2023, Retos, 50, 1240-1250

Pedagogical Content Knowledge in the Physical Education Field. A systematic review of the literature 2011-2022

Conocimiento Pedagógico del Contenido en el campo de la Educación Física. Una revisión sistemática de la literatura 2011-2022

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Abstract . Teaching of Physical Education, knowledge about what to teach, who to teach and how to teach must be considered; within the framework of these aspects, Pedagogical Content Knowledge arises, considered as an amalgamation between content and pedagogy. This study analysed the scientific production in the Scopus, Web of Science and Science Direct databases, regarding the development of Pedagogical Content Knowledge in the Physical Education Field, between 2011 and 2022 and was done systematically. Articles were included in English and Spanish, for a total of 32 articles. The results show that there was a peak of publications in the year 2020; the country in which more studies have been carried out is the United States; regarding the level of research, the vast majority are of an explanatory nature. The studies were classified into three categories: Pedagogical Content Knowledge in school Physical Education, in School Sports and in training programs for physical education teachers. It could be concluded that there is a need for Common Content Knowledge and Specialized Content Knowledge to be better taught in teacher education programs as they are a fundamental basis for Pedagogical Content Knowledge. Likewise, since this construct is dynamic and changing, it should also be considered in the professional development phase, since field experience and the relationships established in the field provide new knowledge and formative experiences.
Keywords: Pedagogical content knowledge, physical education, teacher training, school sports, literature review.

Resumen. En la enseñanza de la Educación Física se deben tener en cuenta el conocimiento sobre qué enseñar, a quién enseñar y cómo enseñar, en el marco de estos aspectos surge el conocimiento pedagógico del contenido, considerado como una amalgama entre contenido y pedagogía. Este estudio analizó la producción cientifica en las bases de datos Scopus, Web of Science y Science Direct, respecto al desarrollo del Conocimiento Pedagogico del Contenido en el campo de la Educación Física, entre 2011 y 2022 y se hizo de forma sistematica. Se incluyeron artículos en idioma inglés y español, para un total de 32. Los resultados muestran que hubo un pico de publicaciones en el año 2020; el país en el que se han llevado a cabo más estudios es en Estados Unidos; con respecto al nivel de investigación en su gran mayoría son de carácter explicativo. Los estudios se clasificaron en tres categorías: Conocimiento pedagógico del contenido en Educación Física escolar, en Deporte escolar y en programas de formación de profesores de educación física. Se pudo concluir que existe una necesidad de que el conocimiento común del contenido y el conocimiento especializado del contenido se enseñen mejor en los programas de formación del profesorado pues son una base fundamental para el Conocimiento Pedagógico del Contenido. De igual manera, dado que este constructo es dinámico y cambiante, también debe ser considerado en la fase de desarrollo profesional, pues la experiencia en campo y las relaciones que se establecen en éste, proveen de nuevos conocimientos y experiencias formativas.
Palabras clave: Conocimiento pedagógico del contenido, educación física, formación de profesores, deporte escolar, revisión de la literatura.

Fecha recepción: 13-04-23. Fecha de aceptación: 28-08-23
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Introduction

[…] pedagogical type knowledge is a kind of amalgam of content and pedagogy, so its essence lies in how teachers understand their own subject matter and transform it into something teachable, i.e., it goes from subject knowledge to pedagogical type knowledge. (Contreras Jordán, 2019)

Physical education (PE) in contrast to other subjects in the educational system develops differently, this is because in it children and young people learn mainly through physical activity, and the learning environments where the class takes place, in addition to the classroom, they include different spaces, such as: the swimming pool, the field, the coliseum, among others (Meier, 2021); which is why the challenges and teaching strategies of PE teachers are also different.

In this order of ideas, the aspects to take into account when it comes to the teaching of PE are diverse, among them we can mention: knowledge about what to teach, who to teach and how to teach, within the framework of these aspects arises Pedagogical Content Knowledge (PCK), which refers to the application or adaptation by the teacher of different knowledge bases according to the characteristics of the students and the particularities of the contexts (Iserbyt et al., 2017).

Since the emergence of the PCK construct, it has been considered as an amalgamation between content and pedagogy (Shulman, 1987), in which the teacher makes what he teaches understandable, pedagogically adapts the content, adjusts the sequences or facilitates the activities so that students can achieve accurate learning (Ayvazo & Ward, 2011; Cambra Badii & Lorenzo, 2021; Martínez-Bello et al., 2021; Sutherland et al., 2016).

The PCK is likely to be approached and worked on in any discipline or science that needs to establish how effectively what should be taught reaches the students (Montoya Grisales & Arroyave Giraldo, 2021), studies have been found on university teaching (Díaz Pacheco, 2017; Medina et al., 2016; Mentado Labao et al., 2017; Parga-Lozano &

Moreno-Torres, 2017); physics (Brines Brines et al., 2016; Campo Nava & Ramírez Díaz, 2019; Melo et al., 2017, 2020), biology (González & Rossi, 2015; Ravanal Moreno & López-Cortés, 2016), among others. A matter that from the didactic aspect puts the reflective action of the teacher to the test based on the contents of a personal order, theoretical or practical required by PE students (Montoya-Grisales et al., 2022), in the field of the PCK has been conceptualized as:

a focal point, a locus, defined as an event in time (and therefore contextually specific) where teachers make decisions in terms of content based on their understanding of several knowledge bases (for example, pedagogy, learning, motor development, students, context and curriculum). (Ward et al., 2015, p. 131)

In this same sense, there is currently a growing awareness of the potential of PCK (Martínez-Bello et al., 2021), especially in the field of PE, this is mainly because, on one hand, PCK does not develop in a vacuum, it is content-specific (Ward & Ayvazo, 2016) but it interferes in the entire didactic structure and, consequently, has the particularity of predicting both the quality of teaching and student learning (Meier, 2021).

Finally, it is necessary to point out that in PE, different investigations have been carried out on how to evaluate the PCK of teachers or future teachers, among which it is possible to highlight various interests, such as: inquiring about the selection of tasks (Ayvazo & Ward, 2011); address common content knowledge (CCK); develop specialized content knowledge (SCK) (Ward, 2009) and how content knowledge (CK) interacts with other PCK elements such as context; relate pedagogy and student knowledge to the decisions teachers make (Ward & Ayvazo, 2016); among others. However, an exhaustive report on the main research results that provide the current state of scientific production on PCK in PE has not been found. We searched PROSPERO and found an ongoing review "the application of TPACK framework in health professions education: a systematic review" (Ait ali & Senhaji, 2022), however, the concept Technological Pedagogical Content Knowledge was not taken into account in the present study, likewise we searched DARE, but no study was found.

Consequently, the purpose of the study was to analyze the scientific production in the main databases, regarding the development of the PCK construct in the field of PE, since there has been no analysis or review of what actually happens in the case of PE, presumably from the curricular point of view, because there is a logic of what content should be addressed, whether from sport, leisure or free time; however, these aspects have not been systematized in a timely and clear manner as it has been done in other areas of knowledge, which is the reason for the need to account for the studies and also to lay the groundwork for future research to account for the approach of PCK in PE.

