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Digital Education in the Therapeutic Healthcare Professions: Occupational Therapy, Physical Therapy, and Speech and Language Therapy: a Scoping Review

Digitale Ausbildung in den therapeutischen Gesundheitsberufen Ergotherapie, Physiotherapie und Logopädie: Ein Scoping Review

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Abstract

Against the background of increasingly complex healthcare needs, well-trained healthcare professionals are urgently needed. New technologies in the field of digital education can both improve access to education and support the development of transformative skills. This raises the question of the didactic use of digital education in the healthcare professions, which acquire professional knowledge, practical skills, and analytical skills as part of their training. Therefore, a scoping review was conducted to investigate what is known in the literature about digital education in occupational therapy, physical therapy, and speech and language therapy. Following a systematic literature search, 100 studies in the past ten years were identified. After prescreening, 16 studies were identified to answer the research question, and for this summarized numerically and then analyzed in a qualitative synthesis. The results provide evidence of positively evaluated teaching concepts and techniques, analytical and practical skill acquisition, and proven technologies. In addition, the results highlight the diversity of digital training options and provide evidence of their effects.

Abstract

Vor dem Hintergrund zunehmender komplexer Versorgungsbedarfe, werden gut ausgebildete Fachkräfte im Gesundheitswesen dringend gebraucht. Neue Technologien im Bereich der digitalen Bildung können dabei sowohl den Zugang zu Bildung verbessern, als auch die Entwicklung transformativer Fähigkeiten unterstützen. Hierbei stellt sich die Frage der didaktischen Nutzung von digitaler Ausbildung in den Gesundheitsberufen, die im Rahmen der Ausbildung Fachwissen, praktische Fertigkeiten und analytische Fähigkeiten erwerben. Im Rahmen eines Scoping Reviews wurde daher der Frage nachgegangen, was in der Literatur über die digitale Ausbildung in der Ergotherapie, Physiotherapie und Logopädie bekannt ist. Im Anschluss an eine systematische Literaturrecherche wurden 100 Studien in den vergangenen zehn Jahren identifiziert. Nach einem Vor-Screening wurden 16 Studien im Rahmen eines Vollscreening zunächst numerisch zusammengefasst und anschließend in einer qualitativen Synthese ausgewertet. Die Ergebnisse geben Hinweise auf positiv evaluierte Lehrkonzepte und -Techniken, auf den analytischen und praktischen Kompetenzerwerb, sowie auf erprobte Technologien. Zudem zeigen die Ergebnisse die Vielfalt von digitalen Ausbildungsmöglichkeiten auf und geben Hinweise auf deren Wirkungen.

Keywords

Digital education – therapeutic healthcare – occupational therapy – physical therapy – speech and language therapy

Keywords

Digitale Ausbildung – therapeutische Gesundheitsberufe – Ergotherapie – Physiotherapie – Logopädie

BACKGROUND

"The right to the enjoyment of the highest attainable standard of physical and mental health," first articulated in the Constitution of the World Health Organization (WHO) in 1946 and recognized as a human right in the 1966 International Covenant on Economic, Social and Cultural Rights (United Nations. Office of the High Commissioner for Human Rights [OHCHR], 2008, p. 1), sets standards worldwide. According to the Constitution, scientifically and medically appropriate care of good quality "requires, in particular, trained health professionals […]" (OHCHR, 2008, p. 4).

In modern societies, demographic and epidemiological changes, such as the increase in older, chronically ill, and multi-morbid people, quantitatively change healthcare needs. At the same time, developments in medicine, technology, and new opportunities in diagnostics and

therapy are qualitative aspects of change (WR, 2012). The increasing complexity in healthcare and technology results in a high level of responsibility for professionals and educators. As a growing number of specialists with good technical and practical training are urgently needed worldwide, academic training is recommended (WR, 2012) and implemented internationally (Scharff Rethfeld & Heinzelmann, 2014; World Federation of Occupational Therapists [WFOT], 2022; World Physiotherapy, 2022).

Digital technology can serve multiple purposes in educating a sufficient number of highly competent professionals. By enabling flexibility and granting individual access to location-independent education, more access for people and settings in rural areas is guaranteed and more people are able to be educated (Wilson et al., 2009). At the same time, digital education offers potential benefits for work-study-life balance (WR, 2022) and enables interprofessional education (IPE). IPE is, due to the high responsibilities in interprofessional cooperation, particularly important. Benefits on quality of care are broadly described (Spaulding et al., 2021; Zwarenstein et al., 2013). In addition, using new technologies in digital didactic concepts can enforce training in both professional core skills, as well as develop a key transformative skill at the same time.

