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Research article

Development and psychometric testing of hybrid education competence instrument for social and health care, and health sciences educators

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ABSTRACT

Background: The competencies of educators in social and health care, and health sciences fields have been studied; however, studies related specifically to hybrid (synchronous face-to-face and online) teaching competence are scarce.
Aim: To develop and psychometrically test the hybrid education competence instrument for the purpose of self-assessment of hybrid education competence.
Design: A cross-sectional study was conducted to develop and psychometrically test the instrument.
Methods: The instrument was developed in four phases: (I) establishing the conceptual framework, (II) testing the face and content validity, (III) testing the construct validity, and (IV) testing the internal consistency of the instrument. The conceptual framework was based on studies related to digital pedagogy and hybrid teaching. The face and content validity were tested using an expert panel ($n = 12$). Pre-testing ($n = 10$) was performed prior to the cross-sectional data collection ($N = 1689$, $n = 206$) which was performed during the autumn of 2022. The data was collected from educators in social and health care, and health sciences fields at six universities and twelve universities of applied sciences in Finland. Construct validity was tested using exploratory factor analysis and internal consistency was tested using Cronbach's alpha.
Results: The newly developed and psychometrically tested instrument contains 46 items across 5 factors: (1) Competence in planning and resourcing hybrid teaching; (2) technological competence in hybrid teaching; (3) interaction competence in hybrid teaching; (4) digital pedagogy competence in hybrid teaching; and (5) ethical competence in hybrid teaching. These five factors explain 70.83 % of the total variance. Cronbach's alpha values ranged from 0.901 to 0.951.
Conclusion: The instrument developed in this study can be used to measure the hybrid education competence of educators in social and health care, and health sciences fields. The instrument can also be utilised in an interdisciplinary manner to assess hybrid teaching competence in other educational fields, but also it can be used in the design of continuous learning and training for educators.

1. Introduction

Educators in the social and health care, and health sciences fields play an important role in teaching future social and health care professionals and health sciences experts. Educators' competencies are central to the delivery of quality education and the achievement of required competencies (Mikkonen et al., 2022a; World Health Organisation (WHO), 2016). The European Digital Education Action Plan with the strategies of creating effective digital education ecosystems and developing the digital competences needed for digital transformation is affecting educators' work and competence development (European Commission, 2021).

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According to the Organisation for Economic Cooperation and Development (OECD, 2019), <40 % of educators in European Union (EU) countries have felt prepared to use digital technologies in their teaching. Recent global challenges, such as COVID-19 pandemic, have affected the planning and implementation of education (WHO, 2023). Moreover, new forms of digital learning and teaching have been developed in education of social and health care that challenges educators. One of the flexible teaching methods used is hybrid teaching that combines online and face-to-face modes of teaching (Bower et al., 2015; Lakhal et al., 2021; Raes et al., 2020). The shift to hybrid teaching has further challenged educators' competence (e.g., Lakhal et al., 2021; Li et al., 2022; Wang, 2021; Zhong et al., 2022). Hybrid teaching requires educators to at least possess strong technological and digital pedagogical skills, good interaction skills, and up-to-date equipment and software (Bower et al., 2015; Lakhal et al., 2021; Raes et al., 2020).

There has been little national or international research on hybrid teaching competence of educators in the social and health care, and health sciences fields, and no suitable instruments have been developed to assess the hybrid teaching competence of educators, although there are a few for measuring digital competence (Redecker and Punie, 2017) and overall competence of health and social care educators (Mikkonen et al., 2020a). In order to assess and develop the hybrid teaching competence of educators in social and health care, and health sciences fields, a psychometrically tested self-assessment instrument is required. Such an instrument can be used in a multidisciplinary manner to assess educators' hybrid teaching competence in higher education, to develop education and educators' hybrid teaching competences, and decrease educators' workload in hybrid learning environments. This will provide higher quality learning experiences and highly competent professionals and experts in social and health care, and health sciences fields.

2. Background

Educators in the social and health care, and health sciences fields play a significant role in teaching future professionals. The WHO (2009, 2016) has defined the core competencies of educators in social and health care fields as learning theories and principles, curriculum development, practical nursing skills, evidence-based practice, interaction and collaboration, ethics and professionalism, and evaluation and leadership. Educators in social and health care, and health sciences fields are required to have strong pedagogical, research, cultural, leadership, collaboration, networking, and international professional interaction skills as well as extensive knowledge of their own professional field, evidence-based practice, and working in digital learning environments (Mikkonen et al., 2018; Salminen et al., 2013; Töytäri et al., 2017). For example, in a national government project in Finland, Mikkonen et al. (2020b) defined educators' competence in social and health care fields at the macro and micro levels. Macro competence areas included competence in evidence-based practice, sustainable innovation and future, and continuing competence development. Micro competence areas included competence in pedagogy; ethics and culture; administration and welfare; collaboration and network; and social and health care, and rehabilitation science fields and professions. The education and qualification of educators in social and health care, and health sciences fields vary internationally (Mikkonen et al., 2018; National League for Nursing, 2022; Nursing and Midwifery Council, 2022). In Finland, in order to teach at the university or at the university of applied sciences, an educator in social and health care, or health sciences fields is usually required to have a professional qualification in social or health care, a teaching qualification, a university degree, and several years of work experience in health or social care (Mikkonen et al., 2020b; University of Applied Science Act 1129/2014 17§).