Methodology

The study used a qualitative approach, since the purpose was to carry out the synthesis of primary studies (Dixon-Woods et al., 2005), the methodological orientation document was used: The art and science of quality systematic reviews proposed by Alexander (2020). The research question was formulated, the search terms were defined, the bibliographic databases were selected and the search for publications began. The inclusion and exclusion criteria were raised, which were the basis for selecting the relevant research. When downloading the relevant articles, they were read and an Analytical Research Summary was used (González Palacio, 2019), which allowed analysing some aspects based on the reference of the text, intention of the work and the methodological component, that is, this matrix allowed the "extraction of data developed on purpose to allow the comparison of the same information units of each selected publication" (Heitink et al., 2016, p. 52) and the categorization process was done in the Atlas ti v.9 software.

Systematic research was carried out in three databases: Scopus, Web of Science and Science Direct, these were used because of their multidisciplinary nature, their high impact factor, their large amount of educational material, and the fact that access to them was available. The same descriptors and Boolean operators were used: "Pedagogical Content Knowledge" AND "Physical Education". The retrieved publications were exported to Mendeley for systematic selection according to the inclusion criteria. All this based on the questions that guided the study: what are the characteristics of the studies that are interested in PCK in PE? How is PCK approached in school PE? How is PCK approached in school sports? How is PCK approached in the initial training of PE teachers?

To obtain the most relevant publications, the following criteria were formulated:

1. The research was published in a refereed journal. Doctoral theses, books, book chapters, and conference reports were not included.
2. The study researched pedagogical content knowledge in physical education in empirical and documentary research.
3. The research had to be published between 2011 and 2022
4. The study could be published in Spanish or English

The data extraction matrix contained the following elements:

- Basic information, such as authors, year of publication, title, country, and theme.
- Research design specifications, such as type of objective, level of research, method, design, population, and instrument.
- Categories.
- Results and conclusions

The compilation process was made from the Analytical Summary of Research (González Palacio, 2019) developed in Excel, it began with an open coding and then three axial categories were established, finally the categories that emerged from a more selective process were associated (Strauss & Corbin, 2002), the analysis was performed in the

Atlas ti V.9 software. The results were organized into the following categories: (1) Pedagogical knowledge of content in school physical education, (2) Pedagogical knowledge of content in school sports, and (3) Pedagogical knowledge of content in physical education teacher training programs; these categories were inductive, that is, they emerged from the information (Bonilla-Castro & Rodríguez Sehk, 2005).

The summary of the identification, selection, eligibility, and inclusion process in the form of a PRISMA diagram (Page et al., 2021) can be seen in Figure 1.

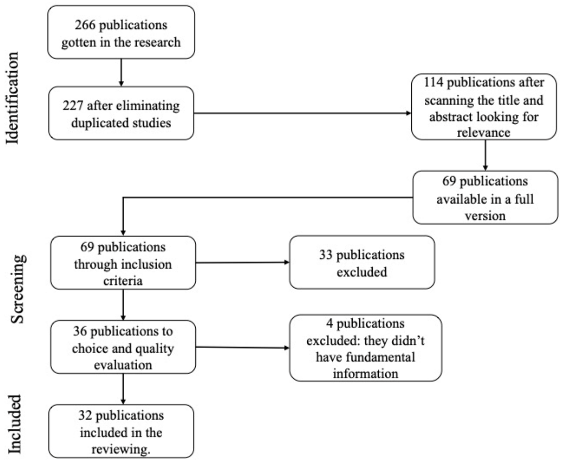

Figure 1. Diagram of the phases and data of the selection strategy

In the identification phase, 266 publications were found in the three databases, upon reviewing them it was found that 39 of them were duplicates. The remaining 227 publications were reviewed by title of relevance and since they did not contain Pedagogical Content Knowledge or Physical Education, 113 were eliminated, another 45 texts presented restricted access to review the entire document, therefore, they were also excluded. This left a total of 69 publications for data extraction, 33 publications were considered to lack information, to be interested in the Technological, Pedagogical, and Content Knowledge (TPACK) construct, or not to deal with issues specifically in the area of physical education. After reviewing the data matrix again, it was considered that there were four texts that were not of sufficient quality to be included in the review, therefore they were also eliminated. In the end, 32 investigations were included in this review.

Results

A peak of publications was found in the year 2020 (19%); the country in which the most studies have been carried out is the United States (22%), in Europe several countries have shown an interest, however, Spain, Belgium and the United Kingdom are the ones that report the most, each with a 9 %, in the case of Latin America they were only found in Chile (9%), Brazil and Colombia (3%); Regarding the level of research, 47% of the studies are of an explanatory nature, followed by an interpretative level (34%); of the journals in which the publications were made, Physical Education and Sport Pedagogy (34%) and RETOS (13%) stand out. The author who has made the most contributions was Dr. Phillip Ward, Professor of Physical Education Teacher Training in the Department of Human Sciences at The Ohio State University, participating in 28% of the reviewed articles.

Table 1 presents the results in chronological order, and an overview of all the publications based on the research method, which includes the approach, the population, and the technique used, the description of the study and the main result.

Table 1.
Research included in the systematic review.

No	Author and year of publication	research method	Study Description	Results
1	(Ayvazo & Ward, 2011)	a. Quantitative b. Two primary PE teachers c. video observation	They observed and measured student-teacher interactions, reviewed instruction adaptations by teaching stronger and weaker units of instruction based on functional analysis, and thus examined PCK.	Functional analysis of instructional accommodations is an effective strategy to examine the PCK, teachers were better able to meet the needs of students in the stronger unit
2	(Marcon et al., 2012)	a. Qualitative b. Four pairs of teachers in training in a PE program c. Structured interviews and reflection logs	It was examined how pedagogical knowledge emerges in the practice of undergraduate teaching and supports the construction of the PCK of future PE teachers.	The construction of the PCK of the investigated future teachers is very superficial, since there is an excessive concern for strictly complying with the plans, that is, for giving the class and meeting the objectives and already
3	(Ward, 2013)	a. Qualitative b. 12 PE coordinators from primary schools c. semi-structured interviews	Using the structured model of Veal and MaKinster, the PCK panorama of primary school teachers about games was examined.	When personal experiences of pedagogy and content knowledge are not challenged or reinforced through teacher training, a very narrow and subject specific PCK is obtained.
4	(Ward et al., 2015)	a. Quantitative b. Four teachers and 96 high school students c. Observation	Based on a quasi-experimental study, the effectiveness of a content knowledge workshop on teachers' PCK and, in turn, the effects on student learning were examined.	A teacher's PCK can change from immature to mature based on the learning of content knowledge and this change has a significant impact on student learning.
5	(Iserbyt et al., 2016)	a. Quantitative b. A teacher and 74 high school students c. test and observation	The students were randomly assigned to a traditional group, one of sports education (SE), one traditional-CK and one SE-CK, it was investigated how the PCK of a teacher differs depending on the CK and the SE and how they contribute on student learning in terms of swimming performance	The teacher's PCK differed based on CK enhancement. The differences in instruction resulted in the students of the Traditional-CK and SE-CK conditions improving their swimming performance in terms of technical efficiency and in terms of times.

