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Cooperative learning interventions and associated outcomes in future teachers: A systematic review☆

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ABSTRACT

The use of cooperative learning as a pedagogical framework in teacher-training colleges and universities has gained special relevance in the last decade. What do we know about the impact of cooperative learning-based interventions on future teachers so far? The purpose was to provide a contemporary picture on cooperative learning interventions in teacher education students conducting a systematic review. More specifically, this paper aimed to answer the following research questions: (1) What was the focus of studies investigating the benefits of cooperative learning in future teachers? (2) Which learning outcomes have been observed? (3) What were the main effects in student-teachers? Several electronic literature databases were involved in the process (Web of Science, EBSCO host, Scopus, ERIC, PsycINFO, SciELO). Quantitative, qualitative or mixed intervention studies were assessed. Nineteen eligible articles, involving 1944 teacher education students, were included to evaluate, organize and produce a high-level synthesis of evidence of this methodological approach. A comprehensive literature review is presented on its effects and learning outcomes. Findings showed that this teaching strategy can be useful for teacher education students' global development: content knowledge, pedagogical content knowledge, personal, inter-personal and transversal skills, and professional skills and competencies. Unfortunately, these improvements are not linear and they need time and high-structured experiences. Cooperative learning has been found a positive framework in teacher education programs worldwide to train future teachers. Formative implications and future research are discussed.

Intervenciones de aprendizaje cooperativo y resultados asociados en futuros docentes: Una revision sistemática

Palabras clave:
Aprendizaje cooperativo
Formación del profesorado
Revisión sistemática

RESUMEN

El uso del aprendizaje cooperativo como marco pedagógico en los centros universitarios de formación del profesorado ha cobrado especial relevancia en la última década. ¿Qué sabemos hasta ahora sobre el impacto de las intervenciones de aprendizaje cooperativo en los futuros docentes? El propósito de este estudio ha sido proporcionar una imagen contemporánea sobre la utilización del aprendizaje cooperativo en la formación del profesorado mediante una revisión sistemática. Más específicamente, este estudio ha tenido como objetivo responder a las siguientes preguntas de investigación: (1) ¿Cuál ha sido el enfoque de los estudios que investigaron los beneficios del aprendizaje cooperativo en la formación del profesorado? (2) ¿Qué resultados de aprendizaje se han observado? (3) ¿Cuáles han sido los principales efectos en los futuros docentes? Varias bases de datos electrónicas han sido empleadas en el proceso de búsqueda (Web of Science, EBSCO host, Scopus, ERIC, PsycINFO, SciELO). Estudios de intervención cuantitativos, cualitativos o mixtos han sido analizados. Un total de 19 artículos, involucrando a 1944 estudiantes, han sido incluidos para evaluar, organizar y producir una síntesis de calidad sobre la evidencia en el empleo de este enfoque metodológico. Se presenta una revisión exhaustiva de la literatura sobre sus efectos y

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resultados de aprendizaje. Los hallazgos muestran que esta estrategia de enseñanza puede ser útil para el desarrollo global de los futuros docentes: conocimiento del contenido, conocimiento del contenido pedagógico, habilidades personales, interpersonales y transversales, y habilidades y competencias profesionales. Desafortunadamente, estas mejoras no son lineales y necesitan tiempo y experiencias altamente estructuradas. El aprendizaje cooperativo se ha mostrado como un formato instructivo positivo en los programas de formación de docentes de todo el mundo. Se discuten las implicaciones formativas y la investigación futura.

Introduction

Teaching is a challenging but rewarding profession. What makes a great teacher? What is needed to become a better teacher? All around the world, there is interest to uncover the key elements needed to be effective in teacher training contexts (Symeonidis, 2020). Some of them have been connected to teaching and learning methodologies (Vermunt & Endedijk, 2011). For example, active participating strategies have been claimed to develop successful teachers (Lavigne & Good, 2019).

Content knowledge and the teaching methods associated have also been considered two essential components in teacher education and teacher professional development (Johnson & Johnson, 2017). Regarding the second one, *cooperative learning* (CL) is considered a student-centred pedagogical practice of interest in preservice teacher education (Abramczyk & Jurkowski, 2020). Three basic types of classroom goals structures have been identified: individualistic, competitive and cooperative (Johnson & Johnson, 1994). Alternatively to work alone or against each other, in CL contexts students work together to achieve common goals (Johnson et al., 2015). However, it is not as simple as putting individuals in groups to work (Khun, 2015). CL is much more than just the idea of working together.

There are five elements that mediate the effectiveness of CL (Johnson & Johnson, 2005): (1) *Positive interdependence*: individuals reach their group goals only if their groupmates achieve them too, (2) *Individual accountability*: each group member is responsible for his/her part of the groups' work, (3) *Promotive interaction*: group members must support each other while working, (4) *Group processing*: groups must assess their functioning to decide what actions should stay and which should be modified, and (5) *Social skills*: individuals learn to help each other, to debate or to share resources. Johnson et al. (2009) proposed three ways to structure CL in educational contexts: (a) *formal CL*: students work together during one or several lessons; (b) *informal CL*: participants work together only a few times; and (c) *cooperative base groups*: participants work in long-term and stable groups. Finally, different CL techniques have been implemented in educational contexts: Learning Together, Jigsaw, Teams-Games-Tournament, Co-op Co-op or Think-Pair-Share.

Four major theoretical perspectives have been identified on CL (Slavin, 2014): (a) *Motivational*: task motivation is the key element of the teaching-learning process; (b) *Social-cohesion*: group cohesiveness is the most important factor for the group to be effective; (c) *Cognitive*: mental processing of information is promoted by the groups' interactions to increase students' achievement; and (d) *Developmental*: collaboration between group members help them operate within one another's proximal zones of development (Vygotsky, 1978) and advance more than what they could do individually. Nevertheless, the four perspectives can be connected because group cohesion can enhance group interactions, which can motivate individuals to engage in mental processes to help each other master the tasks and learn (Slavin, 2014).

Over the last four decades, research has documented CL effectiveness on students' learning at various levels of schooling and across different subject domains (Gillies, 2014). Similar positive benefits have also been found in higher education (Chan et al., 2021; Johnson et al., 2014; Supanc et al., 2017). For example, CL has been shown to be more effective than other teacher-centered methods (e.g. direct instruction) when implemented in teacher education students (Cohen & Zach, 2013; Legrain et al., 2018). Understanding the effects of CL in preservice teachers is very important, given their proximity to future teaching practice at schools. In addition, CL can be a great teaching strategy to connect student-teachers, in-service teachers and teacher educators, making easier the communication and collaboration of these three groups of educators (Lawson et al., 2020).

In educational research, most interventions tend to be conducted in a variety of contexts and using a diverse range of methodological approaches (Cohen et al., 2018). Thus, it seems necessary to carry out evidence-based research synthesis that portrays a more comprehensive view on a topic (Suri, 2014). Based on these ideas, the aim of this study was to provide a broader and contemporary picture on CL interventions in teacher education conducting a systematic review. To our knowledge, no similar study has been published. Systematically review research can provide a rich understanding of this topic. Thus, the following general research question was formulated: What do we know about the impact of cooperative learning interventions on future teachers so far? More specifically, this paper aimed to answer the following research questions: (1) What was the focus of studies investigating the benefits of cooperative learning in future teachers? (2) Which learning outcomes have been observed? (3) What were the main effects in student-teachers?

Method

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines (PRISMA, Moher et al. 2015). Additionally, scientific rigour was observed following these stages of research synthesis (Cohen et al., 2018): formulate a problem, search for relevant literature, extract relevant information from selected studies, integrate findings across studies, and present the findings as a scientific report. The protocol was registered at the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) with the number 202180099 and the DOI number 10.37766/inplasy2021.8.0099.

Information sources and search strategy

Six electronic literature databases were involved in the process (Web of Science, EBSCO host, Scopus, ERIC, PsycINFO, SciELO). A combination of keywords and filters were used with the Boolean logic-commands "AND" and "OR". Searches included article titles, abstracts and keywords following this query string: [("cooperative learning" OR "collaborative learning") AND ("preservice teacher*" OR "prospective teacher*" OR "student* teacher*" OR "future teacher*" OR "teacher education" OR "higher education" OR "teacher* training") AND ("intervention*" OR "program*" OR "effect*" OR "experimental group" OR "control group" OR "compar-

ison group")]. For a greater systematization of the search process, the same query string was used for all search engines. No previous research has addressed a systematic review on this topic. Therefore, to obtain a contemporary picture of the field, a 20-year reviewing period was selected.

