 shows the results of Pearson's Chi-Square Test of Independence. The null hypothesis (H_{01}) is rejected. The results of the test of H_{01} showed that there is the relationship between the use of the competency-based approach and training and development in the organisation ($p < 0.001$, Cramer's $V = 0.178$). The value of Cramer's V shows that the strength of the relationship is low.

	Value	*df*	Asymptotic Significance (2-sided)
Pearson's Chi-Square	42.864	1	< 0.001
Continuity Correction	41.801	1	< 0.001
Likelihood Ratio	51.538	1	< 0.001
Cramer's *V*	0.178		
N of Valid Cases	1,360		

Table 3: Pearson's Chi-Square Test of Independence for contingency table 1, 2013–2021 (source: own survey)

Although most organisations that utilise the competency-based approach are dedicated to the training and development of their employees (276 from 296 organisations; 93.2%), not all these organisations systematically evaluate the efficiency of employee training and development. Only 65.2% of organisations evaluate the efficiency of training (180 from 276 organisations, 65.2%). For comparison, the results from the original sample of organisations that train and develop their employees (n = 1,084; 40.1%) are again presented. As this is a complimentary issue related to training and development, the sample is smaller because is cleansed from organisations that do not support the training and development of their employees. Training and development efficiency was monitored only in organisations that train and develop their employees. The results are shown in Table 4.

			Evaluation of training and development efficiency		Total
			Yes	No	
Use of the competency-based approach in the organisation	Yes	Count	180	96	276
		% within Use of the competency-based approach in the organisation	65.2%	34.8%	100%
	No	Count	255	553	808
		% within Use of the competency-based approach in the organisation	31.6%	68.4%	100%
Total		Count	435	649	1,084
		% within Use of the competency-based approach in the organisation	40.1%	59.9%	100%

Table 4: Contingency table 2, 2013–2021 (source: own survey)

Table 5 shows the results of Pearson's Chi-Square Test of Independence. The null hypothesis (H_{02}) is rejected. The results of the test of H_{02} showed that there is the relationship between the use of the competency-based approach and the evaluation of training and development efficiency in the organisation ($p < 0.001$, Cramer's $V = 0.299$). The value of Cramer's V shows that the strength of the relationship is moderate.

	Value	*df*	Asymptotic Significance (2-sided)
Pearson's Chi-Square	97.005	1	< 0.001
Continuity Correction	95.609	1	< 0.001
Likelihood Ratio	95.993	1	< 0.001
Cramer's *V*	0.299		
N of Valid Cases	1,084		

Table 5: Pearson's Chi-Square Test of Independence for contingency table 2, 2013–2021 (source: own survey)

Organisations utilising the competency-based approach, and that also evaluate the efficiency of the training process (n = 180), most often evaluate employees' reactions immediately after training, the objectives fulfilment defined by the employee training and development plan, informal feedback from line managers and trained employees themselves, the evidence of the total number of training days per employee, job observation and measurement of job performance before and after training (immediately or after a certain period).

Elaboration analysis

Because both null hypotheses were rejected, there was a suspicion that these results may be affected by another factor - the size of the organisation. That would mean that more interest in employee training and development do not have organisations using the competence-based approach but organisations that are large (according to the number of employees of the organisation with more than 250 employees).

This third variable (size of organisation) can cause concurrent changes in both monitored variables.

The purpose of elaboration analysis is to better understand the relationship between the initial two variables (*X* and *Y*) and to elaborate on what lies behind the correlation of these two variables (de Vaus, 2014). To prove that the observed relationships are true, the third test (control) variable (*Z*) was considered. This test variable might influence the relationship between the initial two variables. Tables 6 and 9 show the modified contingency tables. Row percentages are not stated because of the table scope and clarity. In Tables 7 and 10, it is possible to compare three groups of test results based on Pearson's Chi-Square Test of Independence. The strengths of the relationships are shown in Tables 8 and 11.

Size of the organisation			Training and development		Total
			Yes	No	
1–49 employees	Use of the competency-based approach in the organisation	Yes	67	14	81
		No	346	180	526
	Total		413	194	607
50–249 employees	Use of the competency-based approach in the organisation	Yes	71	3	74
		No	239	56	295
	Total		310	59	369
More than 250 employees	Use of the competency-based approach in the organisation	Yes	138	3	141
		No	223	20	243
	Total		361	23	384
Total	Use of the competency-based approach in the organisation	Yes	276	20	296
		No	808	256	1,064
	Total		1,084	276	1,360

Table 6: Modified contingency table 1, 2013–2021 (source: own survey)

Size of the organisation		Value	*df*	Asymptotic Significance (2-sided)
1–49 employees	Pearson's Chi-Square	9.259	1	0.002
	Continuity Correction	8.496	1	0.004
	Likelihood Ratio	10.182	1	0.001
	N of Valid Cases	607		
50–249 employees	Pearson's Chi-Square	9.816	1	0.002
	Continuity Correction	8.736	1	0.003
	Likelihood Ratio	12.508	1	< 0.001
	N of Valid Cases	369		
More than 250 employees	Pearson's Chi-Square	5.902	1	0.015
	Continuity Correction	4.868	1	0.027
	Likelihood Ratio	6.854	1	0.009
	N of Valid Cases	384		
Total	Pearson's Chi-Square	42.864	1	< 0.001
	Continuity Correction	41.801	1	< 0.001
	Likelihood Ratio	51.538	1	< 0.001
	N of Valid Cases	1,360		

Table 7: Pearson's Chi-Square Test of Independence for modified contingency table 1, 2013–2021 (source: own survey)

In Table 7, three groups of Pearson's Chi-Square test results are compared. The results obtained are still convincing because the null hypothesis (H_{01}) is rejected in all three groups at the 5% level of significance. The dependency rates are shown in Table 8. The Cramer's *V* value in the Total category matches the value stated in Table 3.

In Table 10, three groups of Pearson's Chi-Square test results are also compared. The results obtained are still convincing because the null hypothesis (H_{02}) is rejected in all three groups at the 5% level of significance. The dependency rates are shown in Table 11. The Cramer's *V* value in the Total category matches the value stated in Table 5.

Size of the organisation			Value	Approximate Significance
1–49 employees	Nominal by Nominal	Cramer's *V*	0.124	0.002
	N of Valid Cases		607	
50–249 employees	Nominal by Nominal	Cramer's *V*	0.163	0.002
	N of Valid Cases		369	
More than 250 employees	Nominal by Nominal	Cramer's *V*	0.124	0.015
	N of Valid Cases		384	
Total	Nominal by Nominal	Cramer's *V*	0.178	< 0.001
	N of Valid Cases		1,360	

Table 8: The strengths of the relationships for modified contingency table 1, 2013–2021 (source: own survey)

Size of the organisation			Evaluation of training and development efficiency		Total
			Yes	No	
1–49 employees	Use of the competency-based approach in the organisation	Yes	39	28	67
		No	65	281	346
	Total		104	309	413
50–249 employees	Use of the competency-based approach in the organisation	Yes	41	30	71
		No	75	164	239
	Total		116	194	310
More than 250 employees	Use of the competency-based approach in the organisation	Yes	100	38	138
		No	115	108	223
	Total		215	146	361
Total	Use of the competency-based approach in the organisation	Yes	180	96	276
		No	255	553	808
	Total		435	649	1,084

Table 9: Modified contingency table 2, 2013–2021 (source: own survey)

Size of the organisation		Value	*df*	Asymptotic Significance (2-sided)
1–49 employees	Pearson's Chi-Square	46.303	1	< 0.001
	Continuity Correction	44.234	1	< 0.001
	Likelihood Ratio	40.752	1	< 0.001
	N of Valid Cases	413		
50–249 employees	Pearson's Chi-Square	16.249	1	< 0.001
	Continuity Correction	15.143	1	< 0.001
	Likelihood Ratio	15.827	1	< 0.001
	N of Valid Cases	310		
More than 250 employees	Pearson's Chi-Square	15.451	1	< 0.001
	Continuity Correction	14.596	1	< 0.001
	Likelihood Ratio	15.827	1	< 0.001
	N of Valid Cases	361		
Total	Pearson's Chi-Square	97.005	1	< 0.001
	Continuity Correction	95.609	1	< 0.001
	Likelihood Ratio	95.993	1	< 0.001
	N of Valid Cases	1,084		

Table 10: Pearson's Chi-Square Test of Independence for modified contingency table 2, 2013–2020 (source: own survey)

Size of the organisation			Value	Approximate Significance
1–49 employees	Nominal by Nominal	Cramer's *V*	0.335	< 0.001
	N of Valid Cases		413	
50–249 employees	Nominal by Nominal	Cramer's *V*	0.229	< 0.001
	N of Valid Cases		310	
More than 250 employees	Nominal by Nominal	Cramer's *V*	0.207	< 0.001
	N of Valid Cases		361	
Total	Nominal by Nominal	Cramer's *V*	0.299	< 0.001
	N of Valid Cases		1,084	

Table 11: The strengths of the relationships for modified contingency table 2, 2013–2021 (source: own survey)

A more detailed elaboration analysis, made possible by the classification of the third-tier data, showed that all the conclusions drawn about the relationship between the initial two variables were true. If the relationships shown in all the conditional coefficients are like the zero-order relationship (*X* and *Y*), it is possible to confirm that the initial relationship is not due to the influence of the test variable (*Z*). Some correlations are a little bit weaker or stronger than the initial correlations of 0.178 and 0.299, but the drop/increase in correlations is small. Therefore, we should regard the conditionals as being the same as the zero-order (de Vaus, 2002).