Flexible teaching methods for individual learning experiences, such as hybrid teaching, are becoming more common in education of social and health care, and health sciences. Hybrid learning, which is a particular form of blended learning, is defined in different ways in different contexts and global geographical areas (Lakhal et al., 2021). For example, in literature, synchronous face-to-face and distance learning is referred to as blended synchronous learning (Bower et al., 2015; Lakhal et al., 2021), synchronous hybrid learning (Raes et al., 2020), synchronous learning in distributed environments (Wang and Huang, 2018), synchromodal learning (Bell et al., 2014), multi-access (Irvine et al., 2013), here or there instruction (Zydney et al., 2020), and HyFlex (which means a flexible hybrid learning method in which students can choose when and whether to attend face-to-face or distance learning) (Malczyk, 2019; Abdelmalak and Parra, 2016); moreover, HyFlex has been used to specifically describe synchronous face-to-face and online learning as well (Detyna et al., 2023). In this study, we use the term hybrid teaching to describe student participation synchronously in face-to-face and online teaching (Wang and Huang, 2018) so that remote students are brought into the classroom by means of video conferencing, web conferencing, and the virtual world (Bower et al., 2015).

Fluent communication between online students and the educator and between online students and face-to-face students, engagement of online learners, equal attention to both groups of students by the educator, and audio quality are essential for a hybrid learning environment to be considered effective in supporting learning (Wang et al., 2018). According to Bower et al. (2015), synchronous face-to-face and online learning increases cognitive load on higher education educators: educators are required to master online technology, audio technology, enable interaction between distance and face-to-face students, distribute attention evenly to both groups, and manage communication (e.g. text chat). While research has shown that hybrid learning can create a more flexible and engaging learning environment compared to fully online or fully face-to-face learning, hybrid learning typically presents pedagogical, technological, organisational, and logistical challenges (Raes et al., 2020; Bower et al., 2015; Lakhal et al., 2021).

In order to assess, describe, and develop educators' hybrid teaching competence and appropriate education, it is important to have a suitable instrument. The instrument also helps to create conceptual framework for educators regarding hybrid teaching competence. After all, hybrid teaching competence enhances the quality of teaching and promotes continuous learning and, thus, maybe better learning.

3. The study

3.1. Aims

The aim of this study was to develop and psychometrically test the hybrid education competence instrument (HybridEduCom) for the purpose of self-assessment of hybrid education competence of educators in social and health care, and health sciences fields. The following research questions were addressed in this study: (i) What is the face and content validity of the HybridEduCom instrument? (ii) What is the construct validity of the HybridEduCom instrument? (iii) What is the internal consistency of the HybridEduCom instrument?

3.2. Design

A cross-sectional study was conducted to develop the instrument and psychometrical testing was performed. The COnsensus-based Standards for the selection of health status Measurement Instruments (COSMIN) guidelines have been utilised in the instrument development process (Mokkink et al., 2010).

3.3. Participants

The participants (N = 1689; n = 206, response rate 12.2 %) were educators in the social and health care, and health sciences fields at six universities and twelve universities of applied sciences in Finland. The inclusion criteria to participate in the study were 1) experience of hybrid teaching, 2) willingness to participate in the study, 3) working as an educator in the social or health care, or health sciences fields at a university or a university of applied sciences.

3.4. The instrument and its development phases

The HybridEduCom instrument was developed in four phases: (I) establishing the conceptual framework, (II) testing the face and content validity, (III) testing the construct validity, and (IV) testing the internal consistency of the instrument (see Fig. 1).

3.4.1. Phase I

The development of the HybridEduCom instrument was preceded by an acquaintance with the background conceptual framework (Mikkonen et al., 2022b), which included the detailed competence instrument used to measure the overall competence of educators in social and health care fields (HeSoEduCo) (Mikkonen et al., 2020a), DigCompEdu framework (Redecker and Punie, 2017), a systematic review of digital learning