Eligibility criteria

Empirical studies had to meet the following inclusion criteria: (1) Peer-reviewed journal articles indexed in the Journal Citation Reports (JCR) or the Scimago Journal Rank (SJR), published and written in English from January 2001 to December 2020, (2) CL interventions including fundamental CL elements, CL structures (e.g. jigsaw) or similar cooperative teaching strategies, (3) Intervention studies (quantitative, qualitative or mixed design approaches), and (4) Teacher education programs in a university degree to train graduates to teach in the different educational stages prior to college.

Upon selection of the articles, researchers ensured that the studies met the "Population, Intervention, Comparison and Outcome" (PICO) standards (Liberati et al., 2009). *Population*: student-teachers of any ethnicity or country enrolled in university training. *Intervention*: studies that assessed effects and reported the impact on learning outcomes. Comparison: learning outcomes were assessed post-intervention and/or compared with control, equivalent or comparison groups. *Output*: the studies identified changes in learning outcomes.

Exclusion criteria were: (1) Cross-sectional designs, (2) Group or team work studies without guaranteeing the fidelity of a CL-based intervention, (3) Combining CL with other teaching strategies, (4) Other university degrees (e.g. law, engineering, veterinary) (5) Implementations conducted in courses, seminars or other short formats outside the university context.

Data extraction and risk of bias

The potentially eligible studies were initially screened (titles and abstracts) by two independent researchers (with ample previous experience in systematic reviews in educational contexts) following the previously mentioned criteria (search protocol) prepared in advance (Viswanathan et al., 2018). In those studies with unclear abstracts and/or titles, discrepancies were solved through discussion and consensus (Higgins et al., 2019). In a second phase, the two researchers, independently, read the full-texts of the articles preselected in the previous phase, creating the final list of potentially eligible studies. A third investigator was used when no consensus was reached regarding acceptability (van Sluijs et al., 2007). Finally, the full-texts of the screened articles were carefully examined for further analysis.

Study identification and selection

A total of 2.820 records were identified (Web of Science = 699, EBSCO host = 1.257, Scopus = 3, ERIC = 199, PsycINFO = 631, SciELO = 31). From an initial pool of 1.337 non-duplicated papers, 1.298 were excluded attending to the eligibility criteria and the PICO strategy (cross-sectional = 65, wrong CL-based intervention = 971, wrong population = 186, wrong context = 76). After reading the full-texts, 20 more studies were excluded due to: not including student teachers ($n = 4$), not focusing on teacher education ($n = 11$), and being conducted in courses/seminars outside the university context ($n = 5$). Finally, 19 studies fulfilled the inclusion criteria and were selected for further analyses (Figure 1). A chronological analysis of the studies considered in this systematic review revealed the recent development of this area of research, highlighting that 12 articles were published between 2016 and 2020 (the last five years).

Quality appraisal and certainty of evidence

First, the quality assessment of this systematic review, including risk of bias, was checked using the Assessing the Methodological Quality of Systematic Reviews (AMSTAR-2) tool (Shea et al., 2017). Global rating was calculated from 16 items described in Chart 1 . The AMSTAR-2 allows to classify reviews into four quality levels based on weaknesses or flaws: (1) *High*: no or just one non-critical weakness; the review provides an accurate and comprehensive summary of the results; (2) *Moderate*: more than one non-critical weakness, but no critical flaws; the review provides an accurate summary of the results; (3) *Low*: one critical flaw, with or without non-critical weaknesses; the review may not provide an accurate and comprehensive summary of the results; and (4) *Critically low*: more than one critical flaw, with or without non-critical weaknesses; the review should not be relied on to provide an accurate and comprehensive summary of the results. This systematic review reached moderate quality. The absence of meta-analyses led to this modest rating, but it should be considered that it examined a complex domain with a large variety of methodological approaches (Cohen et al., 2018).

Second, to guarantee the selection of relevant articles and obtain a quality score on each study, a checklist used in a recent review on CL in educational contexts was used (Bores-García et al., 2021). It was based on the following criteria: (a) description of the program; (b) JCR/SJR journal; (c) detailed methodological description; (d) sample or number of participants; and (e) length of the implementation. Each item was scored from 0 to 2 using the criteria described in Table 1. A total quality score for each one of the selected publications was calculated adding all the scores. Finally, studies were classified as: (a) low quality: score lower than 3; (b) moderate quality: score between 4 and 6; and (c) high quality: score of 7 or more. A total of 17 studies included in this systematic review reached high quality, and the remaining two moderate.

Results

Results are discussed regarding the elements used in the categorization of the 19 articles presented in Chart 2 : (a) year and country, (b) participants and length, (c) type of research, (d) design, intervention program and content, (e) purpose and main findings, and (f) learning outcomes.

Year and country

The use of CL as a pedagogical practice in teacher-training colleges and universities has gained special relevance in the last decade, since the vast majority of studies (15) have been conducted from the year 2010, except for two which were published very close to this year (Bulut, 2009; Hornby, 2009) and another two from the beginning of the previous decade (Veenman et al., 2002; Veenman et al., 2003). The momentum observed in the use of CL in teacher education over the last decade is taking place mainly in Europe, since most studies have been conducted in European countries (8), especially in countries like Spain (Cecchini et al., 2020; Fernández-Rio et al., 2014; Larraz et al., 2017; Palomares-Montero & Chisvert-Tarazona, 2016) or Germany (Kaendler et al., 2016; Supanc et al., 2017). Nevertheless, researchers from very different countries like Turkey (Öztürk & Kalyoncu, 2018; Tombak & Altun, 2016), Israel (Cohen & Zach, 2013), South Africa (Mentz & Van Zyl, 2018), the United States (Egger, 2019), Indonesia (Halimah & Sukmayadi, 2019) and Kuwait (Al-Yaseen, 2020) have also used and studied CL in their teaching training programs. In the same

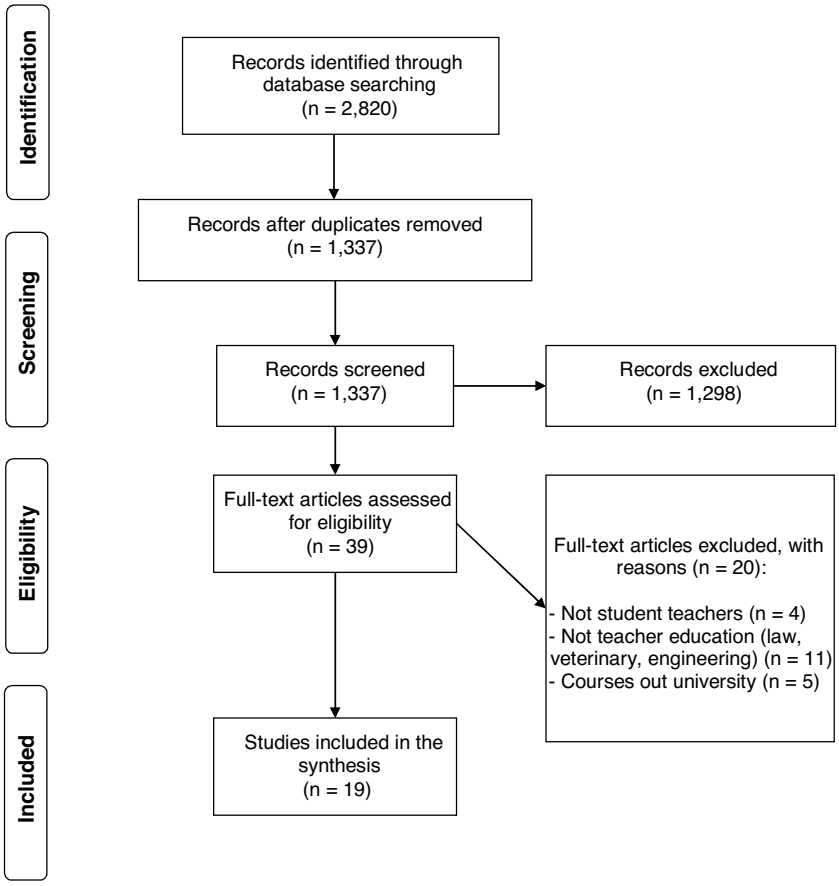

Figure 1. Flow-chart of studies selection procedure.