DISCUSSION

Competencies are among the factors that influence employees' performance (Nguyen et al., 2020) and generate the value for achieving the competitive advantage (Fenech et al., 2019). Nowadays, employees must have high competencies which are able to respond to the business environment changes to improve their performance (Sabuhari et al., 2020). Therefore, organisations are constantly developing innovative and effective means to engage the employees to feel committed to the organisation and stay motivated during this tough time of the COVID-19 pandemic (Chanana and Sangeeta, 2021). Leadership must be created by leaders with high competencies who can overcome challenges and take advantage of new opportunities to achieve competitive advantage and adopt change (Talu and Nazarov, 2020).

The quality of knowledge is more important than quantity, and for this, it is critical to cultivate the skills of employees and further develop their competencies (Ghezir et al., 2021). Competency-based training and development can thus be understood as a whole lifetime process (Cejas Martínez et al., 2019). Brightwell and Grant (2013) emphasize that competency-based training and development describe progression through the demonstrated ability to perform certain tasks. Although the identification of competencies is important for companies (Berková and Holečková, 2022), the competency-based approach is still considered an emerging practice (Quesnay et al., 2021). Therefore, the evolution from competency-based training and development to competency-based practice is inevitable (Cate and Carraccio, 2019).

The survey showed that the competency-based approach is used only by every fifth organisation in the sample, which is even less than stated by the survey HR Monitor® Červenková (2016), according to which competency models are used in every third organisation. In this case, however, the sample consisted of only 300 organisations. The results of the survey also showed that the four main areas in which competencies are used in organisations are employee appraisal (75.7%), employee training and development (70.6%), employee selection (63.9%) and recruitment (54.1%), which follows the conclusions presented by Armstrong (2009). However, the percentages in particular categories are slightly different.

Statuary and mandatory training are insufficient for the improvement of labour efficiency and business performance and therefore, managers have to pay particular attention to employees' personal development, engagement and motivation. The competency-based approach formulates objectives in a way that leads to the improvement of business performance by achieving better results, changing employee behaviour, increasing productivity and efficiency of the organisation (Tymoshyk. 2020). The use of the competency-based approach in employee training and development facilitates the correct definition of the content of employee training and development in accordance with the competencies that need to be applied in their jobs. Competencies are measurable outcomes of training, assessed in the workplace as knowledge, skills, attitudes, and behaviours, which allow evaluating work performance in a transparent and reproducible manner (The CoBaTrICE Collaboration, 2006). The training and development of employees benefit an organisation in many ways - it expands the work potential of employees, and thus the possibilities for the dynamic development of both work teams and, ultimately, the organisation as a whole.

Bowden and Masters (1993) state that the competency-based approach to training and development reduces the period necessary for learning the demands of the practice of the workplace. However, to achieve this effect, the organisations' training and development programs must have a clear concept about anticipated future changes. At the same time, it is necessary to continuously evaluate the benefits of training and development programs (even if it is a complex issue - suitable criteria are the competencies of the employee (achievement of a higher level of competencies) and the subsequent improvement of work performance). The training and development courses must match the performance objectives and meet the identified training needs (Schultz et al., 2012). Training service quality is strategically crucial due to its ability in establishing satisfaction, trust, and motivation of employees which will impact their achievement during the training process (Budiyanti et al., 2020). Getha-Taylor and Morse (2013) emphasize the importance of a strategic

approach to training. Besides, using core competencies which are internationally applicable but still able to accommodate local requirements. This provides the foundation upon which an international competency-based training and development program can be built (The CoBaTrICE Collaboration, 2006).

The COVID-19 pandemic has led to new ways of working and a renewed focus on employees (Mihalache and Mihalache, 2022). Organisations need to rely on human resource development now more than before, which can further the agenda of human resource development to secure a seat on the strategic table (Dirani et al., 2020). The major strategic human resource management outcomes at the individual level are the involvement, commitment, engagement, and retention of employees; at the organisation level, its outcomes have an impact on the organisation's performance, reputation, and attractiveness (Chams and García-Blandón, 2019).

The results of the survey are limited by the selection of the sample. While the sample is suitable for data mining and allows the evaluation of the use of the competency-based approach in the relevant organisations, the conclusions cannot be generalised to all organisations operating in the Czech Republic (population). Ensuring the representativeness of a sample is a common problem faced not only by researchers, research teams and consulting companies (e.g., Armstrong, 2009; KPMG, 2010; Červenková, 2016, etc.) but also by central state administration bodies. Another problem may be the interpretation of Cramer's *V*. In order not to make subjective conclusions, an established scale (de Vaus, 2014) has been used for interpretation, which is used in several similar studies.

CONCLUSION

In accordance with the resource approach to creating a competitive advantage, it is precisely employees who, thanks to their competencies, become an important source for achieving a competitive advantage. However, the benefit of utilising competencies lies mainly in their application. The use of the competency-based approach thus represents an effective tool for systematic work with human resources within an organisation. Therefore, in our long-term research, we examined the level of human resource management in organisations using the competency-based approach. This article presents the partial results in the field of employee training and development. For this reason, we examined the relationship between using employee training and development and the competency-based approach. Both hypotheses H_{01} and H_{02} were rejected. The results of the Pearson's Chi-Square tests confirmed that organisations that use the competency-based approach place more emphasis on the training and development of their employees than organisations that do not use the competency-based approach. At the same time, in several cases, these organisations systematically evaluate the efficiency of employee training and development.

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OVER THREE DECADES OF DATA ENVELOPMENT ANALYSIS APPLIED TO THE MEASUREMENT OF EFFICIENCY IN HIGHER EDUCATION: A BIBLIOMETRIC ANALYSIS

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ABSTRACT

The higher education efficiency evaluation model using the data envelopment analysis method has interested many researchers. This paper uses bibliometric analysis on publications extracted from the Scopus database to provide a comprehensive overview of research publications on the measurement of higher education efficiency based on data envelopment analysis: its growth rate, major collaboration networks, the most important and popular research topic. A total of 169 related publications were collected and analyzed from 1988 to 2021. The analysis results show that: Publications published every year have increased sharply in the last six years; The quality of publications is relatively high as publications tend to be published in journals with high-ranking indexes; Countries with the most influence in studies on this topic are: Italy, China, Spain, the USA, and the United Kingdom; Authors with the most influence in this research direction are Agasisti T., Abbott M., Doucouliagos C., Avkiran N.K., and Johnes J.; The research cooperation among countries and among affiliations is not strong. Finally, the paper has provided recommendations for future studies based on the findings.

KEYWORDS

Bibliometric, data envelopment analysis, efficiency, higher education, Scopus

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Highlights

- *Research trends using DEA to measure higher education performance have recently received much attention.*
- *The three most influential authors in researching measuring efficiency in higher education using DEA are Agasisti T., Johnes J., and Johnes G.*
- *The main keywords in the research on this field formed in recent years include: efficiency measurement, resource allocation, Malmquist index, performance evaluation, benchmarking, SFA.*

INTRODUCTION

The higher education (HE) sectors of many countries derive part of their income from public funds. Therefore, for the sake of accountability, measuring the efficiency of institutions including this sector is essential (Johnes, 2006). Unlike economic efficiency, which is measured through the combination of several inputs with one output, the higher education sector has characteristics that are difficult to measure its performance: it is a non-profit operation; absence of input and output prices; and higher education institutions generate many outputs from many inputs (Daghbashyan, 2009; Johnes, 2006). Efficiency concepts are frequently found in national education planning documents but without clarification as to whether efficiency is a final goal or a channel to achieve a certain educational objective. When used by economists the term efficiency is mostly context-specific, whereas practitioners affix diverse, conceptually different, uses to the term. In this section the conceptual and definitional issues regarding efficiency in education is presented. The commonly examined types of efficiency in both the public sector and education studies cover both technical and allocative efficiency (Kosor, 2013). McMahon (1983) expands these two concepts to four efficiency concepts in the provision of education: technology, price,

exchange, and allocative efficiency. Technical efficiency examines the time and resources used in the production of a given output (these resources include teaching methods, instructional materials, student's learning activities, over some time period). Price efficiency is an extension of technical efficiency since it takes into consideration the relative costs of resources. Exchange efficiency represents education's ability to meet the needs of other institutions (business, civic and religious organisations), and concerns questions like whether the credentials are valued in the labour market or whether workers are overqualified. Allocative efficiency is attained when there is technical, (factor) price and exchange efficiency, i.e., it represents the maximisation of satisfaction given scarce resources with competing uses (and it allows for a comparison of educational costs with its expected benefits.