Digital education or e-learning are defined as educational concepts that are realized by using digital technology and following didactical aims (Fischer, 2014). It does not present a didactical method on its own, as many variations exist, just as in traditional education. Due to the conceptual and methodological openness of digital education, questions of didactic strategies and techniques become highly relevant (Kergel & Heidkamp-Kergel, 2020).

Many different techniques and definitions can be found in the literature, using varying proportions of technology. For example, the concepts blended learning and flipped classroom (FC), or the terms synchronous and asynchronous, are often mentioned. Blended learning is characterized by a combination of face-to-face and remote teaching and aims to profit from the didactic advantages of both settings. The FC technique follows the same aim by realizing knowledge acquisition individually through online materials before a discussion or training in a traditional face-to-face setting closes the session (WR, 2022). It can be organized synchronously or asynchronously. Synchronous courses require the simultaneous presence of both teachers and students in a real or virtual space (e.g. in a videoconference), whereas asynchronous courses are provided on a website and can be attended by students at individual times (WR, 2022).

The importance of skill-oriented education for health professionals lies in their continuous need for competence in adapting to new and evolving situations (Tudor et al., 2022). Bloom's taxonomies (1956) allow for the categorisation of skills into professional knowledge (PK), practical skills (PS), and analytical skills (AS). PK is described as the first step to gain and understand knowledge before it can be applied practically, analysed, and further processed.

As stated above, prospective therapists must not only receive theoretical, practical, and reflective training to provide the best possible care. Additionally, competencies for skill transformation, rooted in new scientific knowledge and evidence, must be cultivated to serve as the basis for lifelong learning (Pfingsten & Borgetto, 2022).

Research in the field of digital education for healthcare professionals indicates that broader establishment of standards, concepts, and evidence for digital education is yet to be realized (WR, 2022). Furthermore, besides medical education and nursing education, the therapeutic professions are notably underrepresented in other reviews (e.g., Car et al., 2019; Kyaw et al., 2019).

To gain more specific insights, this article will concentrate on the academic education of therapeutic healthcare professions: occupational therapy (OT), physical therapy (PT), and speech and language therapy (SLT). This article intends to provide an overview of digital education for therapeutic healthcare professions. The research question is: What is known about digital education for OT, PT, and SLT described in the therapeutic health literature?

METHODS

To answer our research question, we use the methodology of the scoping review. Scoping reviews are a feasible scientific way "to explore the extent and nature of a body of literature, […] and to identify evidence gaps, [they] are particularly useful where evidence is extensive and widely dispersed (i.e., many different types of evidence), or emerging and not yet amenable to questions of effectiveness" (Peters et al., 2021, p. 3).

Following the methodological framework outlined by Arksey and O'Malley (2005), the research question was formulated as previously described. Subsequently, relevant studies were identified and selected for analysis. An electronic search was conducted on 13 February 2023 in PubMed, ERIC, and CINAHL, as well as in OTseeker, evilog, SpeechBite and PEDRO. Keywords used were "distance education" OR "distance learning" OR "digital education" OR "online education" OR "online learning" AND "occupational therapy/education" OR "speech and language therapy/education" OR "physiotherapy/education." The PubMed research was performed with the Medical Subject Headings (MeSH) "occupational therapy/education,") OR ("speech therapy/education" OR "speech language pathology/education" OR "physical

therapists/education" AND "education, distance" for 2012 through 2023.

Inclusion criteria for selection were: any type of paper with reported evaluation, published between 2012 and 2023, and covering students or teachers in OT, PT, and SLT education in all academic educational settings and all academic education levels.

Studies on clinician advanced education or investigation of therapeutic approaches were excluded. A lack of information on the subject in a study or on its used didactical concept also led to exclusion. Studies conducted during COVID-19 which focused on student perception or well-being were excluded to prevent a bias towards COVID-specific dynamics.

Across all platforms, 67 studies were found (24 in PubMed, 20 in ERIC, and 23 in CINAHL). The other databases provided 19 results, all of which were excluded after title screening, since they focused on investigating therapeutic approaches or clinician advanced education. An additional search using the snowball system in Web of Science and Google Scholar revealed 14 records. All were excluded after title and abstract screening, since they focused on COVID-19.