Chart 1
Quality assessment of the systematic review (AMSTAR-2)

AMSTAR-2 Items	Appraisal
1. Did the research questions and inclusion criteria for the review include the components of PICO?	Y
2. Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?	Y
3. Did the review authors explain their selection of the study designs for inclusion in the review?	Y
4. Did the review authors use a comprehensive literature search strategy?	Y
5. Did the review authors perform study selection in duplicate?	Y
6. Did the review authors perform data extraction in duplicate?	Y
7. Did the review authors provide a list of excluded studies and justify the exclusions?	Y
8. Did the review authors describe the included studies in adequate detail?	Y
9. Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review?	PY
10. Did the review authors report on the sources of funding for the studies included in the review?	Y
11. If a meta-analysis was performed, did the review authors use appropriate methods for statistical combination of results?	NM
12. If a meta-analysis was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis?	NM
13. Did the review authors account for RoB in primary studies when interpreting/discussing the results of the review?	Y
14. Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?	Y
15. If they performed quantitative synthesis, did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review?	NM
16. Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?	Y
Global quality rating	Moderate

Note. N = No; Y = YES; PY = Partial Yes; NM = No Meta-analysis conducted.

line, three of the four studies conducted prior to this last decade, came from European countries: the Netherlands (Veenman et al., 2002; Veenman et al., 2003) and England (Hornby, 2009), and the one from Turkey (Bulut, 2009). Therefore, CL seems to be a consolidated pedagogical approach in the teacher training European tradition, but it is slowly permeating in countries all over the world. This expansion is expected to keep growing over the next decade.

Participants and length

A total of 1.944 teacher education students were involved in the 19 assessed studies. In addition, 1.063 pupils of these future teachers were assessed to test if the prospective teachers correctly implemented the different CL techniques used (Veenman et al., 2002). The studies' sample size varied widely from only 32 (Palomares-Montero & Chisvert-Tarazona, 2016) to 332 (Cecchini et al., 2020) pre-service teachers. In those studies where gender was

Chart 2
Summary of cooperative learning intervention studies in teacher education

Author(s), year and country	Participants and length	Type of research	Design, intervention program and content	Purpose	Main findings and conclusions	Learning outcomes
Veenman et al. (2002) Netherlands	College A: 42 third-year student teachers (treatment group) / 10 lessons. S1: 19 student teachers (17 female and 2 male) S2: 38 student teachers S3: 908 pupils (429 girls and 479 boys), 39 primary schools (grades 3-6). S4: 41 student teachers College B: 17 second-year student teachers (treatment and control groups) / 12 lessons. S1: 17 student teachers (11 in treatment group and 6 in control group) S2: 16 student teachers (10 in the treatment group and 6 in the control group) S3: 155 pupils from 7 primary school classes (74 girls and 81 boys; grades 1-6). S4: 10 student teachers (treatment group)	Quantitative: observation and questionnaires	Pre-test-post-test control group design Learning together, structural approach and five-element of CL (treatment groups) and free method (control groups) Course on CL and mathematics, reading, social studies and expressive subjects were the content areas in which CL was used most frequently The student teachers were free to choose a subject of their own choice (but not physical education) for applying CL activities	To describe the effects of the implementation of a course on cooperative learning for future teachers: (1) find out if future teachers show a more positive attitude towards CL after taking the CL course, (2) value the CL course, (3) implement the desired CL teaching behaviors as presented in the course, as well as, (4) if the course on CL appear to affect pupil engagement rates in classes with student teachers who participated in the course, and (5) if the pupils of student teachers who participated in the course on CL perceive working in CL groups	A significant treatment effect was found for four of the five basic elements regarded as essential for a lesson activity to be cooperative: positive interdependence, face-to-face interaction, social skills and group processing. A course on CL can have a positive effect on the cooperative instructional skills of student teachers. The positive attitudes of the student teachers towards CL show they view CL as a worthwhile instructional strategy. In addition, the course had a positive effect on the engagement rates of the pupils of student teachers in the treatment condition. Also, the pupils taught by the treatment student teachers also showed positive attitudes towards working in groups and rated the benefits of working in groups relative to working alone quite positively.	Student teachers: 5 key elements of CL (positive interdependence, individual accountability, face-to-face interaction, social skills, group processing) Monitoring Workgroups Willingness to use CL Positive attitudes towards CL Positive attitudes towards group work management Pupils: Pupil engagement rates Benefits of CL for pupils Positive experiences with working in groups Benefits of working in groups versus working alone
Veenman et al. (2003) Netherlands	College A (second-year student teachers): treatment group ($n = 16$) control group ($n = 2$) College B (first -year student teachers): treatment group ($n = 30$) control group ($n = 15$) Collage C (second-year student teachers): treatment group ($n = 19$) control group ($n = 10$) 3 weeks (3 workshops, 3 hours each)	Quantitative: observation schedule and course evaluation questionnaire	Pre-test-post-test control group design Treatment group: course on direct and activating instruction - direct instruction and four CL structures (Think-Pair-Share, Numbered-Heads Together, Pairs, and Placema) Control group: another course not defined. Mathematics	To examine the effects of a course involving elements of direct instruction and CL on the instructional behaviors of prospective primary school teachers	The course on direct and activating instruction positively influenced the instructional skills of student teachers. Although student teachers showed less success with the use of cooperative-practice activities, so cooperative activities that were undertaken were not clearly structured and less than half of them succeeded in CL activities during their lessons. Also, student teachers rate both the internal and external quality of the training manual, the workshops, and the practicality of the course very positively.	Instruction skills Attitude towards course

Chart 2 (*Continued*)

Author(s), year and country	Participants and length	Type of research	Design, intervention program and content	Purpose	Main findings and conclusions	Learning outcomes
Bulut (2009) Turkey	92 undergraduate students (66 females, 26 males) Treatment group ($n = 52$) Control group ($n = 40$) 16 weeks (20 meetings)	Quantitative: questionnaires (SEI, CLUS, CLAS), class achievement and grades, class attendance, and group discussions	Pre-test-post-test control group design CL instruction (treatment group) and traditional lecture classes (control group) Psychology: Child and Adolescent Development class	To investigate the effect of CL techniques on pre-service teachers' cooperative learning usage, CL attitude, self-esteem, class and discussion group (case) grades, and class and discussion group attendance	CL techniques have a positive effect on college students'self-esteem, attitude toward cooperative learning, usage of CL, class and case achievement grade, and class and case attendance rates.	Self-esteem CL usage CL attitude Class attendance Case attendance Class achievement grade Case achievement grade
Hornby (2009) England	44 third-year Bachelor of Education students (41 females, 3 males) Treatment group ($n = 23$) Control group ($n = 21$) 2 hours	Mixed: Multi-choice test and post- intervention questionnaire (both with an open-ended question)	Pre-test-post-test control group design Same content for both groups through Jigsaw II. Individual accountability and positive interdependence were built into the workshop for the treatment group but were not included for the control group Foundation course: cooperative learning	To investigate the impact of group work involving individual accountability and positive interdependence on the academic achievement and experiences of teacher trainees	To achieve optimum effectiveness, individual accountability and positive interdependence should be built into cooperative learning activities. Although the inclusion of these two elements don't significantly affect students' experiences and attitudes towards CL	Individual accountability Positive interdependence Students' experiences Attitudes towards CL
Ruys et al. (2011) Belgium	105 second-year student teachers Four 2 -hs training workshops and 7-month practical apprenticeship	Mixed: TSES, CLIQ, ECLIS and assessment tasks	One-group design CL training workshops and practical apprenticeship based on CL Different subject as Dutch (mother tongue), Social studies and science, Religious/moral education, Physical education, Music/art, and French (second language)	To explore the skills of future teachers in relation to the implementation of CL using a multilevel repeated measures design	Student teachers generally perform well in implementing CL. Skills improve over time, although this is not linear, being closely linked to the feeling of teaching effectiveness. In addition, training sessions and pedagogical knowledge have a negative impact on the organization	Teachers' skills of CL implementation: Introduction Organizational guiding Socio-affective guiding (Meta-) cognitive guiding Realization of key principles of CL Evaluation Knowledge about CL Conceptions about CL General teaching self-efficacy Self-efficacy in using CL
Cohen & Zach (2013) Israel	49 undergraduate students CLG ($n = 25$) DIG ($n = 24$) 15-weeks methods class (once a week for 90 minutes)	Quantitative: PETE self-efficacy questionnaire and rubrics	Pre-test-post-test control group design CLG: CL method classes DIG: Classes of different models of instruction Physical education: methods	To examine whether the CL teaching model contribute to the teaching efficacy and planning skills of student teachers	DIG perceived their teaching efficacy to be higher than did the CLG, but the CLG included more cooperation principles in their planning compared to their counterparts	Teaching self-efficacy Planning skills