Efficiency measures can be divided into four aspects, technical efficiency, allocative efficiency, scale of efficiency and dynamic efficiency. Two methods are mainly used to measure efficiency: Stochastic Frontier Analysis (SFA), and Data Envelopment Analysis (DEA) (Cavaignac and Petiot, 2017). SFA was first introduced by Aigner et al. (1977) and Meeusen and Van den Broeck (1977). It consists of estimating a parametric marginal econometric model. DEA, proposed by Charnes, Cooper and Rhodes in 1978, is a non-parametric method for measuring the production efficiency of Decision-Making Units (Charnes et al., 1978). Its main advantage over SFA is that it does not require any parametric assumptions regarding production frontiers. The contour of the observed input and output levels of DMUs are calculated by the linear programming and can be considered as the best practice frontier. By measuring the gap between a company and the efficient frontier, it is possible to calculate the efficiency of Decision-Making Units (Cavaignac and Petiot, 2017). Various DEA models (two-stage DEA, input/output-oriented DEA, etc.) have been used in materials, and additional statistical inference methods may consolidate the validity of the results (Simar and Wilson, 1998). DEA also has many weaknesses, for example, it gives efficient frontiers that can be quite large (Cooper et al., 2011). Currently, DEA has been widely used in the field of higher education efficiency evaluation, achieving many significant findings. DEA-based higher education efficiency studies have appeared in various academic journals worldwide.

Bibliometrics is an essential branch of information and library science, and it is based on various literature. It provides a quantitative analysis of academic literature (Merigó et al., 2015). Scientific research in bibliometrics has developed recently (Liu, 2019). It can also be used to evaluate the growth of scientific research in a country and understand its current position (Ha et al., 2020; Pham-Duc, Tran, et al., 2020; Pham-Duc, Nguyen, et al., 2020). Many authors have also used bibliometrics as an approach to evaluate higher education efficiency (Abramo et al., 2011; Abramo et al., 2008; Abramo and D'Angelo, 2009; Andersson et al., 2017; Andersson and Sund, 2021; Ferro and D'Elia, 2020; Ibrahim and Fadhli, 2021; Johnes and Johnes, 1992; Mikušová, 2017). Bibliometric analysis of studies using the DEA method of efficiency evaluation has been applied in various fields such as: energy efficiency (Trianni et al., 2018; Yu and He, 2020), trajectories of efficiency measurement (Lampe and Hilgers, 2015), Islamic banking (Rusydiana et al., 2021), transport sector (Cavaignac and Petiot, 2017). Furthermore, in evaluating "efficiency in higher education", there has also been a bibliometric analysis by Ramírez-Gutiérrez et al. (2019) about university rankings disclosure and efficiency in higher education.

In this paper, the author's objective is to do a bibliographic analysis of all scientific publications on the measurement of efficiency in higher education using the DEA method, which has been indexed in the Scopus database recently. We consider scientific articles, conference papers, book chapters, and reviews for analysis. The three objectives are: (a) summarize the general characteristics and trends of scientific publications, the most important source journals, the most productive institutions, and the most productive scholars; (b) analyze the international cooperation between countries in this sector; and (c) to extract the most popular research topics and trends based on word analysis of titles, abstracts, and keywords. After presenting the methodology, in the next section, we will present our main findings and discuss them before concluding the study in the final section.

Five central bibliographic databases can be used to conduct a bibliometric analysis, including Web of Science (WoS), Scopus, Google Scholar, Microsoft Academic, and Dimensions (Moral-Muñoz et al., 2020). Among them, WoS and Scopus are most used for bibliometric analyses. We decided to use the Scopus database as the search engine because it covers a broader range of documents than other databases (Ha et al., 2020; Mongeon and Paul-Hus, 2016; Pham-Duc, Tran, et al., 2020).

METHODOLOGY

This study used a general scientific mapping process consisting of five stages: 1) Study design; 2) Data collection; 3) Data analysis; 4) Data visualization; and 5) Interpretation (Börner et al., 2005; Zupic and Čater, 2015).

In the study design stage, the main research question was: What is the bibliography of research publications indexed in the Scopus database on measuring efficiency in higher education using the Data Envelopment Analysis method? The data collection stage is divided into three sub-stages: data collection, data filtering and data cleaning.

Step 1: Collect data. The authors performed the search from the Scopus database (http://www.scopus.com), with advanced search options for entering search terms and matching operators according to this search engine's syntax. The identified search keyword consists of 3 components: 1) Related to efficiency and efficiency evaluation: efficiency; "measurement efficiency"; performance; "measurement performance". 2) Related to Higher Education: university; "higher education"; "higher public education" and 3) Related to data envelopment analysis: "data envelopment

analysis"; DEA. The author uses the OR and AND operators to combine the keywords accordingly. Such keywords are searched in the document's abstract, keywords, and title.

The data limited to the Document type is article, conference paper, book chapter, and review. The field of study is identified as social sciences, written in English.

```
TITLE-ABS-KEY ((efficiency OR "measurement efficiency" OR performance OR "measurement performance") AND (university OR "higher education" OR "higher public education") AND ("data envelopment analysis" OR dea)) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "cp") OR LIMIT-TO (DOCTYPE, "ch") OR LIMIT-TO (DOCTYPE, "re")) AND (LIMIT-TO (SUBJAREA, "SOCI")) AND (LIMIT-TO (LANGUAGE, "English"))
```

Box 1: Query string in the Scopus database

Data query was performed from the Scopus database on July 05, 2021. As a result, 226 documents were obtained.

Step 2: Filter the data. The author conducted data filtering by censoring titles, abstracts, and keywords to remove documents that are not directly related to the research issue. The number of documents remaining was 169. With these lists, we conducted some initial analysis on the tools provided by Scopus to collect additional information regarding authors, affiliations, and journals.

Metadata of the final publication collection were exported to CSV format for post-processing in two bibliometrics analysis tools, the Biblioshiny and the VOSviewer. Additional information on the Scopus website (https://www.scopus.com/), and from the Scimago Journal & Country Rank (https://www.scimagojr.com/) was also used to support our analyses.

Step 3: Clean the data. The downloaded data should be cleaned because the quality of the analysis is highly dependent on the quality of input data (Ha et al., 2020). Several data errors were fixed in this sub-step. For example, "Lancaster University Management School" and "University of Lancaster" and "The Management School, Lancaster University" were corrected as one affiliation.

In the data analysis stage, the author used several analytical techniques to extract information from a collection of publications.

In order to understand the growing trend of the research field, general information on publication collection was summarized, and the number of publications per year was analyzed.

Contribution by countries, institutions, journals, and authors based on the number of papers and citations was analyzed to identify the most productive ones.

The top 10 most cited papers were extracted based on the number of citations, along with their citations and the authors' information.

A co-occurrence network of 40 most popular keywords based on their frequency was generated using the VOSviewer tool. In addition, keywords often appearing in published papers were coded in the same colors and grouped in the same clusters.

RESULTS

General information and growth trend

The primary information of the paper's dataset is shown in Table 1. The total number of publications in the collection is 169 documents, published in 92 different Sources (journals, books, etc.) from 1988 to 2021. Most are articles with 156 publications (92.3%), followed by conference papers: 6 publications, book chapters: 4, and review papers: 3 publications. The total number of citations is 3695, or 21.86 citations per document. The h-index of this collection is 30, which means that out of 169 publications under study, 30 have been cited at least 30 times). 367 authors have participated in research and publication in this field (equivalent to 2.17 Authors per Document). In particular, the percentage of Single-authored documents in the collection is quite large, with 37 documents (21.9% of publications) of 34 authors.

The information on annual publication output and cumulative citations is shown in Figure 1. The annual growth rate of studies on measuring efficiency in HE using DEA is 8.94%. The growth trend of scientific output can be divided into three sub-stages:

Stage 1: 1988–2003: The first stage saw a light output, and the first publications in this field began to appear. However, studies on this issue were not continuous over the years. A total of 11 publications were published during this 15-year stage.

Stage 2: 2004–2015: Number of publications published: 58. Annual Growth Rate: 6.5%. During this stage, the number of publications published annually was always less than 10. Therefore, the growth of studies in this field was not evident.

Stage 3: 2016–2021: This stage saw a significant increase in the number of published publications. There were 100 publications from 2016 to the time that the data for this study were collected (July 5, 2021) that have been published. Excluding 2021 data (because the time of the study is not over yet), the Annual Growth Rate: is 17.76%

The number of citations increased steadily every year during stages 2 and 3, increasing rapidly in recent years, corresponding to the increase in the number of studies on this topic.