6	(Sutherland et al., 2016)	a. Qualitative b. 13 teachers in training in physical education program c. Interviews and daily reflections	They explored the PCK promulgated by preservice teachers learning to teach an alternative curriculum model in urban high schools.	Four themes represented the demonstration of PCK by preservice teachers: (1) trusting the sequence, (2) knowing your students, (3) facilitating not dictating, and (4) processing the experience.
7	(Sinelnikov et al., 2016)	a. Quantitative b. 48 students and two secondary PE teachers c. Observations and event log	An experimental design was used to examine the change in teachers' teaching and student learning in their classes before and after a workshop designed to improve teachers' badminton CK.	The results of this study indicate that a CK workshop was effective in changing teachers' PCK behaviors, and these changes produced better student learning.
8	(Castejón Oliva & Fuentes Guerra, 2017)	a. Mixed b. 18 secondary PE teachers c. Survey and interviews	It was investigated to what extent the PE teachers in secondary education show more attention, whether to deepen the CK, the PCK, or both; and what priority do you have throughout your professional development, according to your initial and ongoing training, and the process of interaction with students during PE classes	In initial training and for new content, interest in CK predominates, that is, it is more important to know more about the content than how to teach it; while in the permanent training dimension, the interest is focused on better teaching the contents, they are interested in the PCK.
9	(Iserbyt et al., 2017)	a. Quantitative b. A teacher and 64 secondary PE students c. systematic observations	A teacher taught a six-day badminton unit to four intact classes (comparison), participated in a content knowledge workshop, and then taught a six-day badminton unit to four different classes (experimental) and examined changes in performance. PCK and on student achievement	The teacher's PCK was substantially different before and after the workshop. More descriptions, analogies/metaphors, clues, and specific congruent feedback were observed in the experimental classes compared to the comparison classes.
10	(Herold & Waring, 2017)	a. Qualitative b. teachers in training in PE program c. Interviews, classroom observations, and post-class reflections	They examined the effects that the different levels of CK had on the development of practices in initial PE training.	The adverse impact on the PCK revealed that at least an "adaptation" of the CK is needed if the future teachers are to use more advanced pedagogical strategies.
11	(Marquis & Metzler, 2017)	a. Qualitative b. Nine empirical investigations c. Matrix	A literature review was conducted to identify how dance CK and PCK are addressed within PE teacher training programs.	There is a decrease in courses of specific content in the study plans in PE initial training, this is due to the infusion of subdisciplines and the devaluation of physical activity and sport. For this reason, it is necessary that the programs emphasize the acquisition of skills in the execution of the contents of the and the teaching of the contents.
12	(Araújo et al., 2017)	a. Quantitative b. 21 students and a high school teacher c. Observation, field notes and interviews	The evolution of the PCK was examined through three Sports Education units.	After the interventions, improvements in the organization and presentation of tasks were presented to their teammates, to identify skill errors and provide feedback, as well as the ability to modify tasks for different team members.
13	(Almonacid-Fierro, Feu, et al., 2018)	a. Quantitative b. 203 high school teachers c. Survey	They designed and validated a questionnaire to measure PCK in secondary PE teachers	The instrument presented good values of content, construct, and reliability validity. The dimensions of the questionnaire are general pedagogical knowledge, knowledge of the disciplinary content, and knowledge of the context, associated with the PE classroom.
14	(Almonacid-Fierro, Merellano-Navarro, et al., 2018)	a. Qualitative b. Six high school teachers c. interviews	They described the PE teachers' discourse regarding PCK in the classroom	A teacher who achieves an adequate mastery of the PCK, is capable of generating horizontal dialogues in the construction of knowledge
15	(Herold, 2019)	a. Qualitative b. 12 teachers in training in the PE program and their 12 mentors at the school c. interviews	They investigated the links between preservice teachers' development of subject knowledge and the factors and processes that led to changes in their knowledge and beliefs.	Teachers-in-training valued the gains from PCK and associated it with university-based learning as well as school practices.
16	(Almonacid Fierro et al., 2019)	a. Qualitative b. Six high school teachers c. interviews	They understood the construction process and the sources of the PCK in the EF teachers	Possessing knowledge of a disciplinary nature does not guarantee quality learning for students who participate in the PE classroom, since a PCK is required, which allows the teacher to plan, organize and execute quality teaching-learning situations.
17	(Cañadas et al., 2019)	a. Quantitative b. 308 university professors, 490 graduates and 1,184 students. c. Survey	Based on the perception of graduates, students, and university professors, they identified differences in the acquisition of CK and PCK competencies considered in the initial training of PE teachers.	Perception differences were found among the population of interest, with graduates showing the highest values in the development of competencies and university teachers showing the lowest values.
18	(Backman et al., 2019)	a. to. Qualitative b. b. Nine PE teacher educators c. c. interviews	They described the perception and evaluation of the CK of the PE teacher educators, in the evaluation of the movement courses.	The CK of the movement, both as a knowledge base itself and as part of the PCK, must be approached from a constructivist perspective and must be valued.
19	(Kim & Ko, 2020)	a. Quantitative b. Four high school physical education teachers and 72 students c. Observation and survey	They examined changes in the PCK of content-experienced teachers (C-Exd) and their students' performance after the intervention (CK workshop) and compared it to	C-Exd teachers improved their enacted PCK and students' motor performance after the intervention without showing statistically significant differences from C-Ext teachers.