Chart 2 (*Continued*)

Author(s), year and country	Participants and length	Type of research	Design, intervention program and content	Purpose	Main findings and conclusions	Learning outcomes
Fernández-Rio et al. (2014) Spain	264 students of primary education teacher training Treatment group (n = 130; 87 females and 43 males) Control group (n = 134; 89 females and 45 males) 12 weeks (24 sessions of one hour)	Quantitative: ad hoc questionnaires designed using different validated subscales (PMCSQ-2, BPNS, PLOC, SGS-PE, PES)	Pre-test-post-test control group design Learning together and coop-coop (treatment group) and traditional teaching strategies (control group) Physical education	To analyze how the cooperative learning teaching model influences perceptions of competence, levels of self-determined motivation, social goals related to responsibility and relationships, effort, and boredom in class, in a group of university students	Significant improvements were observed in the experimental group only in terms of levels of perceived competence, self-determined motivation, effort, responsibility and relationships, and a significant decrease in boredom was observed. Regarding gender, women showed significantly different results in competition and boredom	Cooperative learning Perceived competence Motivation (intrinsic motivation, identified regulation, introjected regulation, external regulation, amotivation) Social goals (responsibility, relationships) Effort Boredom
Kaendler et al. (2016) Germany	107 pre-service female teachers of university teacher training program for higher track secondary schools Treatment group (n = 74) Control group (n = 33) 4 hours training program	Quantitative: scale monitoring indicators (to rate three videos)	Pre-test-post-test control group design Collaborative training program across four phases: (1) e-learning environment, (2) pre-test, (3) training phase, and (4) post-test. Treatment group received training phase (CL environment) Control group did not received training phase Mathematics	To show whether video-based collaborative training program can successfully foster monitoring competency, specifically noticing beneficial student interactions	Monitoring competency increases significantly in the video-based collaborative training program, that can effectively enhance pre-service teachers' noticing of behavioral indicators of collaborative, cognitive, and metacognitive student activities in a relatively short time	Monitoring competency
Palomares-Montero & Chisvert-Tarazona (2016) Spain	32 Master's degree in secondary education teaching students 5 face-to-face work sessions (two and a half hours each) and 10 hours of extra study time	Mixed: academic results (grade), observation, field diary, rubric and assembly	One-group design Short film in 3 phases (Co-op Co-op CL technique): (1) planning and organizing the task, (2) creation of the short film, and (3) evaluation of the results Speciality in Technology and Industrial Processes of the Master's degree in secondary education teaching: subject 'Educational Processes and Contexts'	To develop attitudes and skills for cooperative learning in future secondary education teachers	The CL experience was satisfactory. CL increases student's performance and participation, as well as, decision-making, group work, creativity, flexibility, and critical spirit	Student's performance Participation Decision-making Group work Creativity Flexibility Critical spirit
Tombak & Altun (2016) Turkey	80 pre-service teachers (54 male and 26 female) 4-week period (2 hours each lesson per week)	Mixed: questionnaire "Motivational and self-regulated learning components of classroom academic performance", and document analysis	Pre-test-post-test control group design Jigsaw and Team-game-tournament techniques English teaching Computer teaching	To investigate the effects of CL on students' motivation and products at university level	Both the qualitative and quantitative data supported the positive effect of CL on students' motivation and CL strategies	Motivation (self-regulation, intrinsic value, task value, learning belief, self-efficacy, exam anxiety) Student products

Chart 2 (*Continued*)

Author(s), year and country	Participants and length	Type of research	Design, intervention program and content	Purpose	Main findings and conclusions	Learning outcomes
Larraz et al. (2017) Spain	127 student teachers Four months (six weekly sessions of one hour)	Mixed: ad hoc questionnaire (25 closed answer items and 3 open questions), observation and team notebooks	One-group design CL techniques: Aronson's puzzle or Jigsaw, STAD, research groups, Metaplan, peer tutoring, tournament learning, Phillips 66 Mandatory course: Curriculum subject in different contexts	To analyze and assess the impact of CL in the acquisition of generic skills (transversal skills) in teaching students.	CL could promote the acquisition of transversal skills as: personal skills (teamwork, interpersonal relationships, and ethical commitment); instrumental skills (verbal and written communication, problem-solving and decision-making and the ability to analyze and synthesize); and systemic skills (independent learning and motivation for quality). Furthermore, teamwork has benefited the whole of students, allowing them to achieve higher quality learning and more effective performance.	Transversal skills: Instrumental skills Personal skills Systemic skills
Supanc et al. (2017) Germany	259 first-year student teachers (74 male and 185 female) HSCL: 84 students in 18 small groups LSCL: 86 students in 17 groups, and GP: 89 students in 24 presentation groups. 14 sessions (one session per week; 90 minutes per session)	Quantitative: final school grades, questionnaires, and tests	Comparison groups design HSCL, LSCL and GP Psychology	To examine the impact of high structure versus low-structure CL on student teachers' conceptual knowledge, on their self-perceived competence, and on their appraisals of task values	Students in the two cooperative conditions did better on three knowledge tests administered throughout the course of this one-semester project, developed a more favorable view of their subject-specific competence, and appraised the utility and intrinsic value of task assignments more positively than did the control students. In each of the three knowledge tests, students in high-structure groups outperformed students in low-structure groups	Conceptual knowledge Self-perceived competence Subjective task values
Mentz & Van Zyl (2018) South Africa	37 pre-service teacher education students 12 weeks (four sessions of 50 minutes each per weed)	Mixed: SRSSDL, ad hoc questionnaire and interviews	Pre-test-post-test control group design Different CL strategies were implemented each week as part of the intervention. Also, all the elements of CL were included in each learning opportunity Computer Applications Technology: theoretical aspects of computer hardware and software	To discover whether a relationship exist between the implementation of CL strategies in CAT classes and the SDL skills of students. Also, to determine whether CL has a similar or different effect on students' perceived level of SDL skills	CL in the CAT class increased students' perceived SDL in cases where students did not already possess a high level of self-directedness in learning. So, CL might be a valuable strategy to increase SDL amongst students who have moderate levels of self-directedness	Self-directed learning skills: Awareness Learning strategies Learning activities Evaluation Interpersonal skills

Chart 2 (*Continued*)