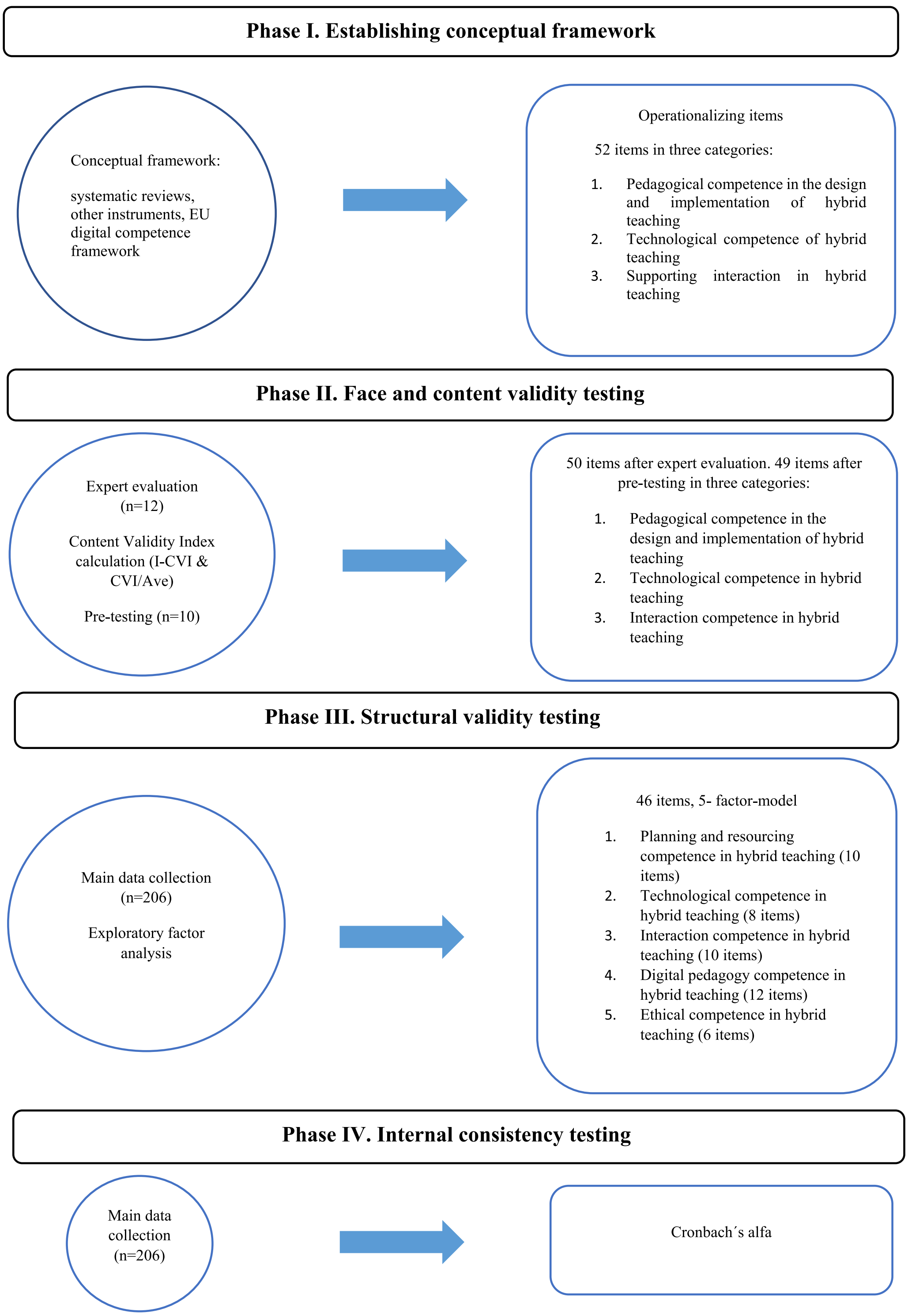

Fig. 1. The four phases of development and testing of the HybridEduCom instrument.

methods in higher education (Sormunen et al., 2020), and a systematic review on hybrid learning (Raes et al., 2020). The conceptual framework was transformed into a measurable form by operationalising items from the background theory into written form (Mikkonen et al., 2022b). A total of 52 items and three categories were created. A five-point Likert scale (1—poor; 2—moderate; 3–good; 4—very good; 5—excellent) was constructed for the instrument.

3.4.2. Phase II

After the items were operationalised, the face and content validity were tested with an expert panel (Mikkonen et al., 2022a, 2022b; Polit et al., 2007). The experts (n = 12) assessed the content validity by commenting on the clarity and relevance of each item. They were mostly (n = 10) university lecturers, researchers, experts in digital learning, and a couple of master students (n = 2) from the teacher education that was conducted in hybrid mode. The experts were asked to rate the relevance and the clarity of the items and evaluated, whether the items were sufficient in each sub-category, and whether an essential item was missing (Polit and Beck, 2017). Based on the experts' ratings, the content validity indexes of the instrument were calculated separately for relevance and clarity, comprising individual item evaluation (I-CVI) and total instrument validation (S-CVI/Ave). A value of I-CVI above 0.78 and S-CVI/Ave above 0.90 indicated excellent content validity (Polit et al., 2007). Face validity was tested using the same expert panel, where experts were asked to comment on each item and the aim was to investigate the cultural appropriateness, understanding of meanings, logical flow, grammar, and syntax of the items (DeVon et al., 2007).