			that of content-expert teachers (C-Ext)	
20	(Meier, 2020)	a. Quantitative b. 511 teachers in training in the PE program c. Survey	An instrument was designed from a bibliographical review, a panel of experts and an exploratory factor analysis and principal components in two independent samples.	The instrument has content and factorial validity, as well as a good adjustment according to the principal component analysis. The dimensions of the questionnaire are Instruction and students
21	(Backman & Barker, 2020)	a. Qualitative b. 18 articles and chapters c. Matrix	A bibliographic review was carried out based on the "snowball" strategies and traditional search in the ERIC and EBSCO databases. Eighteen articles and chapters were reviewed based on four assumptions.	The PCK can imply actions such as the identification of contextual characteristics for "new" and inclusive movement cultures in PE; interpret students' actions and reactions, and identify and act on diversity during PE teaching, among others
22	(Chang et al., 2020)	a. Quantitative b. Three primary school teachers and 66 students c. Observation, checklists, workshops, tests	They examined the influence of the enacted CK and PCK of a four-day throwing unit on a student's throwing performance.	The PCK of the teachers changed according to their CK and the knowledge of the students, with large effect sizes. In addition, the improvement in the PCK of the teachers was associated in a statistically significant way with the improvement in the throwing performance of the students.
23	(Iserbyt et al., 2020)	a. Quantitative b. Three primary school teachers and 66 students c. Observation and coding forms	Based on a pre- and post-intervention study, we investigated how teachers' PCK in the form of task adaptations differed based on content knowledge.	The teacher's decisions to make adaptations are preceded by environmental conditions, for the specific case the performance of the students. In addition, the number of adaptations increased per lesson after the intervention with the CK workshop.
24	(Dervent et al., 2020)	a. Quantitative b. 1,514 teachers in training in the PE program c. Test, content maps, interviews, and analysis of content class programs	A cross-sectional analysis was carried out to examine the depth of CCK and SCK in students training to be PE teachers from the first to the last year.	Students demonstrated limited improvement in CCK and SCK from freshman to senior years. However, the students did not know the content well enough to meet a passing standard commonly used in Turkey.
25	(García-Rico et al., 2021)	a. to. Qualitative b. b. 100 teachers in training in the Physical Activity and Sport program c. c.Non-participant observation, focus groups, group interviews, student portfolio	The effects of University Service-Learning on the professional learning of Physical Activity and Sports students were analyzed.	University Service-Learning has a positive impact on CK, PCK and knowledge of the educational purposes and values of Physical Activity and Sport.
26	(Le Paven et al., 2021)	a. Quantitative b. 48 teachers in training in the PE program c. Video observation and interviews	The students were divided into two groups: the experimental one that used tablets and the control group that followed the same pedagogical curriculum, this in order to identify the benefits of the use of digital tablets in learning during a university futsal teaching module and determine specific links between subject matter knowledge (SMK) and PCK	The technological use of the tablet facilitated access to tactical and strategic knowledge within the SMK involved in this team sport. Thus, the students in training were able to invest this knowledge in the construction of PCK.
27	(Meier, 2021)	a. Quantitative b. 622 teachers in training in PE and sports science programs c. Survey	They compared the PCK of students enrolled in different degree programs in the field of sports science.	PE students outperformed sports science students in terms of the "instructional dimension", in the dimension of students there are no differences.
28	(He et al., 2022)	a. Quantitative b. 129 primary and secondary teachers c. Survey and content maps	They examined the relationship between demographic variables, CCK and SCK in Chinese PE teachers who taught soccer.	Gender and number of workshops attended significantly predict CCK, and number of workshops and teaching rank significantly predict SCK.
29	(Montoya-Grisales et al., 2022)	a. Quantitative b. 146 teachers in training in the PE program who take the practicum. c. Survey	A questionnaire was designed and validated to measure the PCK in PE students who are in the context of the practicum.	The questionnaire provides a valid, reliable, and specific instrument, which allows to identify the knowledge about the pedagogical, the context, the evaluation, the teaching strategies, the students, the experiential, and the content.
30	(Farias et al., 2022)	a. Quantitative b. Three teachers in training, 60 secondary school students, a university supervisor, and a collaborating teacher c. video analysis	Examined the effects of a student-centered step-play focused sport education unit on SCK in pre-service teachers.	The study shows that future teachers can develop CK based on participation in training protocols adapted to the development of CCK and SCK and thus improve PCK.
31	(Mustell et al., 2022)	a. Qualitative b. Six teacher trainers c. semi-structured interviews	From interviews, they determined how ball game experts within teacher training define CK and PCK.	Several educators emphasized that PCK involved choosing which models or approaches to use and that this construct refers to the ability to adapt ball games for different learners.
32	(Musard et al., 2022)	a. Qualitative b. 46 teachers in training in the PE program c. Survey	They understood how a cohort of preservice teachers analyzed CK embedded in teacher-student didactic interactions using the Joint Action in Didactics (JAD) framework.	Use of the JAD framework could further enhance PCK development by providing prospective teachers with a stronger lens for understanding how SCK propositions can be contextualized within students' practical epistemologies.

The results presented in Table 1 show that the preferred research approach is quantitative (56%), especially descriptive cross-sectional studies; followed by the qualitative approach (41%) with case studies and documentary reviews; the rest of the studies (3%) were of a mixed approach.

With respect to the population researched in the empirical articles, the vast majority were teachers in training, practicing teachers in primary and secondary schools and, to a lesser extent, university professors, and in the PCK analysis it was done based on their performance in their classes.

The technique for collecting privileged research was the interview (34%), followed by the survey (31%); however, it is important to mention that in various studies there is a combination of techniques and instruments.

In this order of ideas, there is a predominance of studies with characterization intentions, both qualitative and quantitative, and using questioning techniques that give an account of the current state of the question in different groups of teachers, including teachers in training or in the exercise of their profession at different educational levels, as well as teachers in the sports field.

In terms of the qualitative analysis process of the information, three categories (Figure 2) denote how PCK has been approached in the context of physical education; the first two categories are based on what the teacher does and his or her field of action, i.e., PCK within the school; and on the other hand, the logic of the processes of sports training or school sport; In the first category, the actions are directed from the curricular and the ideal of formation sought in the students is established by the culture and the context; in the second category, the PCK of the teachers is established from the sports ideals, so that the teacher's action is a function of the motor learning of the students, the development of tasks that make it possible and the adaptation to the characteristics of the context.

The third category shows how PCK issues are part of the teacher's training processes, and that training is always permanent, and that even professional life provides new knowledge that makes PCK constantly changing and transforming.

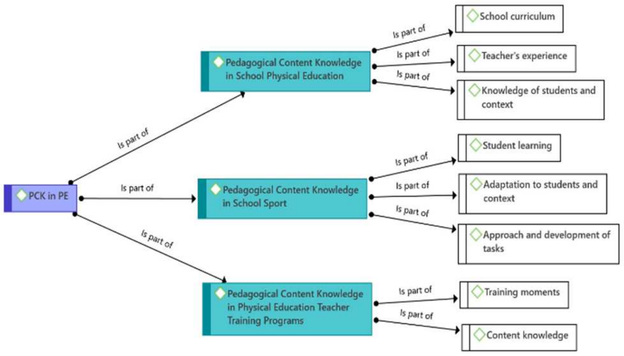

Figure 2. Categorical network

Discussion

As mentioned above, the selected investigations were classified into three categories: Pedagogical Content Knowledge in School Physical Education, Pedagogical Content Knowledge in School Sports and Pedagogical Content Knowledge in Physical Education Teacher Training Programs; in Table 2 they are organized according to these categories and the authors who refer to them and, subsequently, a description of each one is presented.