Author(s), year and country	Participants and length	Type of research	Design, intervention program and content	Purpose	Main findings and conclusions	Learning outcomes
Öztürk & Kalyoncu (2018) Turkey	37 pre-service teachers (12 male and 25 female) Treatment group (n = 19): 6 male and 13 female Control group (n = 18): 6 male and 12 female 8 weeks (2 lessons per week, 2 hours each)	Quantitative: music theory test, musical writing (dictation) test, MET lesson anxiety scale, and state-trait anxiety inventory	Pre-test-post-test control group design Treatment group: cooperative learning (STAD technique) Control group: instruction, Q&A, discussion Music	To examine whether or not the CL method has an effect on lesson anxiety, test anxiety/state anxiety, and achievement in MET lessons	CL has shown no significant effect on the achievement in music theory and in musical writing, and likewise on exam anxiety/state anxiety. However, significant positive effect of CL on lesson anxiety in MET classes has been found	Lesson anxiety Test anxiety/state anxiety Achievement
Legrain et al. (2018) France	69 PE pre-service teachers (46 males and 23 females) CL (n = 21): 14 males and 7 females CLS (n = 28): 20 males and 8 females DI (n = 20): 12 males and 8 females 7 sessions	Quantitative: eight items of the PETE questionnaire, techniques were videotaped and scored, and knowledge questions	Pre-test-post-test comparison groups design Five phases: theoretical basis, pre-test, teacher training period, instructional sessions (CLS, Jigsaw; CL, Jigsaw; DI), and post-test Physical education (French-boxing)	To consider whether PE pre-service teachers are trained during short training sessions aimed to discover new physical activities. Examining the influence of a scaffolding procedure (CLS design) on PE pre-service teachers' knowledge, skills, and self-efficacy in comparison to a CL and a DI experience	Participants in the three conditions progressed on performance, knowledge for practice, knowledge for teaching, and self-efficacy. Although no difference was found in self-efficacy between the three training conditions over time, significant differences appeared on pedagogical knowledge or/and motor skills with an advantage for the CL and CLS participants, respectively	Teaching self-efficacy Performance Knowledge for practice Pedagogical knowledge
Egger (2019) United States	59 participants: elementary generalist education majors (50) and special education majors (9) Treatment group: 29 (23 elementary education majors and 6 special education majors) Control group: 30 (27 elementary education majors and 3 special education majors) Six weeks (3 times per week for 50 minutes on Mondays and Wednesdays, and 110 minutes on Fridays)	Quantitative: rubrics, IMOM and interest survey	Control group design 4 course sections: two course sections worked in a CL environment (treatment group) and two course sections worked individually (control group) Music methods course	To investigate the effect of a CL environment on preservice generalist elementary teachers' interest in, and the integration of music into core academic subjects	Participants in the cooperative learning group scored statistically significantly higher on the music integration project and rated statistically significantly higher interest on their projects. So, participants in the CL group produced work of a higher quality than participants in the control group and that the CL group also showed a higher level of interest in their own music integration projects	Preservice teachers' interest in music Preservice teachers' integration of music

Chart 2 (*Continued*)

Author(s), year and country	Participants and length	Type of research	Design, intervention program and content	Purpose	Main findings and conclusions	Learning outcomes
Halimah & Sukmayadi (2019) Indonesia	60 fourth-year pre-service teachers Class A: 30 participants Class B: 30 participants 14 sessions (100 minutes each)	Qualitative: observation, field notes, and interviews	One-group design (case study) Jigsaw CL technique Subject course: learning and curriculum	To explore the role of Jigsaw model for prospective teachers' understanding of pedagogical content knowledge and how it can be integrated with their instructional communication skills	Jigsaw technique can be considered as one of the most effective ways to encourage students to participate actively in learning and to enhance their communication skills	Pedagogical knowledge Communication skill
Al-Yaseen (2020) Kuwait	40 female student teachers Treatment group: 20 Control group: 20 6 weeks (18 classes, 1 hour each)	Quantitative: speaking test, rubric, and attitude questionnaire	Pre-test-post-test control group design Treatment group: Jigsaw technique Control group: traditional method English	To examine the impact of jigsaw as a cooperative learning technique on enhancing the speaking skill of English language student teachers with a focus on fluency, accuracy, use of vocabulary, and correct pronunciation	The application of the jigsaw technique statistically significantly improved the speaking competencies of the experimental group in their use of vocabulary, correct grammar, fluency, and correct pronunciation. Furthermore, results showed a positive attitude of the experimental group towards CL and the jigsaw technique	Speaking skills (fluency, accuracy, use of vocabulary, correct pronunciation) Attitudes towards CL and the jigsaw technique
Cecchini et al. (2020) Spain	332 first-year student teachers T0: everyone / 10 sessions T1 to T2: HSCL (171 students), and LSCL (161 students) /10 sessions	Quantitative: two close-questions tests, CLQ, the sub-scale intrinsic motivation of the EME and, the sub-scale responsibility goals of the SGS	Pre-test-post-test comparison groups design T0: LSCL T1 to T2: HSCL and LSCL (five-element of CL) Physical education	To compare the effects of two different CL programs: HSCL vs LSCL assessing the variables that mediate its effectiveness, CL regulation dominance in both groups, and the potential benefits of an HSCL program to increase prospective teachers' intrinsic motivation, content knowledge and responsibility	Participants in the HSCL group significantly increased more the five variables that mediate CL effectiveness. Moreover, there was a significant increase in shared-regulation dominance, and a decrease in self and other-regulation dominance in the HSCL group, while there was an increase in other and shared-regulation dominance in the LSCL group. Students in the HSCL group significantly increased more their intrinsic motivation, content knowledge and responsibility.	5 key elements of CL (social skills, group processing, promotive interaction, positive interdependence, individual accountability) Regulation dominance Intrinsic motivation Content knowledge Responsibility goals

Note. S = sample; NAEP-Science Test = national assessment of education progress-science test; ISE = instructional strategies evaluation; CL = cooperative learning/collaborative learning; SEI = self-esteem inventory; CLUS = cooperative learning usage survey; CLAS = cooperative learning attitude survey; TSES = teachers' sense of efficacy scale; CLIQ = cooperative learning implementation questionnaire; ECLIS = evaluation of collaborative learning implementation scale; CLG = cooperative learning group; DIG = direct instruction group; PETE = physical education teaching education; PMCSQ-2 = perceived motivational climate in sport questionnaire; BPNS = basic psychological needs scale; PLOC = perceived locus of causality scale; SGS-PE = social goals scale-physical education; PES = persistence and effort scale; HSCL = high-structure cooperative learning; LSCL = low-structure cooperative learning; GP = group presentation; SRSSDL = self-rating scale of self-directed learning; CAT = computer applications technology; SDL = self-directed learning; MET = musical ear training; STAD = student teams-achievement divisions; Q&A = questions and answers; PE = physical education; CLS = cooperative learning with scaffolding; DI = direct instruction; IMOM = integrated music observation map; CLQ = cooperative learning questionnaire; EME = echelle de motivation in education; SGS = social goals scale.

Table 1
Investigations' quality score checklist

Research	Program description	JCR/SJR inclusion	Methodology	Sample	Length	Total score	Quality level
Veenman et al. (2002)	2	2	2	2	2	10	HQS
Veenman et al. (2003)	2	2	2	2	1	9	HQS
Bulut (2009)	1	2	2	2	2	9	HQS
Hornby (2009)	2	2	2	1	0	**7**	HQS
Ruys et al. (2011)	1	2	1	2	2	8	HQS
Cohen & Zach (2013)	1	2	1	1	2	**7**	HQS
Fernández-Rio et al. (2014)	2	2	2	2	2	10	HQS
Kaendler et al. (2016)	2	2	1	2	0	7	HQS
Palomares-Montero & Chisvert-Tarazona (2016)	2	2	2	1	1	8	HQS
Tombak & Altun (2016)	1	2	1	2	0	6	MQS
Larraz et al. (2017)	2	1	2	2	2	9	HQS
Supanc et al. (2017)	2	2	2	2	1	9	HQS
Mentz & Van Zyl (2018)	1	1	2	1	1	6	MQS
Öztürk & Kalyoncu (2018)	1	1	2	1	2	7	HQS
Legrain et al. (2018)	2	2	2	2	0	8	HQS
Egger (2019)	2	2	2	2	2	10	HQS
Halimah & Sukmayadi (2019)	2	1	2	2	2	9	HQS
Al-Yaseen (2020)	2	1	2	1	2	8	HQS
Cecchini et al. (2020)	2	2	2	2	2	10	HQS

Note. Program description (did the research offer a detailed description of the program?): '0' = not included, '1' = brief and undetailed description, and '2' = detailed description; JCR/SJR inclusion (was the study published in a journal indexed on the JCR or SJR?): '0' = not indexed, '1' = indexed on SJR, and '2' = indexed on JCR; methodology (did the paper report in detail the methodological process used?): '0' = not reported, '1' = reported but imprecise (not completely), and '2' = exhaustive description reported; sample (number of participants): '0' = fewer than 10 participants, '1' = from 10 to 50 participants, and '2' = more than 50 participants; length (duration): '0' = less than eight lessons, '1' = from nine to 14 lessons, and '2' = more than 15 lessons; quality level (calculated by adding all the scores): low quality (LQS) = score lower than 3, moderate quality (MQS) = score between 4 and 6, and high quality (HQS) = score of 7 or more; JCR, Journal Citation Report; SJR, Scimago Journal Rank.

identified (11), there was a notable difference in favor of women, except in two (Legrain et al., 2018; Tombak & Altun, 2016) where there were more males. Finally, two involved no males (Al-Yaseen, 2020; Kaendler et al., 2016). Therefore, teacher education programs using CL included more female than male students.