The statistics for the number of citations of publications-related studies on the measurement of efficiency in HE using DEA are shown in Table 2. The number of uncited articles from any document is 31 (18.3%), and the number of publications with citations more minor than the average number of citations of the whole collection (21.86) is 130 (accounting for 76.9%). The number of articles with more than 50 citations is 20 (11.8%), of which seven articles have more than 100 citations.

Contribution by countries

Information on the top 12 countries with the highest number of publications related to the measurement of efficiency in HE using DEA is shown in Table 3. The total number of published publications in the countries in this list is 117, accounting for 69.2% of the collection. These publications have been

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	1988:2021
Sources (journals, books, etc)	92
Documents	169
Average citations per document	21.86
References	3695
DOCUMENT TYPES	
article	156
book chapter	4
conference paper	6
review	3
AUTHORS	
Authors	367
Authors of single-authored documents	33
Authors of multi-authored documents	334
Single-authored documents	37
Authors per Document	2.17

Table 1: Main information of the publication collection related to the measurement of efficiency in HE using DEA (source: own calculation).

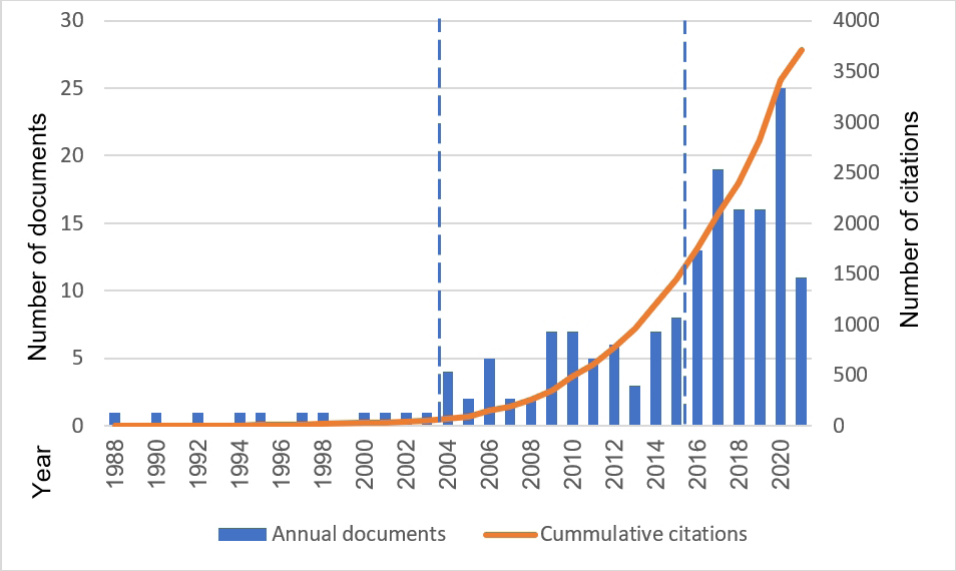

Figure 1: Bar chart illustrates the annual number of publications and their cumulative citations

Number of citations	Number of Documents	Percentage	Citations
>100	7	4.1%	1513
50 to 99	13	7.7%	936
22 to 49	19	11.2%	632
10 to 21	24	14.2%	359
1 to 9	75	44.4%	255
0	31	18.4%	0

Table 2: Number of citations of the publication collection (source: own calculation)

cited 2962 times (80.2% of the total citations for the whole collection. It is noted that the total number of publications in this list is more significant than 117 because an article can have co-authors from different countries.

Italy contributed the most publications in this field, with 20 papers (accounting for 11.8% of publications) and 629 citations (accounting for 17% of total citations). China ranks second on this list with publications less than the leading country, but these publications are cited only 72 times. The following two positions are Spain and the USA, with the same 17 papers and 321 citations. The number of papers is 11, but the United Kingdom has the highest citations among all other countries (834, accounting for 22.6% of total citations), and Taiwan has 96 citations. Australia has the second number of citations, with seven papers (4.1% of publications) and 747 citations (accounting for 20.2%). The remaining five countries on the list have 6, namely India, Colombia, Turkey, Germany, and Brazil, with citations from 111 down to 21.

Rank	Country/ Territory	TP	%	TC	%
1	Italy	20	11.8%	629	17.0%
2	China	19	11.2%	72	1.9%
3	Spain	17	10.1%	321	8.7%
4	USA	17	10.1%	321	8.7%
5	United Kingdom	11	6.5%	834	22.6%
6	Taiwan	11	6.5%	96	2.6%
7	Australia	7	4.1%	747	20.2%
8	India	6	3.6%	111	3.0%
9	Colombia	6	3.6%	37	1.0%
10	Turkey	6	3.6%	32	0.9%
11	Germany	6	3.6%	26	0.7%
12	Brazil	6	3.6%	21	0.6%
Total		117	69.2%	2962	80.2%

TP: Total publications; TC: Total citations

Table 3: The top 12 countries with the highest number of publications (source: own calculation)

The international cooperation network (at least two papers) in the measurement of efficiency in HE using DEA is shown in Figure 2. The size of the nodes indicates the number of publications, while the thickness of the lines between nodes shows the strength of collaboration. Authors from 46 countries participated in the study and had publications in the field. After removing the countries that do not have authors cooperating and linking with other countries, the number of countries remaining is 19. China is the country whose number of publications results from the most extensive international cooperation with other countries such as the USA, Spain, Malaysia, Japan, Germany, Sweden, the Philippines, Korea, and Australia, followed by Italy, Spain, and the USA. The most international cooperation is between Spain and Colombia, followed by Spain and Italy.

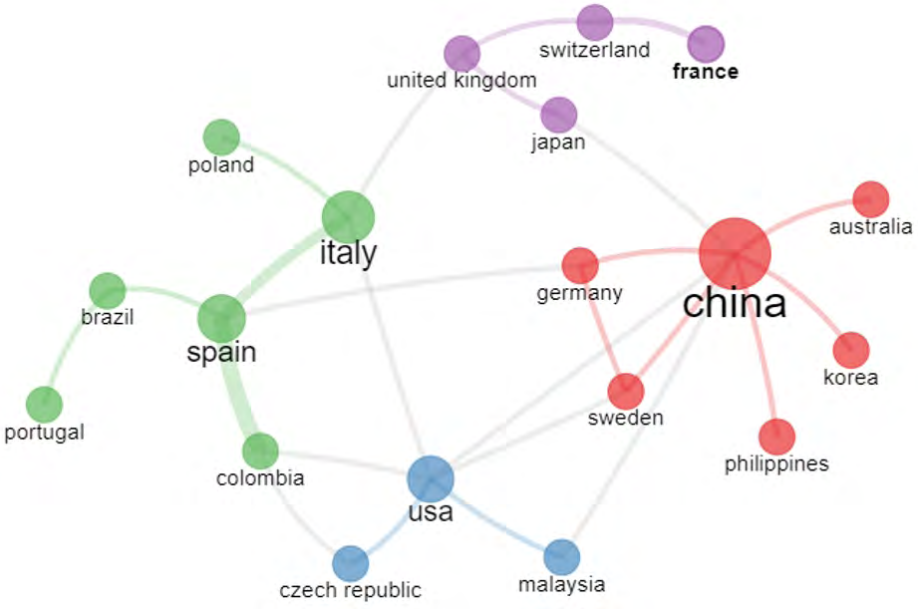

Figure 2: International cooperation network in the measurement of efficiency in HE using DEA. Artwork generated with Biblioshiny.

Contribution by Institutions

According to our retrieved Scopus database, the authors participating in the study on measuring efficiency in HE using DEA came from 160 affiliations. The top 10 most productive institutions are based on the number of publications shown in Table 4. The institutions in this Top 10 list are from Italy (3), China (2), The United Kingdom (1), Spain (1), Poland (1), Australia (1), and Russia (1). The first on this list is Politecnico di Milano with nine published publications that have been cited 382 times. Although ranked second in the number of publications (6 papers), Lancaster University has an astonishing total number of citations with 591. This number of citations mainly comes from two articles with a high number of citations: "Data envelopment analysis and its application to the measurement of efficiency in higher education" (Johnes, 2006) with 381 citations and "Research funding and performance in U.K. University Departments of Economics: A frontier analysis" (Johnes and Johnes, 1995) with 146 citations. The remaining institutions have published three publications.