Table 2.
Categories with authors

Category	Authors
Pedagogical knowledge of the content in school Physical Education	(Almonacid Fierro et al., 2019; Almonacid-Fierro, Feu, et al., 2018; Almonacid-Fierro, Merellano-Navarro, et al., 2018; Ayvazo & Ward, 2011; Castejón Oliva & Fuentes Guerra, 2017; Chang et al., 2020; Ward, 2013)
Pedagogical knowledge of the content in School Sport	(Araújo et al., 2017; He et al., 2022; Iserbyt et al., 2016, 2017, 2020; Kim & Ko, 2020; Sinelnikov et al., 2016; Ward et al., 2015)
Pedagogical knowledge of content in physical education teacher training programs	(Backman et al., 2019; Backman & Barker, 2020; Cañadas et al., 2019; Dervent et al., 2020; Farias et al., 2022; García-Rico et al., 2021; Herold, 2019; Herold & Waring, 2017; Le Paven et al., 2021; Marcon et al., 2012; Marquis & Metzler, 2017; Meier, 2020, 2021; Montoya-Grisales et al., 2022; Musard et al., 2022; Mustell et al., 2022; Sutherland et al., 2016)

Pedagogical knowledge of the content in school Physical Education

The research referred to this category reinforce the idea that the teacher must know the content of physical education and consider the school curriculum. In some of them (Castejon Oliva & Fuentes Guerra, 2017; Ward, 2013) a narrow, erroneous or compromised PCK was reported, since the teachers presented a very basic or limited CK, in some cases due to very early personal experiences, due to the quality of their initial training or the specialization they had as practitioners.

It is important to keep in mind that as Almonacid-Fierro, Merellano-Navarro, et al. (2019) knowledge of a disciplinary nature does not guarantee quality learning for students who participate in the PE classroom; however, it is essential to indicate that a professional who has a large base of contents to later teach them, will be able to develop the PCK in a more effective way (Castejon Oliva & Fuentes Guerra, 2017), and also achieve an adequate mastery of this construct (Almonacid-Fierro, Merellano-Navarro, et al., 2018) and, thus, display a greater repertoire of instructions, recognize the errors and difficulties of the students (Ayvazo & Ward, 2011) and; generate horizontal dialogues in the construction of knowledge, favoring pedagogical instances (Almonacid-Fierro, Merellano-Navarro, et al., 2018) where the game plays a fundamental role, since it energizes the class session, allows collaboration and respect among the participants, and generates multiple benefits of a physiological nature (Almonacid Fierro et al., 2019).

Given the above, it is necessary to examine the levels of development of the PCK of the teachers, either from a functional analysis of the adaptations of the instruction (Ayvazo & Ward, 2011), or applying validated instruments such as tests or questionnaires, such as what was done in a Chilean context, where from dimensions referring to general pedagogical knowledge, knowledge of disciplinary content, and knowledge of content, it was possible to account for the PCK of the teacher associated with the PE class (Almonacid-Fierro, Feu, et al., 2018).

Thus, the findings of the reviewed studies reveal that the PCK is not a static construct, and is susceptible to modifications, adaptations, or changes (Ayvazo & Ward, 2011; Chang et al., 2020), depending on the experiences of the teachers; which, in addition, increases the CK of the students.

The above comments show that the teacher's curricular knowledge of PE is a fundamental factor when addressing the contents in class, however, it is also essential to approach the knowledge of the students and the institution, since subjects and contexts tend to be changing, so it can be said that one of the characteristics of PKC in school PE is that the teacher must be ready to change and adapt.

Pedagogical knowledge of the content in School Sport

The studies that make up this category are characterized by being empirical, that is, in all of them some type of intervention was carried out on teachers, especially with workshops. The variables to be modified or improved focused on student learning (Kim & Ko, 2020; Sinelnikov et al., 2016; Ward et al., 2015), especially on issues related to their motor performance, through correct tests; another matter of interest was the representation of the tasks by the teachers (Araújo et al., 2017; Iserbyt et al., 2016, 2017, 2020), taking into account the type and amount of adjustments made by them, since this denotes, in one way or another, the preparation and adaptation of the teachers to the contexts and needs of the students.

The workshops carried out and which were reported by some investigations, were focused on the development of CCK, SCK or both, since it is based on the fact that the PCK of a teacher differs depending on the CK (Ward et al., 2015). These workshops sought to improve the traditional conditions in sports education, evaluating the correct tasks by the teachers, which included more mature tasks, intra-task adaptations, a greater number of descriptions, analogies/metaphors, or feedback (Iserbyt et al., 2016, 2017, 2020).

In the investigations, it was evidenced that the interventions are effective for: developing the knowledge of the teachers (Araújo et al., 2017; He et al., 2022); substantially increase task accommodations (Iserbyt et al., 2020), whether mature or appropriate (Iserbyt et al., 2016); improve the promulgated PCK (Kim & Ko, 2020); generate changes in PCK behaviors in teachers (Sinelnikov et al., 2016); increase the suitability of selected tasks based on student performance (Iserbyt et al., 2017) and; in general, in generating an impact in the PCK (Ward et al., 2015).

In this category referring to sports, there are some issues that are similar to the school context, since PCK also involves knowing the students, although focusing on motor learning issues, and the teacher must take into account the context; however, there is a strong emphasis on the approach and development of tasks for students to have better performances, therefore the ideals, rather than strictly from the cultural, seem to be anchored to the agonistic logic of sports.

Pedagogical knowledge of content in physical education teacher training programs

Finally, research has been interested in establishing differences in the PCK, depending on the stage of training in which the future teacher is, a matter that has also been empirically demonstrated, for example, according to, there are differences in the PCK of teachers Marcon et al. (2012) in training according to the year they are studying, determining that this is better in the last year (Dervent et al., 2020); one of the main reasons that accounts for the above is that in the early stages of training, the teaching practices are designed to transfer and apply the CK (Marcon et al., 2012), and therefore, the participation of the PCK in the practice and its construction is very Superficially, a little SCK and CCK is presented (Dervent et al., 2020), having the mistaken belief that these two knowledge can be achieved from the practice of a sport (Dervent et al., 2020).

Similarly, studies show that CK limitations have an adverse effect on PCK (Herold & Waring, 2017), given that, as reported by Le Paven et al. (2021), to access a suitable PCK, a deep knowledge of the contents is required; however, it has also been shown that CK by itself is not enough if you want to teach attractive lessons (Herold & Waring, 2017), in addition, that it is necessary to trust the sequence of the class, facilitate the approach to the contents and help process the lived experience (Sutherland et al., 2016). Preservice teachers can develop their CK based on their participation in training protocols tailored to the development of CCK and SCK, and specific pedagogies of Learner-Centered Model-Based Practice (Farias et al., 2022)

Thus, achieving an effective PCK in initial training implies that the teacher in training evaluates where the group he is in charge is at, that is, that he has knowledge of the student, and that he is capable of interpreting his actions and reactions in class (Backman & Barker, 2020; Sutherland et al., 2016), as well as being able to adapt to the conditions of the context (Meier, 2020) and choose which models or approaches to use (Mustell et al., 2022). That is why, the programs that train PE teachers must emphasize the acquisition of skills in aspects such as: the execution of contents and teaching (Marquis & Metzler, 2017), especially from school practices (Herold, 2019); in learning from university service (García-Rico et al., 2021); the use of the joint action framework in didactics (Musard et al., 2022); in knowing how to use the game as a didactic resource and as teaching content (Cañadas et al., 2019) and, in valuing the CK of the movement from a constructivist perspective (Backman et al., 2019). In addition, understanding the PCK is a prerequisite that can allow improving the curricular designs of bachelor's programs in PE (Montoya-Grisales et al., 2022).