Regarding the length of the CL intervention programs, Casey and Goodyear (2015) highlighted that these tend to be conducted in very short periods of time. Nine of the studies selected were based on interventions of 15 sessions or less. Moreover, two of them were based on a single two hours session (Hornby, 2009) and a four hours session (Kaendler et al., 2016). On the other hand, two studies were at the upper limit with 14 sessions each, with a fairly-large sample of 60 (Halimah & Sukmayadi, 2019) and 259 (Supanc et al., 2017) pre-service teachers. In those studies where the program was extremely brief, the results should be treated with caution (disregarding cause-effect relationships), because it is very difficult to successfully implement CL and all its critical elements in such a short period of time; especially when participants are new to the methodology or have limited experience (Legrain et al., 2018). On the other hand, among the studies that dedicated more than 14 lessons to implement CL, Larraz et al. (2017) and Ruys et al. (2011) stand out with a length of four months and seven months respectively. CL implementation in teacher education programs takes time. The claimed findings of short programs should be placed on probation and corroborated in longer implementations.

Type of research

Quantitative (12 studies), qualitative (1 study) and mixed (6 studies) methods have been used when assessing CL implementations in teacher education programs. In the quantitative studies, previously validated full questionnaires and subscales were used as the main assessment instruments, complemented with *ad hoc* questionnaires, knowledge tests, video analysis, observation, and grades. In the qualitative study, the data collection instruments were: observation, field notes, and interviews. As for the mixed studies, they used instruments already mentioned in the two previous methodological approaches, as well as assessment tasks, open-ended questions, assemblies, document analysis, and students' messages. Therefore, quantitative research designs were predominant to assess teacher education programs. However, mixed methods designs are gaining momentum and claiming more room.

Design, intervention program and content

The majority of the articles selected were based on pre-test-post-test research designs (13 studies) with control group (Al-Yaseen, 2020; Bulut, 2009; Cohen & Zach, 2013; Fernández-Rio et al., 2014; Hornby, 2009; Kaendler et al., 2016; Öztürk & Kalyoncu, 2018; Veenman et al., 2002; Veenman et al., 2003), no control group (Mentz & Van Zyl, 2018; Tombak & Altun, 2016) or comparison groups (Cecchini et al., 2020; Legrain et al., 2018). The remaining studies (6), followed a one group (Halimah & Sukmayadi, 2019; Larraz et al., 2017; Palomares-Montero & Chisvert-Tarazona, 2016; Ruys et al., 2011), a control group (Egger, 2019) and a comparison group design (Supanc et al., 2017). Therefore, research based on pre-test-post-test designs is the leading research approach in teacher education, probably because they provide robust results.

The CL implementation programs conducted in the studies selected were based predominantly on the use of different CL techniques such as: Jigsaw (Al-Yaseen, 2020; Halimah & Sukmayadi, 2019; Larraz et al., 2017; Legrain et al., 2018; Tombak & Altun, 2016), Jigsaw II (Hornby, 2009), Learning Together (Fernández-Rio et al., 2014; Veenman et al., 2002), Co-op Co-op (Fernández-Rio et al., 2014; Palomares-Montero & Chisvert-Tarazona, 2016), STAD (Larraz et al., 2017; Öztürk & Kalyoncu, 2018), Think-Pair-Share, Numbered- Heads Together, Pairs, and Placema (Veenman et al., 2003) and others (Larraz et al., 2017; Mentz & Van Zyl, 2018). Other studies were based on CL environments (Bulut, 2009; Cohen & Zach, 2013; Egger, 2019; Kaendler et al., 2016; Ruys et al., 2011; Supanc et al., 2017), on the five variables that mediate CL effectiveness (Cecchini et al., 2020; Mentz & Van Zyl, 2018; Veenman et al., 2002) and on practical apprenticeship based on CL (Ruys et al., 2011; Veenman et al., 2003). It is important to highlight that the intervention programs were conducted from two perspectives: to a greater extent (79%) as a pedagogical model to promote content knowledge in a variety of subjects such as Psychology (Bulut, 2009; Supanc et al., 2017), Mathematics (Kaendler et al., 2016), English (Al-Yaseen, 2020; Tombak & Altun, 2016), Technology (Mentz &

Van Zyl, 2018; Tombak & Altun, 2016), Music (Egger, 2019; Öztürk & Kalyoncu, 2018), Education (Halimah & Sukmayadi, 2019; Larraz et al., 2017; Palomares-Montero & Chisvert-Tarazona, 2016) and Physical Education (Cecchini et al., 2020; Fernández-Rio et al., 2014; Legrain et al., 2018; Ruys et al., 2011), and to a lesser extent (21%), to promote pedagogical content knowledge through specific courses (Cohen & Zach, 2013; Hornby, 2009; Ruys et al., 2011; Veenman et al., 2002; Veenman et al., 2003). Therefore, CL can be used to promote teacher education students' content knowledge and pedagogical content knowledge on a variety of subjects connected to their future practice.

Purpose and main findings

The goals set in the different studies assessed were very diverse; consequently, they produced a wide variety of findings. Some explored prospective teachers' skills (Bulut, 2009; Cohen & Zach, 2013; Legrain et al., 2018; Ruys et al., 2011; Tombak & Altun, 2016), while others investigated attitudes and skills for CL use (Palomares-Montero & Chisvert-Tarazona, 2016). Results showed that the future teachers progressed on teaching performance, knowledge for practice, knowledge for teaching, and pedagogical knowledge on CL (Legrain et al., 2018), but they also increased their participation, decision-making, group work, creativity, flexibility, or critical spirit (Palomares-Montero & Chisvert-Tarazona, 2016). Other studies supported these findings when examining the effects of a CL course/seminar, where the positive attitudes towards CL of both future teachers and their pupils was accentuated (Veenman et al., 2002; Veenman et al., 2003). In this line, Ruys et al. (2011) highlighted that CL skills improve over time, although this is not linear.

On the other hand, the effects of CL on students' academic achievement and experience (Bulut, 2009; Egger, 2019; Hornby, 2009; Öztürk & Kalyoncu, 2018), and on their motivation were also assessed (Tombak & Altun, 2016). Most articles claimed that CL promoted academic achievement, highlighting individual accountability and positive interdependence as the key elements in this achievement (Hornby, 2009). Nevertheless, some results have also been contradictory, since studies conducted in the same context (music education), produced positive (Egger, 2019) and no improvements (Öztürk & Kalyoncu, 2018) on academic performance. Regarding the students' experience with CL, all studies showed positive effects: good attitude towards CL, higher attendance rate (Bulut, 2009), interest on the projects (Egger, 2019) and better lesson anxiety levels, but not exam anxiety (Öztürk & Kalyoncu, 2018). Both qualitative and quantitative data supported the positive effects of CL on students' motivation (Tombak & Altun, 2016). In addition, some studies assessed the positive influence of CL on different self-perceived variables: self-esteem (Bulut, 2009), self-perceived motivation and perceived competence (Fernández-Rio et al., 2014), but not on self-efficacy (Legrain et al., 2018). In one study, students who experienced a traditional teaching approach showed higher levels of self-efficacy (Cohen & Zach, 2013), which indicates that this group of future teachers felt more comfortable implementing a methodological approach that they knew better, instead of CL, which was new to them and, probably, more complex to use (Chan et al., 2021).

Some authors sought to evaluate the impact of CL on transversal skills (Larraz et al., 2017), finding clear evidence that it can promote the acquisition of important abilities such as negotiation, leadership, teamwork or reflection. Other authors explored the connections between CL and self-directed learning skills, concluding that CL can be a valuable tool to increase self-directed learning amongst teacher education students who have moderate levels of self-directedness (Mentz & Van Zyl, 2018).