Pre-testing was used to assess the response time used and the comprehensibility of the entire instrument and items (Mikkonen et al., 2022b). The respondents (n = 10), health sciences educators, were asked to assess the readability, logic, length, clarity, and response time of the questionnaire (DeVon et al., 2007). Moreover, gaining feedback for the technical functioning of the survey was another goal (Mikkonen et al., 2022b; Sue and Ritter, 2016).

3.4.3. Phase III

Construct validity was tested using exploratory factor analysis (EFA) with SPSS for Windows software. Principal axis factoring was used as an extraction method and Promax rotation as a rotation method. Kaiser-Mayer-Olkin and Bartlett's test of sphericity were used to test the suitability of the data for EFA. Factor loadings <0.300 were eliminated (Yong and Pearce, 2013). Further, eigenvalues were used to assess the ability of factors to explain the variance of variables. Factors with an eigenvalue of >1 were included in the factor model (Yong and Pearce, 2013).

3.4.4. Phase IV

The reliability of the instrument was assessed using Cronbach's alpha by calculating the alpha values for each factor separately. Alpha values above 0.70 were considered acceptable for newly developed instrument (DeVon et al., 2007).

3.5. Data collection

Data was collected during the autumn of 2022 via a Webropol survey. An invitation to participate in the study and a link was sent to the contact persons of the participating organisations by email. Background information (gender, age, education, year of graduation, work experience in the fields of social and health care, teacher education, current job title and work organisation, current field of teacher education, work experience as a teacher, and participation in previous digital pedagogy education courses) on participants was collected as part of the survey in addition to 49 items of the HybridEduCom instrument. Reminders to participate in the survey were sent three times.

3.6. Ethical considerations

Research permits were applied simultaneously from all the educational organisations participating in the research (Finnish National Board on Research Integrity, 2012). Data for the research was obtained through a Webropol survey. No names or personal identifiers were collected. All data collected were stored in password-protected files, which were accessible only to the researchers (GDPR 95/46/EC). The data will be destroyed 10 years after the completion of the study (Data Protection Act 1050/2018; GDPR 95/46/EC, 2016). A privacy statement was drawn up on the data collected for this research and its use. The statement of the Research Ethics Committee was not required as the study did not threaten the physical integrity of the subjects, did not involve participants under 18 years of age, did not threaten the safety of the subjects, and did not cause any adverse psychological or physical reactions to the subject (Medical Research Act, 488/1999). This research respected the lives, health, dignity, integrity, self-determination, privacy and confidentiality of personal information, and individual rights of our research participants (World Medical Association, 2013).

4. Results

4.1. Participants

This survey had 206 participants. The mean age of the educators was 49 years (SD = 8.89). Most of the participants were female (85.9 %, n = 177). A majority of the participants had a doctoral or master's degree from a university (85.9 %, n = 177). The mean graduation year of the highest degree was 2011 (SD = 7.64). The mean work experience in the social and health care fields was 16.18 years (SD = 9.6). Most of the educators (83.5 %, n = 172) had completed either vocational teacher training or teacher training in health sciences. The educators' mean work experience in education was 11 years (SD = 9.20) and most of the participants currently worked in the university of applied sciences (82 %, n = 169). The majority of the participants were lecturers (62.1 %, n = 128) or teachers (12.1 %, n = 25) at universities of applied sciences. Numerous participants were currently teaching in social and health care fields (77.7 %, n = 160), and almost a fifth of the participants were currently teaching health sciences at university level (18.4 %, n = 38). Further, a majority of the participants were engaged in education related to technical competence (68.0 %, n = 140) and were helped or mentored by colleagues in digital pedagogy (61.2 %, n = 126) or had had help or mentoring in digital pedagogy (78.9 %, n = 162) in the last two years. In addition, most of the participants had independently studied digital pedagogy (71.4 %, n = 147) and over one-third of the participants had experience in hybrid teaching of over 30 lessons within 2 years (39.8 %, n = 82) (see Table 1).

4.2. HybridEduCom instrument

The results are presented according to the instrument development process: (I) establishing a conceptual framework, (II) testing face and content validity, (III) structural validity, and (IV) internal consistency.

4.2.1. Phase I

The conceptual framework was built on various studies on digital pedagogy (Mikkonen et al., 2020a; Redecker and Punie, 2017; Sormunen et al., 2020) and hybrid learning (Raes et al., 2020). This conceptual framework was operationalised into 52 items, which were divided into three categories: 1) Pedagogical competence in the design and implementation of hybrid teaching, 2) technological competence of hybrid teaching, 3) supporting interaction in hybrid teaching (see Fig. 1.).