A total number of n = 100 studies were screened by title and abstract, of which 64 records were excluded. They either focused on the wrong target group or topic (for example, studies on clinician advanced education, teletherapy, or student well-being during COVID-19).

Two reviewers[1] independently analyzed 36 remaining papers against the eligibility criteria beginning with a pilot analysis to anticipate possible challenges and create criteria for data abstraction. Data abstraction then was done independently in an extraction information table (Table 1, Appendix). Discrepancies were resolved through discussion, and a total of n = 16 studies were selected for full-text analysis (Figure 1). In the next step, abstracted data were sorted using content analysis, new categories were formed, and relevant concepts found in the literature summarized. "Content analysis is a qualitative-synthesis type of analysis that combines qualitative approaches with quantitative analysis to categorize data (e.g., texts or images) to identify and code patterns in data […]" (Guo et al., 2022, p. 76). This means that all found educational goals, educational concepts, technological aspects, and other addressed issues had been extracted and brought together when theoretically fitting. As a result of this step, addressed techniques, skills, and technologies emerged. They were forming relevant main aspects discussed in the selected studies. Levels of evaluation data vary from perceptions of students and faculty staff to a pilot randomized controlled trial (Table 1, Appendix).

"Scoping reviews typically identify, present and describe relevant characteristics of included sources of evidence rather than seeking to combine statistical or qualitative data from different sources to develop synthesized results" (Peters et al. 2021, p. 2). It is a methodological decision of the authors to report the results, including qualitative or quantitative data, for transparency, although data will not be compared in a synthesis or meta-analysis.

RESULTS

Study selection

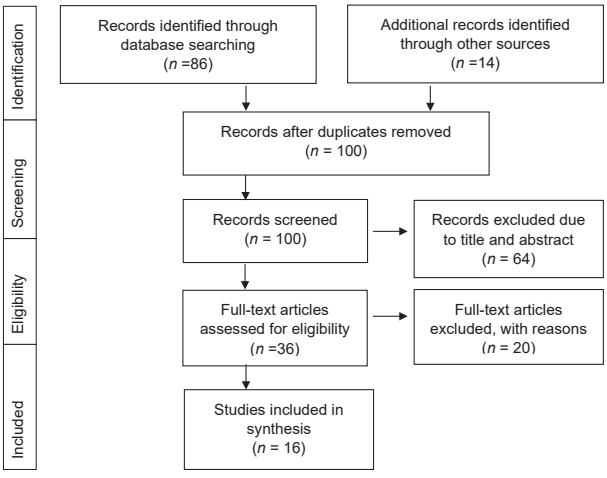

Figure 1: Flow chart of article selection process.

Study characteristics

The findings of this scoping review are going to be described numerically as listed in Table 1 (Appendix).

All articles included were published between 2012 and 2022. Eight of them were conducted from 2012 to 2017, eight more in the last five years. They were published in the U.S. (8), Australia (3), Brazil (2), UK (1), Hong Kong (1), and Canada (1). The studies focused on distance education of prospective OT, PT, and SLT students. Two studies examined IPE with nurses, dentists, or health information management (HIM) experts. OT education and PT education were each represented six times, SLT education seven times. The level of evaluation and the scale of described concepts varied in all articles. Most students were undergraduates. Three articles focused on master or doctoral students and one on post-professional students.

While analysing the selected studies, distinct patterns of interest emerged, which will be reported in the following categories (Figure 2). Firstly, ***techniques*** in the found concepts will be described, before an accumulation of addressed ***skills***, ***technologies, and materials*** will close the section.

[1]The first and second authors of this paper.

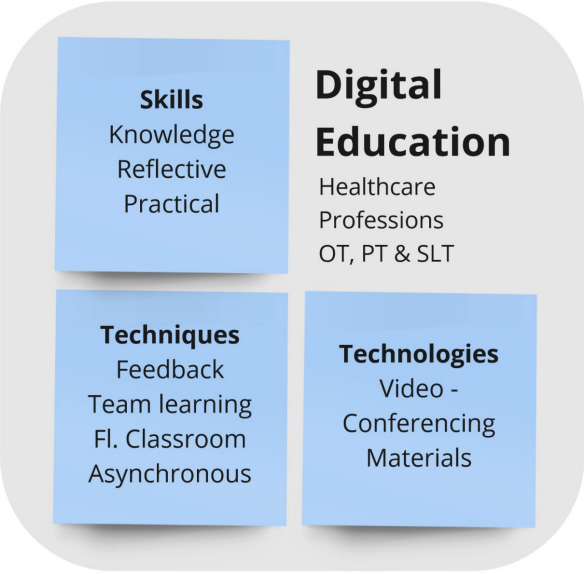

Figure 2: Results: Categories and sub-categories.