Rank	Institution	Country	TP	%	TC	%	TC/TP
1	Politecnico di Milano	Italy	9	5.3%	382	10.3%	42.44
2	Lancaster University	UK	6	3.6%	591	16.0%	98.50
3	Università degli Studi di Roma Tor Vergata	Italy	3	1.8%	143	3.9%	47.67
4	Universidad Autónoma de Madrid	Spain	3	1.8%	120	3.2%	40.00
5	Gdańsk University of Technology	Poland	3	1.8%	120	3.2%	40.00
6	Chinese Academy of Sciences	China	3	1.8%	49	1.3%	16.33
7	University of Chinese Academy of Sciences	China	3	1.8%	49	1.3%	16.33
8	Università degli Studi di Catania	Italy	3	1.8%	28	0.8%	9.33
9	University of New England Australia	Australia	3	1.8%	22	0.6%	7.33
10	National Research University Higher School of Economics	Russia	3	1.8%	5	0.1%	1.67

TP: Total publications; TC: Total citations

Table 4: Top 10 most productive institutions publishing based on the total number of publications (source: own calculation)

Contribution by journals

As mentioned above, the number of sources publishing research publications on measuring efficiency in HE using DEA is 92 different. The top 11 most active journal publishing is shown in Table 5. The number of publications published by these sources is 44 (accounting for 39.1% of the whole collection), but the total number of citations recorded is 2772 (accounting for 75.0% of the whole collection). SEPS is the journal publishing the most publications on this topic, with 12 papers and 617 citations. Followed by Scientometrics with ten papers, 253 citations, and Education Economics with eight papers, 486 citations. The remaining journals publish from 4 to 6 papers on this topic. Regarding citations, it is noteworthy that the Economics of Education Review (EER) with a total citation of 5 papers is 895. This journal has contributed three publications with the highest number of citations, as shown in Table 7. ((Abbott and Doucouliagos, 2003) - 381 citations, (Johnes, 2006) - 329 citations, (Johnes and Johnes, 1995) - 146 citations).

These journals rank highly in Scopus's journal rankings: Q1 (7) and Q2 (2). However, only one journal is rated Q3 (ERIES), and one journal is rated Q4 (IJEED). Ranked according to CiteScore, the Journal of Informetrics has the highest index (8.6), followed by Higher Education (6.3), and two journals with a CiteScore index of 4.9 are SEPS and Research Evaluation.

Rank	Source	Publishing house	TP	TC	Scopus Quartile*	CiteScore 2020*	SJR 2020*
1	Socio Economic Planning Sciences (SEPS)	Elsevier	12	617	Q1	4.9	1.020
2	Scientometrics	Springer Nature	10	253	Q1	5.2	0.999
3	Education Economics	Taylor & Francis	8	486	Q2	2.0	0.481
4	Sustainability	Multidisciplinary Digital Publishing Institute	6	42	Q1	3.9	0.612
5	Economics of Education Review (EER)	Elsevier	5	895	Q1	3.2	1.734
6	Tertiary Education and Management (TEM)	Springer Nature	5	54	Q2	2.3	0.615
7	Higher Education	Springer Nature	4	227	Q1	6.3	1.900
8	Journal of Informetrics	Elsevier	4	99	Q1	8.6	1.605
9	Research Evaluation	Oxford University Press	4	81	Q1	4.9	0.875
10	Journal on Efficiency and Responsibility in Education and Science (ERIES)	Czech University of Life Sciences Prague	4	12	Q3	1.3	0.204
11	International Journal of Education Economics and Development (IJEED)	Inderscience Publishers	4	6	Q4	0.5	0.176

TP: Total publications; TC: Total citations

**According to data from Scimago Journal & Country Rank (https://www.scimagojr.com) dated July 10, 2021*

Table 5: Top 10 most active journals publishing research related to the field of measurement of efficiency in HE using DEA based on the total number of publications (source: own calculation)

Contribution by authors

The top 10 most productive authors based on the number of publications and their citations are shown in Table 6. Half of these top authors are from Italy, followed by the United Kingdom (2 authors), the USA (1), Australia (1), and Germany (1). The author with the most contribution in this field is Agasisti T. from Politecnico di Milano with ten papers and 434 citations. He is the main author of 9/10 papers in this field. This was followed by Johnes J. from the University of Huddersfield with four papers (492 citations) and Johnes G. from Lancaster University with four papers in this field. The remaining authors have published three publications. Among these authors, Abramo G. (Consiglio Nazionale delle Ricerche) and D'Angelo C.A. (Università degli Studi di Roma Tor Vergata) are in their names together in all three papers. The same goes for two authors from the Università degli Studi di Catania, who are Guccio C. and Martorana M.F.

Rank	Author	Institution/ Country	TP	TC	TP/TC
1	Agasisti T.	Politecnico di Milano/ Italy	10	434	43.4
2	Johnes J.	University of Huddersfield/ United Kingdom	4	492	123.0
3	Johnes G.	Lancaster University/ United Kingdom	4	271	67.8
4	Abramo G.	Consiglio Nazionale delle Ricerche/ Italy	3	143	47.7
5	D'Angelo C.A.	Università degli Studi di Roma Tor Vergata/ Italy	3	143	47.7
6	Guccio C.	Università degli Studi di Catania/ Italy	3	28	9.3
7	Martorana M.F.	Università degli Studi di Catania/ Italy	3	28	9.3
8	Coupet J.	NC State University/ USA	3	15	5.0
9	Tran C.D.T.T.	University of New England Australia/ Australia	3	15	5.0
10	Klumpp M.	FOM University of Applied Sciences/ Germany	3	5	1.7

TP: Total publications; TC: Total citations

Table 6: Top 10 most productive authors (source: own calculation)

The annual publications and citations of the top 10 authors can be shown in Figure 3. Agasisti T. is the author with the most and most frequently published publications. His first paper on this topic was in 2007. Johnes J. and Johnes G. are two authors with a long research history on this topic. They have cooperated to publish articles since 1992 (Johnes and Johnes, 1992) and 1995 (Johnes and Johnes, 1995), but the two authors' research history on this topic is not continuous. The remaining authors have several publications that are not large enough to represent research trends, mainly published in recent years.

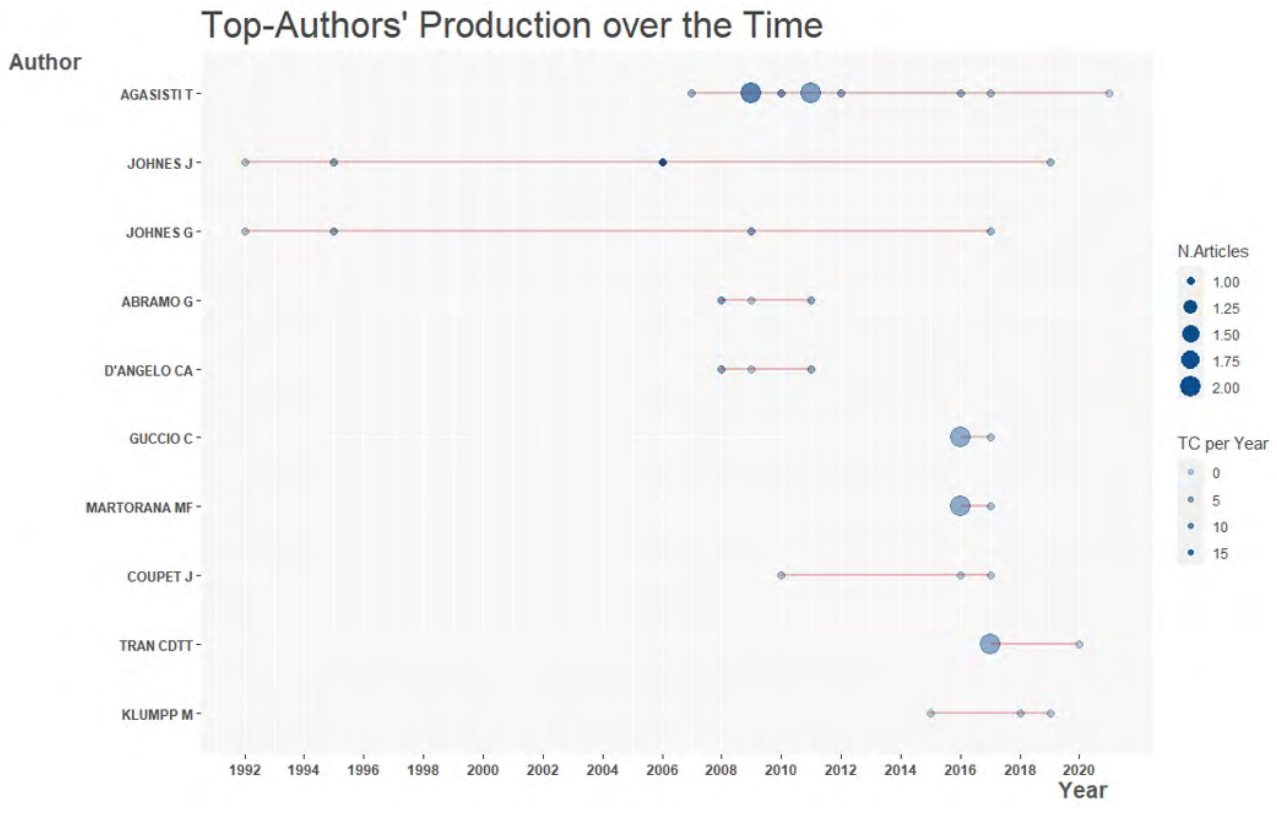

Figure 3: The top 10 most productive authors over the time

The co-authorship network of scholars is shown in Figure 4. Nodes represent authors. The size of the nodes indicates the number of publications, while the thickness of the lines between nodes shows the strength of collaboration (meaning the number of publications they were co-authors). This network consists of authors with at least two published papers in the measurement of efficiency in HE using DEA. There are 34 authors, all meeting this condition. The most significant collaboration is between the group of authors headed by Agasisti T. and the authors: Wolszczak-derlacz J., Landoni P., Dal Bianco A., De La Torre E.M., Johnes G., and Johnes J. There are two groups with three authors: Zhu Q., Wu J. and Zhang G. from China; Guccio C., Martorana M.F., Monaco L. from Italy. In addition, there are six groups of two authors.