4.2.2. Phase II

I-CVI and S-CVI/Ave were calculated for 52 items to determine the clarity and relevance of the instrument based on expert ratings. I-CVI

Table 1
Characteristics of the participants (n = 206).

Characteristics	Participants
Age, years	
Mean (SD)	49.37 (8.89)
Minimum (Min.)	31
Maximum (Max.)	67
Gender, % (n)	
Male	12.6 % (n = 26)
Female	85.9 % (n = 177)
Does not want to answer	1.5 % (n = 3)
Highest degree, % (n)	
Vocational education/Bachelor's degree, university of applied sciences	0.5 % (n = 1)
Master's Degree, university of applied sciences	10.7 % (n = 22)
Master's Degree from a university	60.7 % (n = 125)
Licentiate's degree from a university	2.9 % (n = 6)
Doctoral Degree from a university	25.2 % (n = 52)
Graduation year of the highest degree	
Mean (SD)	2011 (7.64)
Minimum	1986
Maximum	2022
Work experience in social and health care fields in years	
Mean (SD)	16.18 (9.6)
Minimum (Min)	0
Maximum (Max)	42.5
Missing data % (n)	1.0 % (n = 2)
Pedagogical education (60 ECTS), % (n)	
Vocational teacher training	33.5 % (n = 69)
Teacher training in health sciences	50 % (n = 103)
Teacher training in educational sciences	6.8 % (n = 14)
Under 60 ECTS pedagogical education completed	7.3 % (n = 15)
No pedagogical education or ECTS completed	2.4 % (n = 5)
Work experience in education in years	
Mean (SD)	10.97 (9.2)
Minimum (Min.)	0.00
Maximum (Max.)	37.0
Current work organisation % (n)	
University of applied sciences	82 % (n = 169)
University	16.5 % (n = 34)
Does not want to answer	1.5 % (n = 3)
Current employment, % (n)	
Lecturer, university of applied sciences	62.1 % (n = 128)
Principal lecturer, university of applied sciences	3.4 % (n = 7)
Teacher, university of applied sciences	12.1 % (n = 25)
Manager or leader	1,9 % (n = 4)
University lecturer	6.8 % (n = 14)
University teacher	4.9 % (n = 10)
Professor	3.9 % (n = 8)
Researcher	3.9 % (n = 8)
Current teaching field, % (n)	
Social, health care and rehabilitation	77.7 % (n = 160)
Health sciences (university)	18.4 % (n = 38)
Leadership, entrepreneurship	2.4 % (n = 5)
Different topics/fields	1.0 % (n = 2)
Missing data	0.5 % (n = 1)
Participation in continuing education or development of education within two years, % (n)	
Participation in continuing education related to digital pedagogy (<2 ECTS)	28.6 % (n = 59)
Participation in continuing education related to digital pedagogy (>2 ECTS)	15.5 % (n = 32)
Participation in education related to technical competence	68.0 % (n = 140)
Participation in education related to hybrid teaching competence	30.1 % (n = 62)
Participation in science conferences related to education development	22.3 % (n = 46)
Participation in project or development work related to digital pedagogy	37.9 % (n = 78)
Participation in digital pedagogy network at work	38.8 % (n = 80)
Participation in some other activity related to digital pedagogy	40.3 % (n = 83)
Helping/mentoring colleagues in digital pedagogy	61.2 % (n = 126)
Getting help/mentoring in digital pedagogy	78.6 % (n = 162)
Independently studied digital pedagogy	71.4 % (n = 147)
None of the above	2.4 % (n = 5)
Experience in hybrid teaching within two years, % (n)	
<5 lessons	18.9 % (n = 39)
5–10 lessons	15.0 % (n = 31)
10–20 lessons	16.5 % (n = 34)
20–30 lessons	9.7 % (n = 20)
>30 lessons	39.8 % (n = 82)

scores ranged from 0.72 to 1.0 for clarity and 0.75–1.0 for relevance. One item had an I-CVI of 0.75 for clarity and relevance of 0.83. This item was modified to gain better clarity. The I-CVI for another item was below 0.78 for both clarity and relevance and was, therefore, excluded from the instrument (leaving 51 items). The other items had I-CVI values ranging from 0.81 to 1.00 for clarity and from 0.83 to 1.0 for relevance. The S-CVI/Ave value was calculated for the entire instrument and was 0.98 for relevance and 0.96 for clarity, thereby indicating good content validity. The face validity was also assessed based on the written comments of the experts. Therefore, three items were excluded (similarities with other items) and two items were added, thereby leaving 50 items for pre-testing. The sub-categories were 1) pedagogical competence in the design and implementation of hybrid teaching, 2) technological competence in hybrid teaching, and 3) interaction competence in hybrid teaching.