It is then essential to achieve an adequate construction of the PCK during initial training, using different tools and techniques of inquiry and diagnosis that allow knowing the conditions and knowledge of the subjects in training, and thus aiming at the formation of a teacher who is capable of accounting for a pedagogical and disciplinary knowledge based on the contexts and students, which are increasingly changing and challenging, because as expressed by Musard et al. (2022) the development of more effective forms of PCK requires pre-service PE teachers to analyze teaching and learning tasks within contextualized situations.

From this category, it can be synthesized that PCK is indeed a matter that begins to be built in the initial training process, however, although PCK is investigated especially from the declarative, it is achieved, developed and tested in action, therefore, PCK is only possible when the teacher fulfills his social function, in the case of the PE teacher, in the classroom, the playground, the court, among others. In addition, it is also clarified that professional development must also be taken as a formative event that provides new knowledge and experiences.

Conclusions

In general, it is possible to affirm that the study of the PCK is a matter of interest in the field of PE, however, in the case of Latin America it is an incipient matter and deserves to be deepened, not only as a regional matter, but also as a construct that should be considered according to the experiences of PE teachers, their students and contexts.

From the methodological point of view there is a predominance of descriptive studies, or illustration of cases and experiences in particular, the few works that were found that tested some type of intervention, have been done in the sports field, in the case of school and teacher training processes the matter is still incipient.

The PCK in school PE is highly determined by the knowledge and training of the teacher, and what the literature reports is that in some cases the training processes do not account for everything a teacher should know before facing the task of directing a class, so knowing and diagnosing PCK in PE teachers at school is a fundamental task when it comes to improving their teaching practices, which will also provide better coping and attention to students, and in general a better knowledge of the curricular structure of the class, which is anchored to the training ideals of the contexts. A positive aspect to highlight is that the game is named as a key means and element when addressing the contents of the PE class, not only from the conceptual point of view, but also procedural and attitudinal.

Regarding the PCK in school sports, it is that this has been investigated from the pragmatic and empirical, characterized by an eagerness to intervene and promote in teachers how to improve student learning, and above all in understanding the needs and characteristics of the students; therefore, in the logic of sports, the approach and development of tasks to improve student performance is a fundamental aspect in the PCK of this type of teachers.

Faced with the PCK in the initial training process, it is highlighted that this construct must be accompanied by practice, which, in turn, must be combined with the level of training of the future teacher; In the same way, a privilege is given to the fact that the knowledge of the students is a fundamental element of the PCK; in this way, the PCK stands as a construct that implies reflection and a clear theoretical position regarding what is taught; but also, it must be accompanied by effective actions that allow students to put into practice what is theoretically declared. Similarly, it should be noted that the professional development of teachers is a primary source of new content and experiences that help consolidate or transform the PCK according to the needs of the people in charge and the contexts in which they intervene.

In short, it can be concluded that there is a need for CCK and SCK to be better taught in teacher training programs since they are a fundamental basis for PCK; however, the initial training phase is not established as a definitive period in terms of teacher preparation; in this fundamental order of ideas, it does not mean finished, much less when it refers to the PCK, since even in the real pedagogical practice of the teacher's field or in professional development, one is prone to learn, reorder or restructure the PCK, since this as already mentioned and demonstrated, it is a changing construct, not only because the contents to be taught are susceptible to change, but also because the dynamics of the contexts and institutions, but above all the needs of the students, are at the mercy of the influences of life and society.

References

Ait ali,D., & Senhaji, F. (2022). The application of TPACK framework in health professions education: a systematic review. *PROSPERO*. https://acortar.link/sXSxA4

Alexander, P. A. (2020). Methodological Guidance Paper: The Art and Science of Quality Systematic Reviews. *Review of Educational Research*, *90*(1), 6–23. https://doi.org/10.3102/0034654319854352

Almonacid Fierro, A. A., Merellano-Navarro, E., Feu Molina, S., Vizuete Carrizosa, M., & Orellana Fernández, R. (2019). Perspectiva cualitativa en la construcción del conocimiento didáctico del contenido del profesorado de Educación Física [Qualitative perspective in the construction of didactic content knowledge of physical education teachers]. *Retos*, *36*, 459–468. https://doi.org/10.47197/retos.v36i36.68840

Almonacid-Fierro, A., Feu, S., & Vizuete Carrizosa, M. (2018). Validación de un cuestionario para medir el Conocimiento Didáctico del Contenido en el profesorado de Educación Física [Validation of a questionnaire to measure Didactic Content Knowledge in Physical Education teachers]. *Retos*, *34*, 132–137. https://doi.org/10.47197/retos.v0i34.58590

Almonacid-Fierro, A., Merellano-Navarro, E., Molina, S. F., & Vizuete Carrizosa, M. (2018). Conocimiento pedagógico del contenido: un estudio cualitativo en el profesorado de educación física [Pedagogical content knowledge: a qualitative study in physical education teachers]. *Revista Iberoamericana de Ciencias de La Actividad Física y El Deporte*, *8*(7), 1–13. https://doi.org/10.12800/ccd.v1i1.1147

Araújo, R. M. F., Hastie, P. A., de Assunção Bessa Pereira, C. H., & Mesquita, I. M. R. (2017). The evolution of student-coach's pedagogical content knowledge in a combined use of sport education and the step-game-approach model. *Physical Education and Sport Pedagogy*, *22*(5), 518–535. https://doi.org/10.1080/17408989.2017.1294668

Ayvazo, S., & Ward, P. (2011). Pedagogical content knowledge of experienced teachers in physical education: functional analysis of adaptations. *Research Quarterly for Exercise and Sport*, *82*(4), 675–684. https://doi.org/10.1080/02701367.2011.10599804

Backman, E., & Barker, D. M. (2020). Re-thinking pedagogical content knowledge for physical education teachers–implications for physical education teacher education. *Physical Education and Sport Pedagogy*, *25*(5), 451–463. https://doi.org/10.1080/17408989.2020.1734554

Backman, E., Pearson, P., & Forrest, G. J. (2019). The value of movement content knowledge in the training of Australian PE teachers: perceptions of teacher educators. *Curriculum Studies in Health and Physical Education*, *10*(2), 187–203. https://doi.org/10.1080/25742981.2019.1596749

Bonilla-Castro, E., & Rodríguez Sehk, P. (2005). *Más allá de los métodos. La investigación en ciencias sociales [Beyond methods. Social science research]* (3ª ed.). Norma.