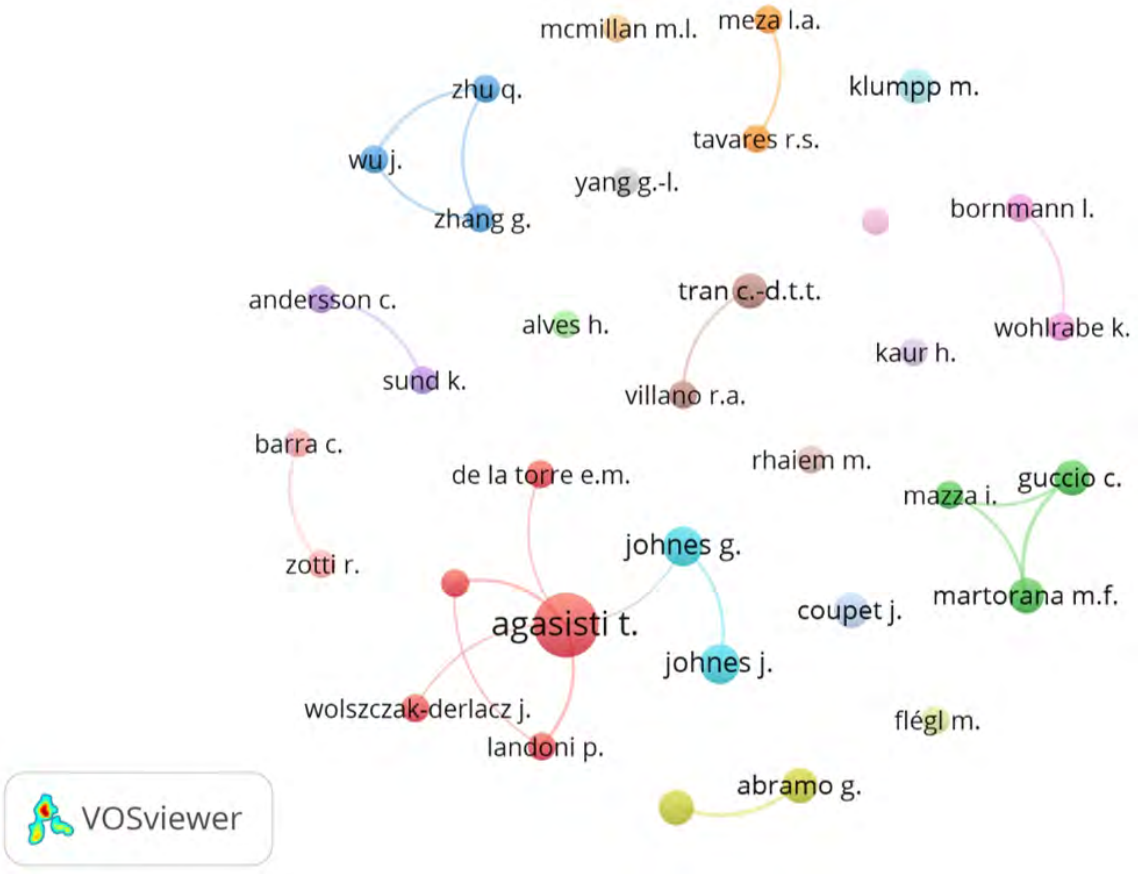

Figure 4: Co-authorship network of 34 scholars with at least two publications related to measuring efficiency in HE using DEA.

The most influential articles

A list of the top 10 most cited papers in the published collection of 169 papers is shown in Table 7, along with their average citations per year. The total number of citations of the top 10 papers is 1785, corresponding to 48.3% of the total citations of the collection at the time of this study (3695 citations). The paper on efficiency of Australian universities, which Abbott M. authors from Victoria University, and Doucouliagos C. from Deakin University (2003) published in Economics of Education Review has the most significant number of citations at 381. The average annual citation number of this paper is 20.05. The second position in terms of the number of citations is the publication of Avkiran N.K. from The University of Queensland (2001), published in Socio-Economic Planning Sciences journal on technical and scale efficiencies of Australian universities, and this paper has been cited 329 times, equivalent to an average annual citation number of 15.67. The third position on this list is a paper on data envelopment analysis and its application to the measurement of efficiency in higher education (Johnes, 2006), authored by Johnes J. from Lancaster University published in 2006 on Economics of Education Review, 312 is the number of citations as of the time of this study, equivalent to 19.50 citations per year. These two papers are publications in the form of Single-authored documents. The remaining papers on the list have citations from 88 to 106, published between 1988 and 2011 (first and second sub-stage).

The three publications on this list have outstanding citations compared to the remaining studies. These are highly representative studies for the research direction of measuring efficiency in HE using DEA.

Table 7 also shows the number of citations of publications by citation position in the scientific article. Cohan et al. (2019) categorize citation intents into three types: background information, methods used, and comparing results. Information on the number of citations by citation position was collected from Semantic Scholar (https://www.semanticscholar.org). Note that the total number of citations for these three categories may not be the same as the number

of citations listed in the TC column because this number of citations is limited to articles for which Semantic Scholar has access to the full text (Semantic Scholar, 2022). Accordingly, the total number of citations of the top 10 most cited articles by content is: Background Citations: 920 (64.2%), Methods Citations: 436 (30.4%), Results Citations: 77 (5.4%).

CR	Document Title	Author	Journal Title	PY	TC	TC/ Year	Background Citations*	Methods Citations*	Results Citations*
1	The efficiency of Australian universities: A data envelopment analysis (Abbott and Doucouliagos, 2003)	Abbott M., Doucouliagos C.	Economics of Education Review	2003	381	20.05	201	95	15
2	Investigating technical and scale efficiencies of Australian universities through data envelopment analysis (Avkiran, 2001)	Avkiran N.K.	Socio-Economic Planning Sciences	2001	329	15.67	181	79	12
3	Data envelopment analysis and its application to the measurement of efficiency in higher education (Johnes, 2006)	Johnes J.	Economics of Education Review	2006	312	19.50	192	113	21
4	Research funding and performance in U.K. University Departments of Economics: A frontier analysis (Johnes and Johnes, 1995)	Johnes J., Johnes G.	Economics of Education Review	1995	146	5.41	75	16	0
5	Measuring the efficiency of British universities: A multi-period data envelopment analysis (Flegg et al., 2004)	Flegg A.T., Allen D.O., Field K., Thurlow T.W.	Education Economics	2004	138	7.67	63	33	10
6	Some statistical and DEA evaluations of relative efficiencies of public and private institutions of higher learning (Ahn et al., 1988)	Ahn T., Charnes A., Cooper W.W.	Socio-Economic Planning Sciences	1988	106	3.12	41	25	5
7	Comparing efficiency in a cross-country perspective: The case of Italian and Spanish state universities (Agasisti and Pérez-Esparrells, 2010)	Agasisti T., Perez-Esparrells C.	Higher Education	2010	101	8.42	44	7	5
8	Efficiency of European public higher education institutions: A two-stage multicountry approach (Wolszczak-Derlacz and Parteka, 2011)	Wolszczak-Derlacz J., Parteka A.	Scientometrics	2011	95	8.64	43	25	5
9	The relative efficiencies of Canadian universities: A DEA perspective (McMillan and Datta, 1998)	McMillan M.L., Datta D.	Canadian Public Policy	1998	89	3.71	50	23	2
10	Relative performance of academic departments using DEA with sensitivity analysis (Tyagi et al., 2009)	Tyagi P., Yadav S.P., Singh S.P.	Evaluation and Program Planning	2009	88	6.77	30	20	2

*CR: Citation ranking; PY: Publication Year; TC: Total citations*According to data from Semantic Scholar (https://www.semanticscholar.org) dated June 15, 2022*

Table 7: The Information on the top 10 most cited papers

The historical direct citation network of the 17 most local cited articles in the publication collection is illustrated in Figure 5. Each node represents a paper, and the lines between nodes indicate a direct citation between two papers. The historical direct citation network is beneficial in identifying the core papers and all related papers to a specific research direction. Several authors in Table 6 also have papers shown in Figure 5, such as Agasisti (2011), (Guccio et al., 2017; Guccio et al., 2016a; Guccio et al., 2016b), etc.