Based on the feedback of the pre-test respondents, the language and comprehensibility of the items were improved, and one item was excluded (leaving 49 items). Respondents' estimates of the response time for the instrument ranged from 7 to 20 min. After pre-testing, there were no changes made to the sub-categories.

4.2.3. Phase III

After pre-testing, the instrument consisted of 49 items and all items were tested using EFA. ~~Four~~ Three items with a factor loading of <0.30 were excluded from the analysis, leaving 46 items. The Kaiser-Mayer-Olkin test score was 0.966, thereby indicating that the data was suitable for factor analysis. Bartlett's test of sphericity also yielded an acceptable value ($x^2 = 9492.779$, df = 1035, $p < 0.001$). Factor analysis was performed using principal axis factoring with Promax rotation, which produced a six-factor model with eigenvalues >1. However, a five-factor model was selected, because it was more appropriate, considering the content, as compared to the six-factor model. In the six-factor model, the sixth factor contained three items of which two were related to the continuous education of educators and one item was fully detached from the context as compared to other items because it was related to using technology in creating a motivational learning environment. Because of the theoretical incoherence in the six-factor model, the five-factor model was explored with EFA by four of the researchers and a consensus was received. The items loaded more logically to the factors in the five-factor model than in the six-factor model, taking theory into account.

The first factor, *competence in planning and resourcing hybrid teaching*, explained 56.049 % of the total variance (eigenvalue = 25.782). The second factor, *technological competence in hybrid teaching*, explained 5.404 % of the total variance (eigenvalue = 2.486). The third factor, *interaction competence in hybrid teaching*, explained 3.561 % of the total variance (eigenvalue = 1.638). The fourth factor, *digital pedagogy competence in hybrid teaching*, explained 3.316 % (eigenvalue =1.525) of the total variance. The fifth factor, *ethical competence in hybrid teaching*, explained 2.507 % (eigenvalue = 1.153) of the total variance. These five factors accounted for 70.833 % of the total variance (see Table 2).

Table 2
Exploratory factor analysis for HybridEduCom instrument.

Factor describing educators' hybrid teaching competence in social and health care, and health sciences fields	Factor items measured with a five-point Likert scale (1—poor; 2—moderate; 3—good; 4—very good; 5—excellent)	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Planning and resourcing competence in hybrid teaching	1. I can assess my resources (e.g. time use, resources) when planning hybrid teaching.	0.881				
	2. I can develop guidelines for hybrid teaching/learning with the learners.	0.759				
	3. I can assess the suitability of hybrid teaching for my teaching.	0.713				
	4. I can design/plan a hybrid learning environment where learners can progress in a self-directed way (without the need for external guidance and control).	0.707				
	5. I can design/plan hybrid teaching to support learners; collaborative learning.	0.703				
	6. I can plan hybrid teaching in cooperation with my colleagues (e.g. other teachers and technical assistant).	0.700				
	7. I consider learners' individual needs when designing hybrid teaching (e.g. the accessibility of the platforms).	0.690				
	8. I understand my role as an educator (teacher, trainer, mentor) in hybrid teaching.	0.671				
	9. I can manage my resources (e.g. time use, resources) during hybrid teaching	0.557				
	10. I can utilise the research data related to hybrid teaching in designing hybrid teaching.	0.538				
Technological competence in hybrid teaching	11. I can check the functionality of the required technical equipment (e.g. camera, external speaker) for successful hybrid teaching.		0.941			
	12. I can solve technical (e.g. visual or audio) problems in hybrid teaching.		0.863			
	13. I can assess the requirements for classroom space (e.g. sound system, additional space) for different hybrid teaching methods.		0.845			
	14. I consider the classroom space requirements (e.g. sound system, additional space) for different groupings in hybrid teaching.		0.822			
	15. I can utilise different tools (e.g. cameras, speakers, headphones, and participants' computers) in hybrid teaching to enable collaborative working.		0.735			
	16. I can change the technological design of my hybrid teaching during the teaching if necessary (e.g. switch to a different video conferencing application due to a technical problem).		0.647			
	17. I can create different study groups in hybrid teaching (online, face-to-face, mixed groups of online and face-to-face learners) utilising technology.		0.542			
	18. I am constantly developing the technical skills required for hybrid teaching (e.g. the use of equipment).		0.535			
Interaction competence in hybrid teaching	19. I can support socio-emotional interaction (e.g. expressing/sharing emotions) in hybrid teaching.			0.969		
	20. I can create an excellent interactive teaching relationship with online learners in hybrid teaching.			0.961		
	21. I can create good interactive teaching relationships with face-to-face learners in hybrid teaching.			0.891		
	22. I can create a safe (e.g. open, supportive, avoiding feelings of fear) learning environment in hybrid teaching			0.812		
	23. I can support the interaction between online and face-to-face learners.			0.656		
	24. I can engage online and face-to-face learners in hybrid teaching using activating methods.			0.641		
	25. I can apply different methods to support collaborative working in hybrid teaching			0.548		
	26. I can communicate in different ways (e.g. chat, communication in small groups) in hybrid teaching.			0.540		
	27. I can identify ethical conflicts in hybrid teaching (e.g. conflicts in the equal guidance of online and face-to-face learners).			0.422		
	28. I can guide online and face-to-face learners in group work during hybrid teaching.			0.382		
Digital pedagogy competence in hybrid teaching	29. I can create digital learning materials (e.g. visual slideshows and videos suitable for hybrid teaching).				0.811	
	30. I can utilise digital teaching methods in hybrid teaching by considering the target group (e.g. games and other applications).				0.809	
	31. I am constantly developing my digital pedagogy skills (e.g. applications that support learning, and new learning environments).				0.759	
	32. I can create opportunities for learners to use digital material (e.g. visual slideshows, and videos) in hybrid teaching.				0.681	
	33. I can utilise learning analytics (e.g. automatic monitoring of learners' performance) in hybrid teaching.				0.681	
	34. I can apply technology to create a motivating learning environment in hybrid teaching.				0.655	
	35. I can use various assessment methods (e.g. tests, questionnaires, concept maps, feedback) in hybrid teaching.				0.638	