Techniques

The selected studies applied a variety of didactical techniques that were similar or overlapping.

Feedback

Various similar concepts emerged that targeted digital feedback strategies and were applied in the context of mentoring, coaching, facilitation, and/or peer feedback.

Kelley et al. (2020) analysed the practical performance of SLT students in vocabulary instruction after receiving prerecorded teaching modules. Students recorded their performance on video, and the experimental group received asynchronous e-mail feedback. They compared the effects of prerecorded teaching modules alone versus teaching modules with e-mail feedback in a quasi-experimental group design by evaluating three main outcomes. "For each outcome [they] conducted a repeated measures analyses of variance with one between-subjects factor (group) and one repeated-measures factor (score on each of the outcomes)." They interpreted that "e-mail feedback had no significant effect on participants' selection of appropriate vocabulary targets [and] use of explicit teaching strategies. For teaching with interaction, there was a main effect of group ($F(1,19) = 60.61$, $p < .001$) and significant group time interaction ($F(1,19) = 11.42$, $p = .02$)" (pp. 363–364).

Plummer et al. (2021) established a coaching model to ensure teaching of psychomotor skills in a virtual environment. Their concept targeted PT students and combined preparatory materials; coaching, reflection, peer feedback, and a graded assessment to structure the teaching of psychomotor skills. This coaching model was evaluated through a mixed methods survey, asking for student's perceived effectiveness and satisfaction. "Feedback from the 1:1 coaching session with the instructor was reported as most beneficial." In a next step, the performance was recorded individually and posted for peer feedback. "Peer feedback, self-reflection, and […] independent practice culminated in a graded final video assignment." 86% "[…] of students agreed that viewing a peer's video improved their learning. Articulating constructive feedback forced them to reflect on their own performance" (pp. 6–7).

Worobey et al. (2022) were exploring the potential of remote learning to teach manual wheelchair skills. In this examination with a pre- and post-training comparison, PT students, together with PT and OT clinicians, practiced 10 skills on a wheelchair skills training (WST) in pairs. Participants submitted videorecordings of their skills and received asynchronous feedback "for each skill […], video quality, WST capacity score, spotter issues, and learner issues." The results of this study show that 33 (80%) participants would encourage others to participate in this type of training" (pp. 753–757). The effects of asynchronous feedback itself were not specifically evaluated.

An investigation of faculty perspectives on faculty-to-student e-mentoring in an online post-professional doctor of OT was conducted in a retrospective mixed-methods design by Doyle et al. (2016). Nine faculty members completed an online survey and a follow-up interview about the nature, perception, and impact of e-mentoring experiences. The authors reported that "the faculty mentors' responses […] indicate that both structure and content are critical aspects of successful and satisfactory e-mentoring relationships. Structurally the participants indicated that frequent contact with mentees (i.e., weekly or bi-weekly) and program-long mentoring relationships contributed to creating student-centered e-mentoring processes." Faculty members reported further that e-mails were the most common technology for individual feedback, followed by videoconferencing (VC) (p. 314).

Davies et al. (2012) described the effect of clinicians' facilitation via VC with groups of students onsite or in an online setting. Evaluation by focus groups on the influence of the facilitator was described under different aspects: "(i) the quality of the facilitation, (ii) facilitator expertise, and (iii) the location of the facilitator relative to the group." The facilitators' "ability to guide the process, probe thinking, and engage quieter group members contributed to the overall perceived quality […]" and the "ability of the facilitator to develop relationships with the students influenced their view of facilitation." These aspects were reported to influence the perception of small

group learning and were very interactive, despite possible technical difficulties (p. e678).
Feedback emerged as a technique to improve PS (Kelley et al., 2020; Plummer et al., 2021; Worobey et al., 2022) and to ensure mentoring and facilitation (Davies et al., 2012; Doyle et al., 2016). Feedback was given asynchronously (Kelley et al., 2020; Worobey et al., 2022), synchronously (Davies et al., 2012; Plummer et al., 2021) or both (Doyle et al., 2016).