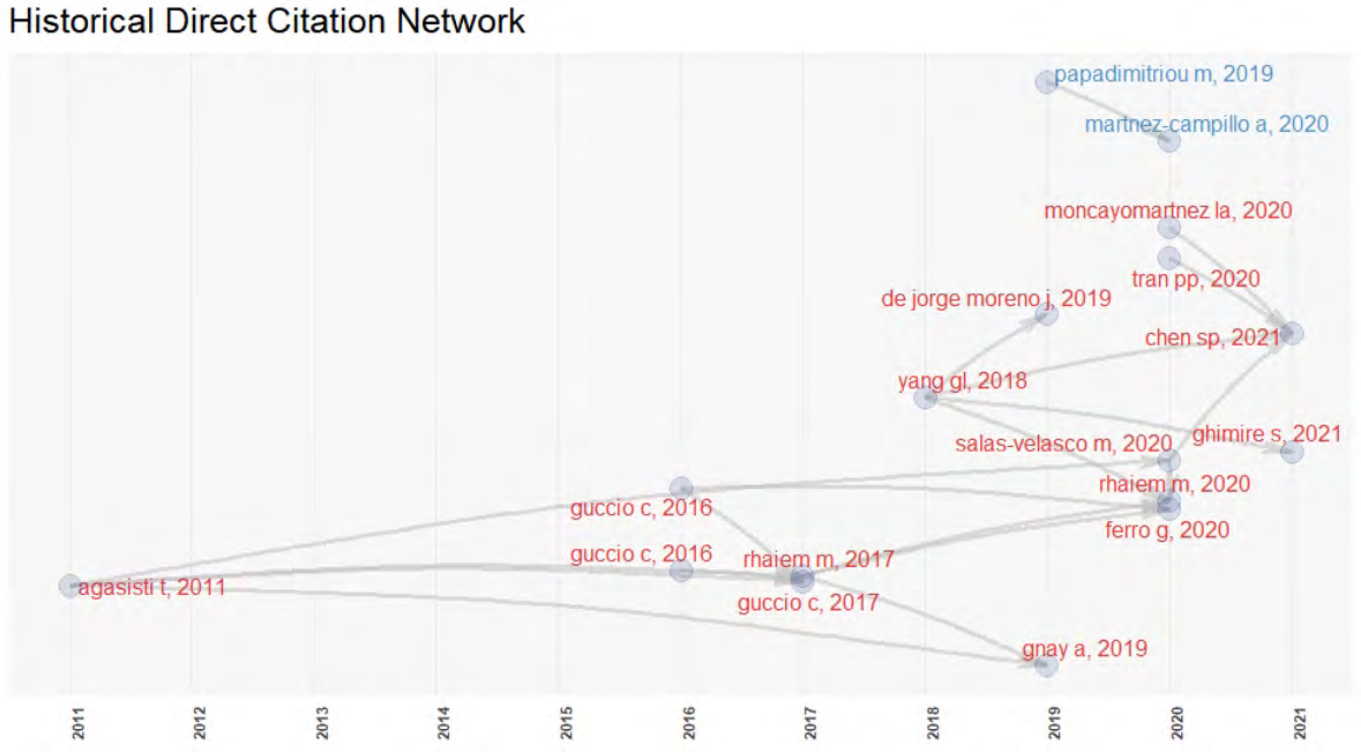

Figure 5: Historical direct citation network of the 17 most local cited papers in the published collection. The artwork was generated with Biblioshiny.

Keywords and terms analysis

The co-occurrence network of keywords over the period is shown in Figures 6. In the co-occurrence network of keywords, each keyword is represented by a node, and the thickness of lines between two nodes is proportional to the strength of the relationship between them. This relationship was determined by the number of times they appeared together in published papers of the published collection. Close and related keywords (or research topics) were coded in the same colors and grouped in the same clusters (Pham-Duc, Tran, et al., 2020). To build this network, the author has removed phrases that cannot show research trends such as: article, review… combined synonymous keywords: dea, "data envelopment analysis (dea)" into "data envelopment analysis"; "Malmquist productivity index (mpi)", mpi into "Malmquist productivity index", etc.

There are 169 publications and 563 keywords for the period 1988–2021. The co-occurrence network of the 40 most popular keywords, which appeared at least three times, is presented in Figure 6. The keywords in the network are grouped into three main groups with three different colors: the Green group with main keyword phrases: data envelopment analysis, Higher education, efficiency, university, productivity, higher education institutions, bibliometrics. The Red group with the keyword phrases: university sector, technical efficiency, performance assessment, efficiency measurement. And the Blue group with the main keywords: China, Malmquist index, sustainability.

Research trends in this field by year through keywords are shown in Figure 7. In this figure, the line represents the timeline of the keyword, a bubble at a given year means the keyword appeared the most in the publications of the respective year, the bubble size is proportional to the number of publications containing this keyword. When building the figure, we only selected keywords that appeared in at least 3 publications. The author also removed the keyword "data envelopment analysis" because according to the search method, this keyword appeared in all publications.

The keywords in Figure 7 can all be found in Figure 6. The topics that have received a lot of attention recently are: efficiency measurement, research efficiency, resource allocation, performance evaluation, benchmarking, stochastic frontier analysis, efficiency analysis. Some topics have received much attention in the past, but have received little attention recently, such as: technical efficiency, university performance, university libraries, scale efficiency. These are good suggestions for research on the topic of measurement of efficiency in higher education using Data Envelopment Analysis.

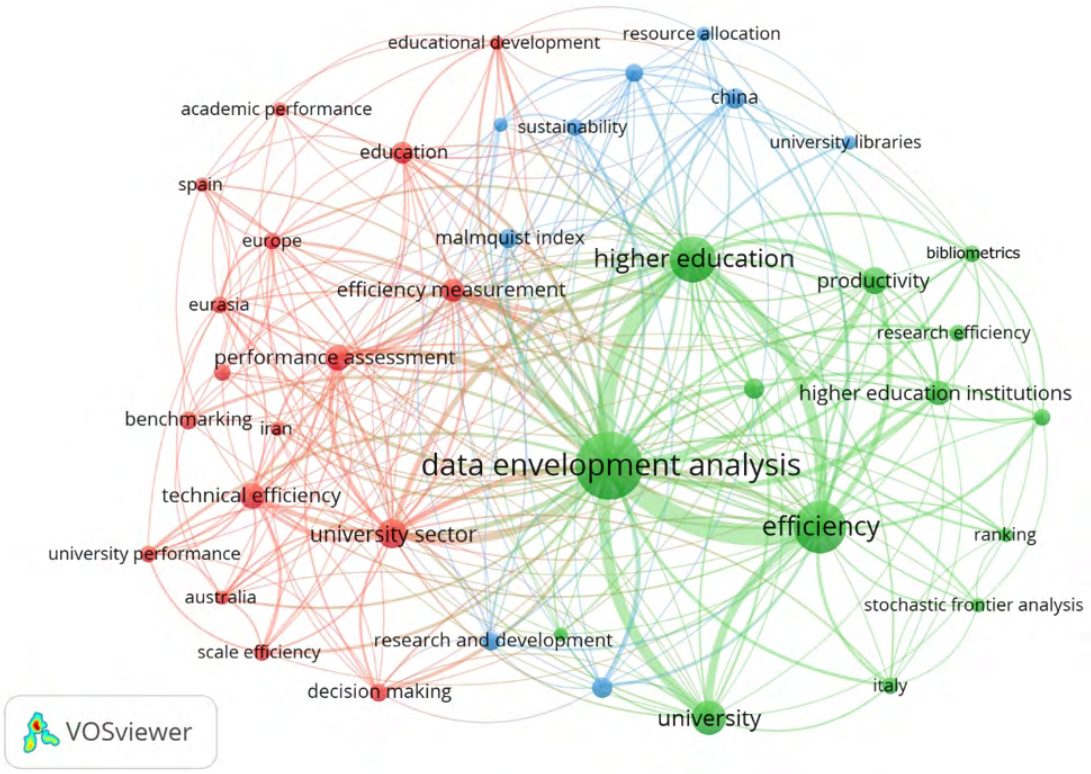

Figure 6: Co-occurrence network of the most popular keywords period 1988 – 2021.