(*continued on next page*)

Table 2 (*continued*)

Factor describing educators' hybrid teaching competence in social and health care, and health sciences fields	Factor items measured with a five-point Likert scale (1—poor; 2—moderate; 3—good; 4—very good; 5—excellent)	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
	36. I can create opportunities for learners to use digital solutions (e.g. different kinds of apps) to support interaction in hybrid teaching.				0.599	
	37. I can support both online and face-to-face learners' self-directed (without external guidance and control) progress during hybrid teaching.				0.489	
	38. I can give feedback about online and face-to-face learners' learning in hybrid teaching.				0.413	
	39. I can develop hybrid teaching in a learner-centred way.				0.375	
	40. I can identify online, and face-to-face learners' guidance needs in hybrid teaching.				0.315	
Ethical competence in hybrid teaching	41. I can consider online and face-to-face learners equally in hybrid teaching.					0.809
	42. I can assess learners' learning in a fair/equal way in hybrid teaching					0.798
	43. I can share responsibilities with colleagues (e.g. educator colleagues, technical assistants) in implementing hybrid teaching.					0.623
	44. I can assess the learners' participation in hybrid teaching.					0.495
	45. I follow ethical principles (e.g. privacy) as an educator in hybrid teaching.					0.440
	46. I can share responsibility for implementing hybrid teaching with learners (e.g. chat monitoring).					0.355
Eigenvalue		25.782	2.486	1.638	1.525	1.153
Percentage of variance explained		56.049	5.404	3.561	3.316	2.507
Total proportion of variance explained by the factor model						70.838
Cronbach's alpha		0.939	0.947	0.941	0.951	0.901

4.2.4. *Phase IV*

The internal consistency of the instrument was assessed using Cronbach's alpha (n = 206). The alpha values of the five factors ranged from 0.901 to 0.951. The alpha value for the first factor, *competence in planning and resourcing hybrid teaching*, was 0.939 (10 items); for the second factor, *technological competence in hybrid teaching*, it was 0.947 (8 items); for the third factor, *interaction competence in hybrid teaching*, it was 0.941 (10 items), for the fourth factor, *digital pedagogy competence in hybrid teaching*, it was 0.951 (12 items), and for the fifth factor, *ethical competence in hybrid teaching* (6 items), it was 0.901 (see Table 2).

5. Discussion

The aim of this study was to develop and psychometrically test the HybridEduCom instrument for the purpose of self-assessment of hybrid education competence of educators in the social and health care, and health sciences fields. HybridEduCom complements the instruments developed in prior studies (Mikkonen et al., 2020a; Redecker and Punie, 2017) by focusing particularly on educators' hybrid teaching competence. The newly developed HybridEduCom instrument measures hybrid education competence holistically, from planning and resourcing, technological aspects, interaction, digital pedagogy, and ethical perspectives.