Team-based learning (TBL)

Several concepts promoted TBL, where students learned together through discussion and exchange.
Furness and Kaltner (2015) encouraged pre-entry OT students to share practical experiences from their clinical placements, ask questions, and share ideas in their peer learning group. One-half participated at the presentation site, while the other half participated remote via VC. Strategies to strengthen students' learning and peer interaction during VC were a discussion-based format, structured tutorial sessions, and the inclusion of all VC sites. The evaluation of students' experience will be presented in ***technology***.
Ng et al. (2014) conducted a face-to-face online problem-based learning (PBL) module for a small group of SLT students. Results regarding performance are reported in *AS* and students' experience of distance learning in ***technology***.
Stickley and Gibbs (2021) reported about PT and HIM master's students' learning together in an online work group using case-based learning. This was done to reflect on the other profession's roles and responsibilities, to enhance interprofessional communication, and to strengthen the understanding of teams and teamwork. The "open-ended survey questions and reflection paper assignments demonstrated that most PT and HIM students found the IPE experience valuable" (p. 7).
As explained above, Davies et al. (2012) described the effect of clinicians' facilitation via VC on small group learning. The influence of group dynamics in this setting is described under the aspects of "(i) ground rules, (ii) roles and responsibilities, and (iii) learning style." For example, "Participants explained how attention to group dynamics paid dividends in terms of group functioning. Others described how group dynamics suffered when they had not been explicit about expectations." (pp. e678–e679). In this setting, the aspects of facilitation and technology were perceived as highly interactive and affecting the learning environment, so the rules, responsibilities, and learning styles became more visible, both in their positive and negative influences.
TBL in every reported case was realized via VC, mostly addressing AS (Ng et al., 2014; Stickley & Gibbs, 2021).

Asynchronous techniques

Some of the selected studies presented an asynchronous learning strategy only.
An interdisciplinary course for dentistry and SLT students was designed by Ramos et al. (2015). Modules were available on an e-platform (Moodle) for 24 hours a day for one month and evaluated individually by students with seven closed and open-ended questions. "Analyzing the open question [they summarized] that the modules obtained higher amounts of positive comments than negative comments" (p. 109). The results related to ***skill*** and the ***technology*** used will be reported in the following sections.
The practical training of SLT students was taught via pre-recorded, online teaching modules during a pre-school practicum (Kelley et al., 2020). Evaluation is reported in the **PS** and **feedback** sections below.
In the study by Doyle and Jacobs (2013), online OT students could choose asynchronous learning materials based on their individual learning style. An online questionnaire was used to evaluate individual experiences with learning style and corresponding materials. The evaluation showed that "three-quarters of the students agreed that inventory […] correctly identified their learning styles and preferences, […] The majority (87.5%) of students agreed that the assignment was an enjoyable learning experience" (p. 249).
Asynchronous techniques are used to address PK and PS.

FC

The FC uses a phase of individual knowledge acquisition by using online materials first. Afterwards, knowledge is discussed or trained in a traditional face-to-face classroom setting (WR, 2022).
Veneri and Mongillo (2021) combined TBL with the FC concept to promote evidence-based practice. PT students had access to preparatory materials and a short summary lecture in class. They then performed a paired or group assignment before discussing the subjects learned in class. Results based on a short, written assignment (one-minute paper) are reported in ***materials***.
Schaber and Shanedling (2012) presented a study on the development of critical thinking (CT) among OT students. The students completed seven asynchronous learning activities with prepared materials regarding OT theories. The results are reported in the **AS** section.
The FC concept was used to promote AS.

Skills

There are special skills to be learned in every profession and in educating healthcare professionals. These skills

are indispensable to ensure quality of care. The skills addressed in the selected studies cover PK, AS, and PS. Studies investigate IPE, interprofessional practice (IPP) and/or collaboration (IPC). The results for IPE will be discussed under **PK**, while IPP and IPC will be discussed under **AS** or **PS**.

PK

The aspects described in these studies, which tend towards pure knowledge without a focus on a related skill will be presented here.

Ramos et al. (2015) describe an interprofessional online SLT and dentistry distance-learning course to improve knowledge about the stomatognathic system. Knowledge gain was measured before and after the course with a multiple-choice questionnaire. They reported a "difference, statistically significant, between the pre- and post-course evaluations ($p < 0.001$), pointing out that the material promoted the students' effective learning" (p. 108).