Brines Brines, A., Solaz-Portolés, J. J., & Sanjosé López, V. (2016). Estudio exploratorio comparativo del conocimiento didáctico del contenido sobre pilas galvánicas de profesores de secundaria en ejercicio y en formación [An exploratory comparative study of the didactic knowledge of galvanic cells content of practicing and trainee secondary school teachers]. *Enseñanza de Las Ciencias*, *34*(2), 107–127. https://doi.org/10.5565/rev/ensciencias.1758

Cambra Badii, I., & Lorenzo, M. G. (2021). La sensibilidad ética y el conocimiento didáctico del contenido de los profesores de ciencias experimentales [Ethical sensitivity and didactic content knowledge of experimental science teachers]. *TED: Tecné Episteme y Didaxis*, *49*, 199–218. https://n9.cl/6xc67

Campo Nava, M., & Ramírez Díaz, M. H. (2019). Diseño de un instrumento para caracterizar el conocimieto didáctico del contenido en profesores de física sobre un tópico específico [Design of an instrument to characterize the didactic content knowledge of physics teachers on a specific topic]. *Góndola, Enseñanza y Aprendizaje de Las Ciencias*, *14*(2), 340–359. https://doi.org/10.14483/23464712.13900

Cañadas, L., Santos, M. L., & Castejón, F. J. (2019). Competencias docentes en la formación inicial del profesorado de educación física [Teaching competencies in the initial training of physical education teachers]. *Retos*, *35*, 284–288. https://doi.org/10.47197/retos.v0i35.64812

Castejón Oliva, F. J., & Fuentes Guerra, J. G. (2017). Conocimiento del contenido y conocimiento pedagógico del contenido de educación física en educación secundaria [Content knowledge and pedagogical content knowledge of physical education in secondary education]. *Retos*, *32*, 146–151. https://doi.org/0.47197/retos.v0i32.51845

Chang, S. H., Ward, P., & Goodway, J. D. (2020). The effect of a content knowledge teacher professional workshop on enacted pedagogical content knowledge and student learning in a throwing unit. *Physical Education and Sport Pedagogy*, *25*(5), 493–508. https://doi.org/10.1080/17408989.2020.1743252

Contreras Jordán, O. R. (2019). *Didáctica de la Educación Física. Un enfoque constructivista* (4a ed.). INDE.

Dervent, F., Devrilmez, E., Ince, M. L., & Ward, P. (2020). A national analysis of the content knowledge of Turkish physical education teacher education students. *Physical Education and Sport Pedagogy*, *25*(6), 613–628. https://doi.org/10.1080/17408989.2020.1779682

Díaz Pacheco, C. M. (2017). El conocimiento pedagógico del contenido en tres docentes ingenieros: Un acercamiento desde el análisis multimodal del discurso [Pedagogical content knowledge in three engineering teachers: A multimodal discourse analysis approach]. *Actualidades Investigativas en Educación*, *17*(1), 1–30. https://doi.org/10.15517/aie.v17i1.27275

Dixon-Woods, M., Agarwal, S., Jones, D., Young, B., & Sutton, A. (2005). Synthesising qualitative and quantitative evidence: A review of possible methods. *Journal of Health Services Research & Policy*, *10*(1), 45–53. https://doi.org/10.1177/135581960501000110

Farias, C., Teixeira, J., Ribeiro, E., & Mesquita, I. (2022). Effects of a two-stage physical education teacher education programme on preservice teachers' specialised content knowledge and students' gameplay in a student-centred Sport Education-Step Game approach. *European Physical Education Review*, *28*(3), 816–834. https://doi.org/10.1177/1356336X221084516

García-Rico, L., Santos-Pastor, M. L., Martínez-Muñoz, L. F., & Ruiz-Montero, P. J. (2021). The building up of professional aptitudes through university service-learning's methodology in sciences of physical activity and sports. *Teaching and Teacher Education*, *105*. https://doi.org/10.1016/j.tate.2021.103402

González Palacio, E. V. (2019). *Representaciones sociales sobre* *la formación inicial y ser maestro en estudiantes de educación física del departamento de Antioquia [Social representations about initial training and being a teacher among physical education students in the department of Antioquia].* [Tesis de doctorado, Universidad de Antioquia]. Repositorio institucional. https://n9.cl/4k4fl1

González, N. V., & Rossi, A. M. (2015). Conocimiento pedagógico del contenido para la enseñanza del tema mitosis: un estudio de casos con docentes universitarios de Argentina [Pedagogical content knowledge for teaching the topic of mitosis: a case study with university teachers in Argentina.]. *Didáctica de Las Ciencias Experimentales y Sociales*, *29*, 215–232. https://doi.org/10.7203/dces.29.4991

He, Y. H., Ward, P., Wang, X., & Yang, G. (2022). Examining Common and Specialized Soccer Content Knowledge and Demographic Variables of Chinese Physical Education Teachers. *Journal of Teaching in Physical Education*, *41*(1), 22–31. https://doi.org/10.1123/jtpe.2019-0159

Heitink, M. C., van der Kleij, F. M., Veldkamp, B. P., Schildkamp, K., & Kippers, W. B. (2016). A systematic review of prerequisites for implementing assessment for learning in classroom practice. *Educational Research Review*, *17*, 50–62. https://doi.org/10.1016/j.edurev.2015.12.002

Herold, F. (2019). Shulman, or Shulman and Shulman? How communities and contexts affect the development of pre-service teachers' subject knowledge. *Teacher Development*, *23*(4), 488–505. https://doi.org/10.1080/13664530.2019.1637773

Herold, F., & Waring, M. (2017). Is practical subject matter knowledge still important? Examining the Siedentopian perspective on the role of content knowledge in physical education teacher education. *Physical Education and Sport Pedagogy*, *22*(3), 231–245. https://doi.org/10.1080/17408989.2016.1192592

Iserbyt, P., Coolkens, R., Loockx, J., Vanluyten, K., Martens, J., & Ward, P. (2020). Task Adaptations as a Function of Content Knowledge: A Functional Analysis. *Research Quarterly for Exercise and Sport*, *91*(4), 539–550. https://doi.org/10.1080/02701367.2019.1687809

Iserbyt, P., Ward, P., & Li, W. (2017). Effects of improved content knowledge on pedagogical content knowledge and student performance in physical education. *Physical Education and Sport Pedagogy*, *22*(1), 71–88. https://doi.org/10.1080/17408989.2015.1095868

Iserbyt, P., Ward, P., & Martens, J. (2016). The influence of content knowledge on teaching and learning in Traditional and Sport Education contexts: an exploratory study. *Physical Education and Sport Pedagogy*, *21*(5), 539–556. https://doi.org/10.1080/17408989.2015.1050662

Kim, I., & Ko, B. (2020). Content knowledge enacted pedagogical content knowledge, and student performance between teachers with different levels of content expertise. *Journal of Teaching in Physical Education*, *39*(1), 111–120. https://doi.org/10.1123/jtpe.2018-0292