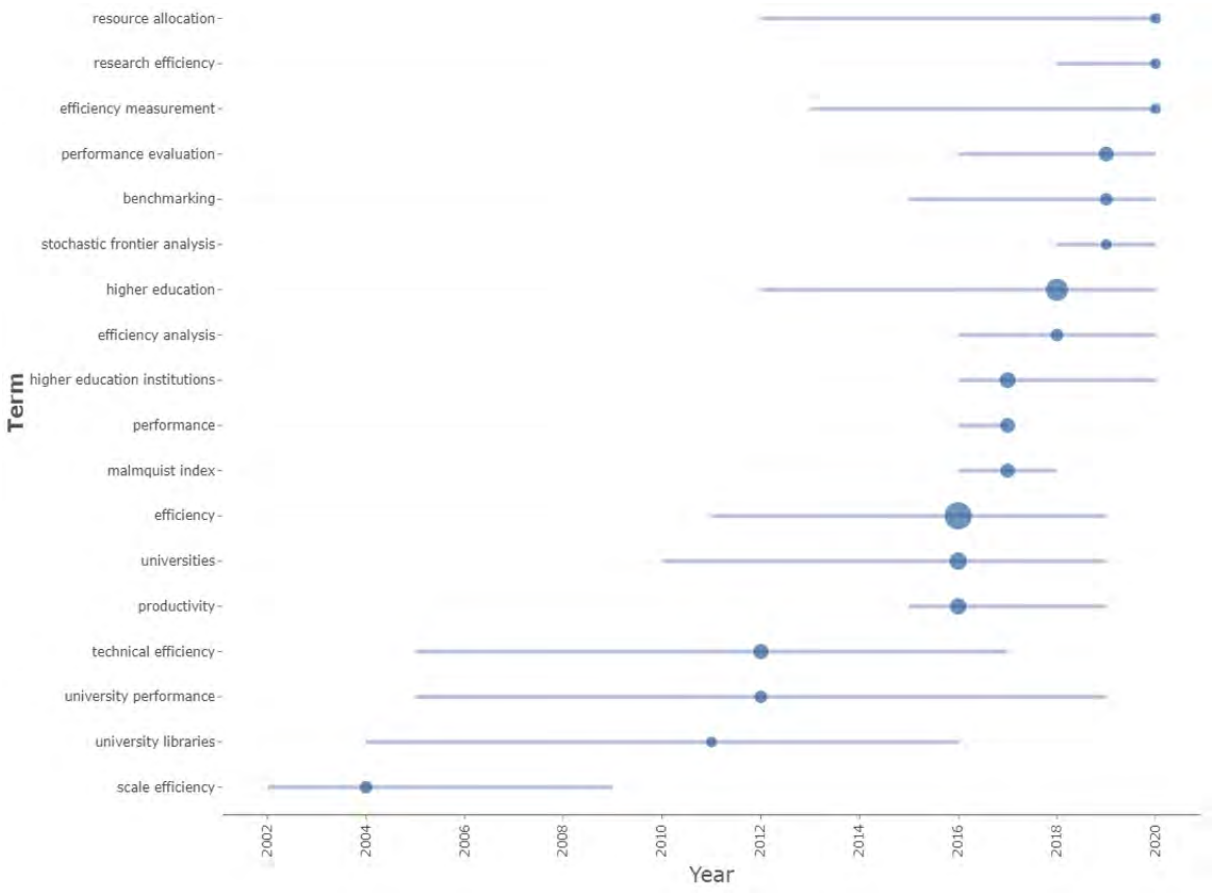

Figure 7: Topic trend of the publication collection related to the measurement of efficiency in HE using DEA. The artwork was generated with Biblioshiny.

DISCUSSION

In this study, bibliographic data in the Scopus database were used to plot the overall picture of all research publications and discussed the measurement of efficiency in higher education using DEA from 1988 to 2021.

In the period from 1988 to 2003, although the number of published publications is not much, these are all highly influential papers with a high number of citations (directive for further studies). From 2004 to 2015, the number of publications published annually has increased but not much. In the recent period, there has been a remarkable growth in studies on this topic. This growth model is quite similar to the bibliometric studies in several other fields in recent years, such as STEM Education (Ha et al., 2020; Özkaya, 2019); Internet of things (Ruiz-Rosero et al., 2017); DEA on Islamic Banking (Rusydiana et al., 2021); DEA applied to energy efficiency (Yu and He, 2020).

The number of studies on the topic of DEA applied to the measurement of efficiency in higher education is significantly less than the research on the application of DEA in other fields. The bibliometric study of Yu and He (2020) shows that there are 1206 research papers on DEA applied to energy efficiency in the period 1992–2018; meanwhile, Cavaignac and Petiot (2017) found 461 research articles on the use of DEA applied to the transport sector (1989–2016) in their research. This shows that scholars have not paid enough attention to the use of DEA to measure efficiency in higher education.

The countries with the most influence in studies on this topic are Italy, China, Spain, the USA, and the United Kingdom, when they have the most significant number of publications and the greatest number of citations (see Table 3). Most affiliations with the most significant number of published papers belong to these countries (see Table 4). Research collaboration in this area is not strong (see Figure 2), both in collaboration among countries and among affiliations.

Authors who research this topic tend to publish in journals with a high ranking in Scopus's journal rankings (See Table 5). Most of the journals in the Top 10 most active journals list have Q1 and Q2 rankings. This demonstrates the quality of studies in this field. Economics of Education Review has only five published papers but has an outstanding number of citations of 895, accounting for 24.2% of total citations. The overall quality of these studies is also reflected in the whole collection's average number of citations, with 21.86 citations/document. This is slightly larger than the average number of citations for publications using DEA in energy efficiency evaluations of 18.33 citations/document (Yu and He, 2020).

The three authors with the most influence in the research direction of measurement of efficiency in higher education using DEA are: Agasisti T., Johnes J., and Johnes G. These are the authors with the most publications and such publications have the most citations. Especially, Agasisti T. is the author of 10 publications in this field and has a research history from 2007 to present. He is also a key member of collaborations with other authors and groups of authors. This research group is also the most significant collaboration among research authors on this topic.

The papers with the most influence on studies in this field are from the following authors: Abbott and Doucouliagos (2003), Avkiran (2001), and Johnes (2006). In addition, the papers in the list of 10 most influential papers also have rapidly increased citations in the past five years. This is consistent with the rapid increase in the number of studies published during this period. The most cited content is used in the background information, with nearly two-thirds of the total citations of the top 10 publications with the highest citations. This shows that these publications have a significant role in guiding the research on this topic.

The keyword analysis showed that the studies focused on using the DEA method to evaluate efficiency in higher education. In addition, the studies also go into specific directions such as: efficiency measurement, resource allocation, Malmquist index, performance evaluation, benchmarking, stochastic frontier analysis, efficiency analysis, bibliometrics. These research directions have been shaped mainly in recent years.

Although this study only deals with studies related to higher education performance assessment using the data envelopment analysis method, through keyword analysis, the results show that research trends in this area include both parametric and non-parametric techniques such as DEA, the Malmquist index, and stochastic frontier analysis (SFA). This can be explained by the keywords that appear in the reviews, or there may be studies using multiple analytical methods, as in the study by Ferro and D'Elia (2020). Ferro and D'Elia analyzed 89 studies published between 1997 and 2019 on higher education efficiency frontier analysis. Most of the papers used the non-parametric DEA model to estimate the efficiency (54%), followed by the SFA model (40%), and both methods (6%).

Considering higher education as a production process with corresponding inputs and outputs for performance evaluation is a common approach across many fields today (see also (Viet Nguyen et al., 2019)). Higher education efficiency is about maximizing output and minimizing input in the production process. Tools for estimating this degree of optimization have, to date, been developed very rapidly; Accordingly, the DEA method is very commonly used in statistical research in the world today. Therefore, implementing scientific quantification to find the main exploitation directions and quality documents on DEA is necessary, helping researchers and managers have an overview to select and use. Use appropriate documents to build a higher education performance analysis tool.

This study has several limitations, which were already reported in previous papers (Ha et al., 2020; Pham-Duc, Tran, et al., 2020). First, this study analyzed only publications related to measuring of efficacy in HE by DEA from the Scopus database, written in English. Indeed, the data will not include all articles on this topic. Publications not analyzed may include publications written in languages other than English; publications from sources not yet indexed in the Scopus database. Second, the authors have attempted to filter out all irrelevant articles from Scopus data manually, but this filtering may not be ideal and may contain omissions. Third, some types of information, such as author names and author institutions, are not standardized in the Scopus database. Since manual corrections are not possible, the results may be affected as the analysis depends entirely on the quality of the input information retrieved from the Scopus database.

CONCLUSION

This study uses bibliometric analysis to analyze research trends and develop publications using DEA to evaluate the efficiency of higher education indexed in the Scopus database. The authors used a 5-step process recommended by Börner et al. (2003) and Zupic and Čater (2015) to conduct the study. The main findings of this study are: 1) Although the first publications on this topic appeared in 1988, the studies on this topic have received much attention in the last five years. Therefore, the influence of publications in the first period (1988–2003) is quite considerable, oriented for further studies; 2) The overall quality of publications is relatively high when the average number of citations is significant, and publications are mostly published on journals with high ranking indexes; 3) The countries with the most influence in studies on this topic are: Italy, China, Spain, the USA, and the United Kingdom but the international cooperation in these studies is not strong; 4) While Agasisti T. is the author with the most publications, the authors with the most influence on research trends are: Abbott M., Doucouliagos C., Avkiran N.K., and Johnes J. when publishing the publications with the highest number of citations.

The research direction on applying the DEA method in evaluating the efficiency of higher education is a research direction with high application and efficiency. However, the number of studies on this topic is still modest. Scholars interested in the field can refer to the high-influence publications mentioned above. Scholars also should strengthen international cooperation further to improve the quality of studies in the coming time.

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