Finally, focusing on the framework used, some authors assessed the effects of high versus low-structured CL (Cecchini et al., 2020; Supanc et al., 2017) and, in the same line, the effects of Jigsaw as a CL technique (Al-Yaseen, 2020; Halimah & Sukmayadi, 2019). Teacher education students in high-structured CL conditions reached higher conceptual/content knowledge, intrinsic motivation and responsibility (Cecchini et al., 2020). In contrast, in the field of educational psychology (Supanc et al., 2017), the students in the high-structured CL group had better self-perceived competence than the ones in the low-structured CL, while in physical education it was the opposite. Therefore, CL can produce different outcomes in different contexts. It should be noted that participants in the high-structured CL group significantly increased more the five variables that mediate CL effectiveness (Cecchini et al., 2020). Regarding Jigsaw as a CL technique, student teachers showed a positive attitude, considering it as one of the most effective ways to encourage students to actively participate in their own learning, since it improved communication skills (Halimah & Sukmayadi, 2019) and speaking skills in English (Al-Yaseen, 2020). Therefore, prospective teachers' teaching, transversal and personal skills, as well as attitudes and skills for CL use can be improved when using CL, but these advances are not linear and they need time and high-structured experiences, because students are familiar with simple, well-known pedagogical approaches instead of CL.

Learning outcomes

The learning outcomes assessed in the different teaching training programs were very diverse: students' perceptions on CL (Fernández-Rio et al., 2014), the five variables that mediate CL effectiveness (Cecchini et al., 2020; Veenman et al., 2002) or just some of them such as individual accountability and positive interdependence (Hornby, 2009), experience or attitudes towards CL (Al-Yaseen, 2020; Hornby, 2009; Veenman et al., 2002; Veenman et al., 2003), conceptual/content knowledge (Cecchini et al., 2020; Supanc et al., 2017), and knowledge for practice and pedagogical knowledge (Halimah & Sukmayadi, 2019; Legrain et al., 2018). On the other hand, various teaching skills were also assessed: instruction skills (Cohen & Zach, 2013; Palomares-Montero & Chisvert-Tarazona, 2016; Ruys et al., 2011; Veenman et al., 2003), transversal skills (Larraz et al., 2017), self-directed learning skills (Mentz & Van Zyl, 2018), communication skills (Halimah & Sukmayadi, 2019), and speaking skills (Al-Yaseen, 2020). Also, personal variables including self-esteem (Bulut, 2009), self-efficacy or perception of competence (Cecchini et al., 2020; Cohen & Zach, 2013; Fernández-Rio et al., 2014; Legrain et al., 2018; Supanc et al., 2017), self-determined motivation (Cecchini et al., 2020; Fernández-Rio et al., 2014), global motivation (Tombak & Altun, 2016), effort, boredom (Fernández-Rio et al., 2014), anxiety (Öztürk & Kalyoncu, 2018), interest and integration (Egger, 2019), and attitude and attendance (Bulut, 2009) were also evaluated. Finally, it is worth mentioning academic achievement or performance (Bulut, 2009; Legrain et al., 2018; Öztürk & Kalyoncu, 2018; Tombak & Altun, 2016) and monitoring competency (Kaendler et al., 2016). Finally, interpersonal variables like social goals (Fernández-Rio et al., 2014) were also assessed. Therefore, teaching skills, personal and interpersonal skills and knowledge on CL have been the focus of research in teacher training programs worldwide.

Discussion

This systematic review presented several important strengths. It is the first research synthesis to analyse the effect of CL-based interventions in prospective teachers. The inclusion of quantitative, qualitative and mixed research studies provided complete,

concrete and nuanced answers to the research questions (Heyvaert et al., 2013). This systematic review has contributed (1) to draw a contemporary picture on the effectiveness of CL in future teachers' training, including different CL techniques (Suri, 2014) and (2) to map the current knowledge base on this topic. Unfortunately, the wide variety of studies prevents a meta-analysis, which is a limitation. In the same line, some studies did not include a control group. Therefore, the outcomes portrayed should be interpreted with caution. However, this systematic review followed the steps of a research synthesis with scientific rigor (Cohen et al., 2018). Future reviews should broaden the focus of analysis of the present one towards the effectiveness of CL in teachers' long process of permanent training. On the other hand, future reviews should also broaden the analysis focus of this review towards the effectiveness of CL use in the training of professionals besides educators (e.g. veterinarians, law, engineers). Still further, in the immediate future, new CL environments related to technology in cooperative virtual scenarios that can complement face-to-face interactions should also be assessed.

Conclusions

The purpose of this systematic review was to determine the state-of-the-art on the existing literature testing the effects of CL interventions in teacher education and findings supported the positive impact of CL as an instructional framework. It has been found useful for teacher education students' global development: content knowledge, pedagogical content knowledge, personal, inter-personal, transversal and professional skills and competencies. Therefore, CL should be used in teacher education programs worldwide to train future teachers. Unfortunately, these improvements are not linear and they need time and high-structured experiences.

Based on the results uncovered in the present systematic review, some implications for teacher educators can be drawn. Future teachers feel more confident when using traditional teaching approaches (Cohen & Zach, 2013); therefore, unusual (to them) instructional approaches like CL should be properly structured to be fully integrated. Moreover, long-term experiences are needed for the framework to produce the claimed outcomes (Ruys et al., 2011). Only through time and appropriate structures, student teachers can see CL a good instructional framework that can benefit not only them, but also their future students.

References

Abramczyk, A., & Jurkowski, S. (2020). Cooperative learning as an evidence-based teaching strategy: What teachers know, believe, and how they use it. *Journal of Education for Teaching*, *46*(3), 296–308. https://doi.org/10.1080/02607476.2020.1733402

Al-Yaseen, W. S. (2020). Impact of jigsaw cooperative learning technique on enhancing Kuwait English language student-teachers' speaking skills. *The New Educational Review*, *61*(3), 119–130. https://doi.org/10.15804/tner.2020.61.3.10

Bores-García, D., Hortigüela-Alcalá, D., Fernandez-Rio, J., González-Calvo, G., & Barba-Martín, R. (2021). Research on cooperative learning in physical education: Systematic review of the last five years. *Research Quarterly for Exercise and Sport*, *92*(1), 146–155. https://doi.org/10.1080/02701367.2020.1719276

Bulut, S. (2009). The effect of cooperative learning techniques on pre-service teachers' self-esteem, achievement and absences. *Contemporary Psychology*, *12*(1), 23–41.

Casey, A., & Goodyear, V. A. (2015). Can cooperative learning achieve the four learning outcomes of physical education? A review of literature. *Quest*, *67*(1), 56–72. https://doi.org/10.1080/00336297.2014.984733

Cecchini, J. A., Fernández-Rio, J., Méndez-Giménez, A., González, C., Sánchez-Martínez, B., & Carriedo, A. (2020). High versus low-structured cooperative learning. Effects on prospective teachers' regulation dominance, motivation, content knowledge and responsibility. *European Journal of Teacher Education*, 1–16. https://doi.org/10.1080/02619768.2020.1774548

Chan, S., Maneewan, S., & Koul, R. (2021). Cooperative learning in teacher education: Its effects on EFL pre-service teachers' content knowledge and teaching self-efficacy. *Journal of Education for Teaching*, 1–15. https://doi.org/10.1080/02607476.2021.1931060

Cohen, L., Manion, L., & Morrison, K. (2018). *Research methods in education*. Routledge.