Worobey et al. (2022) investigated the potential of remote learning to teach manual wheelchair skills. Besides the development in PS, this study also examined the gain in PK and found that "Participant scores on the Knowledge Test improved significantly post-training (70.8 ± 7.5 vs 67.0 ± 5.4, p ¼ 0.004)" (p. 756).

Pulga et al. (2014) analyzed the knowledge of SLT students about the therapeutic procedure in phonological disorders in an online versus face-to-face pre/post-design. The analysis, based on pre- and post-protocol questionnaires, showed that in the postprotocol questionnaire, the Experimental Group (EG) average was higher than their average in the preprotocol questionnaire and the Comparison Group postprotocol questionnaire average. [….] The statistical analysis within the EG showed a significant difference ($p<0.001$), meaning that the students improved their performance considerably on the postprotocol questionnaire after application of the technology. The statistical analysis [between the EG and CG] showed a statistically significant difference, meaning the EG median was the highest ($p = 0.008$; Pulga et al., 2014, pp. 270–271).

Power et al. (2020) compared online versus face-to-face delivery of an educational program covering aphasia communication partner training (CPT) to OT students. Results indicated that the CPT program (online and F2F) improved (1) overall knowledge and attitudes towards aphasia from pre- to post-training, with a large effect identified (AASK Total) (χ 2(2) = 20.038, $p = 0.000$, $\varepsilon 2 = 0.71$; control versus online: $p = 0.002$, control versus F2F: $p = 0.000$) without a significant difference between online and face-to-face (p. 858).

To summarize, the studies focusing on gaining PK show either positive results (Pulga et al., 2014, Ramos et al., 2015) or no difference between online and face-to-face settings (Power et al., 2020).

PS

The analysed PS cover skills that students must learn practically, such as skills in handling a wheelchair or processing phonetic transcription.

Titterington and Bates (2018) investigated SLT students' PS of transcribing phonetically by comparing student engagement in the online training "Ulster Set" with the final transcription course work. The authors found "[…] a low statistically significant association between the mean scores on the 'Ulster Set' and scores on the final coursework indicating that students who did better on the 'Ulster Set' also did better on the final coursework (Pearson's r =.48, $p = .01$)" (p. 13).

Another study with SLT students investigated vocabulary instruction during shared storybook reading with pre-schoolers (Kelley et al., 2020). The progress was observed through videos, coded blind to condition, and evaluated with the three main outcomes: (1) choose good words; (2) teach explicitly; (3) teach with interaction." "To estimate effect sizes, Tau U was calculated for each participant and each outcome […] for evaluating the magnitude of Tau U: small effect = 0–0.65; medium effect = 0.65–0.92; large effect = 0.93–1.00." The following results were reported for all participants per outcome: 1: 0.54, 2: 0.86, 3: 0.76. (p. 360).

Plummer et al. (2021) established a coaching model for psychomotor skills in a virtual environment. The concept targeted PT students and combined preparatory materials; coaching, reflection, and peer feedback, as well as a graded assessment to structure teaching of psychomotor skills. The coaching model was evaluated through a mixed-methods survey, asking for students' perceived effectiveness and satisfaction. They reported that "73% of individuals strongly agreed or agreed that there was adequate practice and feedback to be effective in their performance of these skills." Furthermore, qualitative data underlines the value of "[…] additional practice that took place through recording and pre-recording videos" (p. 6).

As discussed earlier, Worobey et al. (2022) explored the potential of remote learning to teach manual wheelchair skills. In this examination, with a pre/posttraining comparison via questionnaire (Q), PT students and PT and OT clinicians practiced 10 intermediate and advanced skills on the WST. The results show that "Participants demonstrated statistically significant improvements compared to baseline in WST-Q capacity (73.9 ± 19.1 vs 16.8 ± 15.6, $p < 0.001$), and confidence (80.1 ± 12.2 vs 47.6 ± 18.2, p ¼ 0.003) following the intervention" (p. 754).

To summarize, concepts for PS were evaluated positively on the levels of performance (Kelley et al., 2020; Titterington & Bates, 2018; Worobey et al., 2020) and self-perception (Plummer et al., 2021; Worobey et al., 2022).

AS

The evaluated AS cover a range of skills, such as CT, problem solving, and clinical decision making.