Further, the factor analysis performed in this study revealed that more granular categorisation of the competence areas was required. For educators, *competence in planning and resourcing hybrid teaching* is important to be able to assess, for example, time and resources available and to use research evidence to improve the effectiveness of hybrid teaching (Lakhal et al., 2017; Lakhal et al., 2021; Wang and Huang, 2018; Bower et al., 2015; Zydney et al., 2020). *Technological competence in hybrid teaching* is a prerequisite for educators to be able to assess, for example, the suitability of the devices, tools, and software used in hybrid teaching and to use them (Lakhal et al., 2021; Raes et al., 2020); *interaction competence in hybrid teaching* helps ensure, for example, that both the educator and the students are able to work together and that the educator can create a safe (e.g. open, supportive, and avoiding feelings of fear) learning environment in hybrid teaching (Lakhal et al., 2021; Raes et al., 2020). Further, educators' *digital pedagogy competence in hybrid teaching* is related to mastering digital pedagogical skills relevant to hybrid teaching, such as applying technology to create a motivating learning environment (Lakhal et al., 2021). *Ethical competence in hybrid teaching* is also important for educators in order to be able to consider and resolve ethical conflicts in hybrid teaching, such as assessing and paying attention to the face-to-face students and online students learning equally (Lakhal et al., 2021; Raes et al., 2020). It is important to provide hybrid teaching education as a part of continuous education for educators in social and health care, and health sciences fields to meet current and future teaching challenges that may occur because of changes in the digital, health, and educational environments.

Hybrid teaching, at its best, can be engaging and support learning compared to fully online or fully face-to-face learning (Raes et al., 2020; Wang et al., 2018). The hybrid teaching competence of educators should not be neglected in educational fields because hybrid teaching is also an important teaching method when facing, for example, unforeseen pandemia, worldwide catastrophes, or providing an option for traditional ways of learning for students who need flexible ways to attend classes (Lakhal et al., 2021; Wang et al., 2018; Zydney et al., 2020). Thus, the HybridEduCom instrument provides the conceptual framework for developing and assessing the effectiveness of educational and training courses related to hybrid teaching and measuring the hybrid teaching competence of educators.

5.1. *Limitations and strengths*

This study has a few limitations. One limitation of this study is the low response rate, with only 206 educators in social and health care, and health sciences fields responding to the survey (response rate of 12.2 %). This may be explained by the fact that hybrid teaching is still a rather new teaching method, and many educators may not have had sufficient experience in hybrid teaching to feel comfortable enough to participate in this study. For the factor analysis, the goal was to get five respondents per item—that is, a total of approximately 245; however, only 206 responses were received (DeVon et al., 2007). On the other hand, it has also been suggested that if the data contains several high factor loading values (>0.60), the pattern may be interpreted irrespective of the sample size used, but usually 150 respondents is sufficient (Guadagnoli and Velicer, 1988; Yong and Pearce, 2013). Since there were several high factor loadings in this data set, a response rate of 206 was considered acceptable, and the low response rate does not significantly undermine the reliability of the study. Although the conceptual framework included international studies, the study was conducted only in Finland; thus, with international data collection, the instrument could have had different culturally heterogeneous characteristics. The categories and items of the newly developed instrument were translated into English using back-translation to enhance the semantic equivalence (Maneesriwongul and Dixon, 2004), as the original items were in Finnish. Scientifically accepted methods were used to develop the instrument, and the study had excellent reliability scores. The COSMIN checklist was used to improve the validity and transparency of reporting (Mokkink et al., 2010).

6. Conclusions

The instrument developed in this study can be used to measure the hybrid education competence of educators in the social and health care, and health sciences fields. The instrument can also be utilised for interdisciplinary analysis to assess hybrid teaching competence in other educational fields. Further, the instrument can be used as a conceptual framework for the design of continuous learning and training for educators and can be used in cross-sectional or longitudinal studies. It can also be used in the construction of curricula for student educators. In addition, the instrument can be translated into different languages. However, it would be useful in the future to strengthen the instrument by collecting more international data to further improve its validity and test it in an international context. Rapid technological development places additional demands on hybrid teaching competence; therefore, the instrument should be updated in the future. In addition, the content of the instrument should also be updated with the increased research on hybrid education.

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Ethical approval

The Dean of the University of Oulu provided a statement (11.1.2022) that the planned research was ethically acceptable. Ethical statement of ethical committee was not required according to Finnish data protection act: https://www.oulu.fi/en/university/faculties-and-units/eudaimonia-institute/ethics-committee-human-sciences

CRediT authorship contribution statement

Henna Jokinen: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Visualization. **Sari Pramila-Savukoski:** Conceptualization, Methodology, Formal analysis, Investigation, Writing – review & editing, Visualization. **Heli-Maria Kuivila:** Conceptualization, Methodology, Investigation, Visualization, Writing – review & editing. **Riina Jämsä:** Conceptualization, Methodology, Investigation, Visualization, Writing – review & editing. **Jonna Juntunen:** Conceptualization, Writing – review & editing. **Tiina Törmänen:** Conceptualization, Writing – review & editing. **Minna Koskimäki:** Conceptualization, Writing – review & editing. **Kristina Mikkonen:** Conceptualization, Methodology, Formal analysis, Visualization, Writing – review & editing, Supervision.

Declaration of competing interest

Given her role as Editor of the target journal, Professor Kristina Mikkonen was not involved in the peer-review of this article and has no access to information regarding its peer-review. An independent editor was given full responsibility for the editorial process of this article.

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