Cohen, R., & Zach, S. (2013). Building pre-service teaching efficacy: A comparison of instructional models. *Physical Education and Sport Pedagogy*, *18*(4), 376–388. https://doi.org/10.1080/17408989.2012.690374

Egger, J. O. (2019). Effects of cooperative learning on preservice elementary teachers' interest in and integration of music into core academic subjects. *International Journal of Music Education*, *37*(4), 608–621. https://doi.org/10.1177/0255761419852173

Fernández-Rio, J., Cecchini, J. A., & Méndez-Giménez, A. (2014). Effects of cooperative learning on perceived competence, motivation, social goals, effort and boredom in prospective primary education teachers. *Infancia y Aprendizaje*, *37*(1), 57–89. https://doi.org/10.1080/02103702.2014.881650

Gillies, R. M. (2014). Developments in cooperative learning: Review of research. *Annals of Psychology*, *30*(3), 792–801. https://doi.org/10.6018/analesps.30.3.201191

Halimah, L., & Sukmayadi, V. (2019). The role of "jigsaw" method in enhancing indonesian prospective teachers' pedagogical knowledge and communication skill. *International Journal of Instruction*, *12*(2), 289–304. https://doi.org/10.29333/iji.2019.12219a

Heyvaert, M., Maes, B., & Onghena, P. (2013). Mixed methods research synthesis: Definition, framework, and potential. *Quality and Quantity*, *47*(2), 659–676. https://doi.org/10.1007/s11135-011-9538-6

Higgins, J. P. T., López-López, J. A., Becker, B. J., Davies, S. R., Dawson, S., Grimshaw, J. M., McGuinness, L. A., Moore, T. H. M., Rehfuess, E. A., Thomas, J., & Caldwell, D. M. (2019). Synthesising quantitative evidence in systematic reviews of complex health interventions. *BMJ Global Health*, *4*(1), Article e000858 https://doi.org/10.1136/bmjgh-2018-000858

Hornby, G. (2009). The effectiveness of cooperative learning with trainee teachers. *Journal of Education for Teaching*, *35*(2), 161–168. https://doi.org/10.1080/02607470902771045

Johnson, D. W., & Johnson, R. T. (1994). *Leading the cooperative school* (2nd ed). Interaction Book Company.

Johnson, D. W., & Johnson, R. T. (2005). New developments in social interdependence theory. *Genetic, Social, and General Psychology Monographs*, *131*(4), 285–358. https://doi.org/10.3200/MONO.131.4.285-358

Johnson, D. W., & Johnson, R. T. (2017). The use of cooperative procedures in teacher education and professional development. *Journal of Education for Teaching*, *43*(3), 284–295. https://doi.org/10.1080/02607476.2017.1328023

Johnson, D. W., Johnson, R. T., & Holubec, E. J. (2009). *Cooperation in the classroom* (6th ed). Interaction Book Company.

Johnson, D. W., Johnson, R. T., & Holubec, E. J. (2015). *Cooperation in the classroom* (9th ed). Interaction Book Company.

Johnson, D. W., Johnson, R. T., & Smith, K. A. (2014). Cooperative learning: Improving university instruction by basing practice on validated theory. *Journal on Excellence in College Teaching*, *25*(4), 85–118.

Kaendler, C., Wiedmann, M., Leuders, T., Rummel, N., & Spada, H. (2016). Monitoring student interaction during collaborative learning: Design and evaluation of a training program for pre-Service teachers. *Psychology Learning & Teaching*, *15*(1), 44–64. https://doi.org/10.1177/1475725716638010

Khun, D. (2015). Thinking together and alone. *Educational Researcher*, *44*(1), 46–53. https://doi.org/10.3102/0013189X15569530

Lavigne, A. L., & Good, T. L. (2019). *Enhancing teacher education, development, and evaluation. Lessons learned from educational reform*. Routledge.

Lawson, H. A., Kirk, D., & MacPhail, A. (2020). The professional development challenge: Achieving desirable outcomes for students, teachers and teacher educators. In A. MacPhail, & H. A. Lawson (Eds.), *School physical education and teacher education: Collaborative redesign for the 21st century* (pp. 141–152). Routledge.

Larraz, N., Vázquez, S., & Liesa, M. (2017). Transversal skills development through cooperative learning. Training teachers for the future. *On the Horizon*, *25*(2), 85–95. https://doi.org/10.1108/oth-02-2016-0004

Legrain, P., Escalié, G., Lafont, L., & Chaliès, S. (2018). Cooperative learning: A relevant instructional model for physical education pre-service teacher training? *Physical Education and Sport Pedagogy*, *24*(1), 73–86. https://doi.org/10.1080/17408989.2018.1561838

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: Explanation and elaboration. *BMJ (Clinical research ed.)*, *339*, b2700. https://doi.org/10.1136/bmj.b2700

Mentz, E., & Van Zyl, S. (2018). The impact of cooperative learning on self-directed learning abilities in the computer applications technology class. *International Journal of Lifelong Education*, *37*(4), 482–494. https://doi.org/10.1080/02601370.2018.1513426

Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P., Stewart, L. A., & PRISMA-P Group. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews*, *4*(1), 1. https://doi.org/10.1186/2046-4053-4-1

Öztürk, G., & Kalyoncu, N. (2018). The effect of cooperative learning on students' anxiety and achievement in musical ear training lessons. *Journal of Measurement and Evaluation in Education and Psychology*, *9*(4), 356–374. https://doi.org/10.21031/epod.411010

Palomares-Montero, D., & Chisvert-Tarazona, M.-J. (2016). Cooperative learning: A methodological innovation in teacher training. *Culture and Education*, *28*(2), 378–395. https://doi.org/10.1080/11356405.2016.1158448

Ruys, I., Van Keer, H., & Aelterman, A. (2011). Student teachers' skills in the implementation of collaborative learning: A multilevel approach. *Teaching and Teacher Education*, *27*(7), 1090–1100. https://doi.org/10.1016/j.tate.2011.05.005

Shea, B. J., Reeves, B. C., Wells, G., Thuku, M., Hamel, C., Moran, J., Moher, D., Tugwell, P., Welch, V., Kristjansson, E., & Henry, D. A. (2017). AMSTAR 2: A critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. *BMJ*, *358*, j4008. https://doi.org/10.1136/bmj.j4008

Slavin, R. E. (2014). Cooperative learning and academic achievement: Why does groupwork work? *Annals of Psychology*, *30*(3), 785–791. https://doi.org/10.6018/analesps.30.3.201201

Supanc, M., Völlinger, V. A., & Brunstein, J. C. (2017). High-structure versus low-structure cooperative learning in introductory psychology classes for student teachers: Effects on conceptual knowledge, self-perceived competence, and subjective task values. *Learning and Instruction*, *50*, 75–84. https://doi.org/10.1016/j.learninstruc.2017.03.006

Suri, H. (2014). *Towards methodologically inclusive research synthesis*. Routledge.

Symeonidis, V. (2020). *Europeanisation in teacher education. A comparative case study of teacher education policies and practices*. Routledge.

Tombak, B., & Altun, S. (2016). The effect of cooperative learning: University example. *Eurasian Journal of Educational Research*, *16*(64), 173–196. https://doi.org/10.14689/ejer.2016.64.10

van Sluijs, E. M., McMinn, A. M., & Griffin, S. J. (2007). Effectiveness of interventions to promote physical activity in children and adolescents: Systematic review of controlled trials. *BMJ*, *335*(7622), 703. https://doi.org/10.1136/bmj.39320.843947.BE

Veenman, S., Denessen, E., van den Oord, I., & Naafs, F. (2003). Direct and activating instruction: Evaluation of a preservice course. *The Journal of Experimental Education*, *71*(3), 197–225. https://doi.org/10.1080/00220970309602063

Veenman, S., van Benthum, N., Bootsma, D., van Dieren, J., & van der Kemp, N. (2002). Cooperative learning and teacher education. *Teaching and Teacher Education*, *18*(1), 87–103. https://doi.org/10.1016/s0742-051x(01)00052-x

Vermunt, J. D., & Endedijk, M. D. (2011). Patterns in teacher learning in different phases of the professional career. *Learning and Individual Differences*, *21*(3), 294–302. https://doi.org/10.1016/j.lindif.2010.11.019

Viswanathan, M., Patnode, C. D., Berkman, N. D., Bass, E. B., Chang, S., Hartling, L., Murad, M. H., Treadwell, J. R., & Kane, R. L. (2018). Recommendations for assessing the risk of bias in systematic reviews of health-care interventions. *Journal of Clinical Epidemiology*, *97*, 26–34. https://doi.org/10.1016/j.jclinepi.2017.12.004

Vygotsky, L. S. (1978). *Mind in society*. Harvard University Press.