Le Paven, M., Clayton, R., & Kermarrec, G. (2021). Learning to teach and play futsal using digital tablets: What knowledge do sports science students mobilize? *Physical Culture and Sport, Studies, and Research*, *91*(1), 34–46. https://doi.org/10.2478/pcssr-2021-0017

Marcon, D., Graça, A. B. S., & Nascimento, J. V. (2012). Analysis of the pedagogical knowledge of prospective physical education teachers. *Kinesiology*, *44*(2), 113–122. https://hrcak.srce.hr/file/139182

Marquis, J. M., & Metzler, M. (2017). Curricular Space Allocated for Dance Content in Physical Education Teacher Education Programs: A Literature Review. *Quest*, *69*(3), 384–400. https://doi.org/10.1080/00336297.2016.1256223

Martínez-Bello, V. E., Bernabé-Villodre, M. del M., Lahuerta-Contell, S., Vega-Perona, H., & Giménez-Calvo, M. (2021). Pedagogical Knowledge of Structured Movement Sessions in the Early Education Curriculum: Perceptions of Teachers and Student Teachers. *Early Childhood Education Journal*, *49*(3), 483–492. https://doi.org/10.1007/s10643-020-01090-0

Medina, J., Cruz, L., & Jarauta, B. (2016). La dimensión dialógico-reflexiva del Conocimiento Didáctico del Contenido en la docencia universitaria [The dialogic-reflexive dimension of Didactic Content Knowledge in university teaching]. *Revista de Educación*, *374*, 69–93. https://doi.org/10.4438/1988-592X-RE-2016-374-326

Meier, S. (2020). Development and validation of a testing instrument to assess pedagogical content knowledge of German preservice physical education teachers. *Journal of Physical Education and Sport*, *20*, 3010–3016. https://doi.org/10.7752/jpes.2020.s5409

Meier, S. (2021). Pedagogical content knowledge in students majoring in physical education vs. sport science. The same but different? *German Journal of Exercise and Sport Research*, *51*(3), 269–276. https://doi.org/10.1007/s12662-021-00725-7

Melo, L., Cañada, F., & Díaz, M. (2017). Formación continua del profesorado de Física a través del conocimiento didáctico del contenido sobre el campo eléctrico en bachillerato: un caso de estudio [Continuing education of physics teachers through didactic knowledge of electric field content in high school: a case study]. *Caderno Brasileiro de Ensino de Física*, *34*(1), 131–151. https://doi.org/10.5007/2175-7941.2017v34n1p131

Mentado Labao, T., Cruz Garcette, L., & Medina Moya, J. L. (2017). Preparar para aprender: Una manifestación del conocimiento didáctico del contenido en la práctica [Preparing to learn: A manifestation of didactic content knowledge in practice]. *Estudios Sobre Educación*, *33*, 27–48. https://doi.org/10.15581/004.33.27-48

Montoya Grisales, N. E., & Arroyave Giraldo, D. I. (2021). Conocimiento didáctico del contenido, una revisión sistemática exploratoria [Didactic content knowledge, an exploratory systematic review]. *REDIPE*, *10*(8), 55–71. https://doi.org/10.36260/rbr.v10i8.1384

Montoya-Grisales, N. E., Almonacid-Fierro, A., Arroyave Giraldo, D. I., & Valdebenito González, K. B. (2022). Design and validation of a questionnaire to assess the Pedagogical practicum. *Pedagogy of Physical Culture and Sports*, *26*(5), 300–310. https://doi.org/10.15561/26649837.2022.0504

Musard, M., Bezeau, D., & Wallhead, T. L. (2022). Pre-service teachers content-related analyses of a physical education learning task. *Physical Education and Sport Pedagogy*, 1–13. https://doi.org/10.1080/17408989.2022.2061936

Mustell, J., Geidne, S., & Barker, D. (2022). How ball games experts legitimate ball games knowledge within Swedish physical education teacher education. *Physical Education and Sport Pedagogy*, 1–15. https://doi.org/10.1080/17408989.2022.2138305

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, *372*(71), 1–9. https://doi.org/10.1136/BMJ.N71

Parga Lozano, D. L., & Moreno Torres, W. F. (2017). Conocimiento didáctico del contenido en química orgánica: Estudio de caso de un profesor universitario [Didactic content knowledge in organic chemistry: case study of a university profesor]. *Revista Electronica Educare*, *21*(3), 1–21. https://doi.org/10.15359/ree.21-3.3

Ravanal Moreno, E., & López-Cortés, F. (2016). Mapa del conocimiento didáctico y modelo didáctico en profesionales del área biológica sobre el contenido de célula [Map of didactic knowledge and didactic model in professionals of the biological area on cell content]. *Revista Eureka Sobre Enseñanza y Divulgación de Las Ciencias*, *13*(3), 725–742. https://acortar.link/ZDJtmi

Shulman, L. S. (1987). Knowlegde and teaching: foundations of the new reform. *Harvard Educational Review*, *57*(1), 1–21. https://people.ucsc.edu/~ktellez/shulman.pdf

Sinelnikov, O. A., Kim, I., Ward, P., Curtner-Smith, M., & Li, W. (2016). Changing beginning teachers' content knowledge and its effects on student learning. *Physical Education and Sport Pedagogy*, *21*(4), 425–440. https://doi.org/10.1080/17408989.2015.1043255

Strauss, A., & Corbin, J. (2002). *Bases de la investigación cualitativa. Técnicas y procedimientos para desarrollar la teoría fundamentada [Basis of qualitative research. Techniques and procedures to develop grounded theory]*. Universidad de Antioquia.

Sutherland, S., Stuhr, P. T., & Ayvazo, S. (2016). Learning to teach: pedagogical content knowledge in adventure-based learning. *Physical Education and Sport Pedagogy*, *21*(3), 233–248. https://doi.org/10.1080/17408989.2014.931365

Ward, G. (2013). Examining primary schools' physical education coordinators' pedagogical content knowledge of games: are we just playing as this? *Education 3-13*, *41*(6), 562–585. https://doi.org/10.1080/03004279.2011.595424

Ward, P. (2009). Content matters: Knowledge that alters teaching. *Historic Traditions and Future Directions of Research on Teaching and Teacher Education in Physical Education*, *January 2009*, 345–356. https://acortar.link/esCzZh

Ward, P., & Ayvazo, S. (2016). Pedagogical content knowledge: Conceptions and findings in physical education. *Journal of Teaching in Physical Education*, *35*(3), 194–207. https://doi.org/10.1123/jtpe.2016-0037

Ward, P., Kim, I., Ko, B., & Li, W. (2015). Effects of improving teachers' content knowledge on teaching and student learning in physical education. *Research Quarterly for Exercise and Sport*, *86*(2), 130–139. https://doi.org/10.1080/02701367.2014.987908