SLT students should improve their problem solving skills in relation to communication disorders in either an online or face-to-face group. Ng et al. (2014) compared performances quantitatively through an assignment written on site after the course. "The descriptive statistical analysis showed no significant difference in grades between the online and face-to-face group, indicating that online PBL appears to be similarly effective as traditional face-to-face PBL" (p. 114).

Schaber and Shanedling (2012) presented a study on the development of CT among OT students (see above). The students completed seven asynchronous learning activities with prepared materials regarding OT theories. "The direct measure of learning […] demonstrated a significant, gradual, positive improvement in student CT skills from module one to module seven, measured over 15 weeks ($t = -9.621$, $p < 0.000$) with a slight decline in mean scores in modules five and six." Furthermore "students reported overall that, to a "great extent" in the course, they developed CT skills that will be applicable to their future learning and practice in Occupational Therapy" (p. e12).

As explained above, in the study by Stickley and Gibbs (2021) PT and HIM master's students learned together in an online workgroup using case-based learning. The results show that "The differences in the overall SPICE-R2 scores by program (PT, HIM) and time (pre- and post-test) was significant for the main effect of time ($F=5.784$, $\rho = .019$), but not for program ($\rho = .065$) or the interaction of program and time ($\rho = .714$)" (p. 7).

In total, the evaluated concepts showed positive results on the development of AS.

Technology and material

Table 1 presents the various digital technologies and types of materials that have been employed across the selected studies. Technologies that were evaluated explicitly are VC and the materials used.

VC

Students interviewed by Furness and Kaltner (2015) widely accepted the use of VC. The majority rated the quality of interaction during an online survey "as good to very good with the other students (76%) [and] the facilitator (100%)." According to the authors "peer learning partnerships [during VC] have been identified as one strategy to reduce students' feeling of social isolation when completing rural placements" (pp. 251–252).

Besides the comparison of face-to-face and remote groups during the online PBL course, Ng et al. (2014) investigated the perceptions of SLT students who participated in the course via VC. "Responses from the questionnaire indicated that all students were satisfied or very satisfied with both Adobe Connect system and the online PBL tutorials. […] Regardless, all students unanimously preferred synchronous online PBL to traditional PBL" (p. 122).

As explained before, Davies et al. (2012) described the effect of clinicians' facilitation via VC on small-group learning. Evaluated by focus groups "Students identified technology itself as one of the three main influences on their experiences of remote facilitation with emphasis on (i) audio and (ii) visual" (p. e678). Both audio and visual had to work properly, according to the students, to ensure the learning interaction with facilitators and within the group.

Divanoglou et al. (2018) presented a whole PT curriculum organized as a dual-campus concept. The program is offered on two regional campuses in Australia, situated 300 kilometers apart, with one being the onsite and the other being the remote campus. Lectures on the remote campus were conducted via VC. Based on a combination of focus groups and individual students' evaluation, the study states that with the dual campus "1. Student location influences learning. 2. Videoconferencing impacts learning and teaching. 3. Dual-campus delivery determines teaching structures and shapes teaching processes." Some students perceived an inequity in learning chances between the campuses, as "Several students voiced dislike of the videoconferencing system, and felt that it slowed down the learning experience [and] that the sharing of and access to information relating to teaching content and logistics across the campuses was inconsistent and lacked standardization" (pp. 92–95).

Stickley and Gibbs (2021) reported that PT and HIM master's students learned together in an online workgroup using case-based learning via VC. The results have been previously reported in *AS*.

Overall, three studies demonstrate that VC, when combined with TBL, facilitates learning of AS (Furness & Kaltner, 2015; Ng et al., 2014; Stickley & Gibbs, 2021).

Materials

A number of the selected studies described and evaluated the materials employed.

As explained above, Worobey et al. (2022) investigated the potential of remote learning to teach manual wheelchair skills with prerecorded learning materials. The results show that "introductory materials being very text-heavy with a preference indicated for the information to be delivered in a video format […] Some participants found navigating the [removed for blinding] platform difficult to navigate for file sharing" (Appendix, p. 1).

In the study by Veneri and Mongillo (2021), TBL was combined with FC. PT students had access to preparatory materials and a short summary lecture in class. They then performed a paired or group assignment before discussing the learned subjects in class. One-minute paper evaluation show that

> Students reported that the micro learning videos (PowerPoint with voiceover (n=45 [71%]), Quizlet (n=53 [84%]), Concept Checks (n=44 [70%]) and the weekly list of vocabulary terms (n=31 (41%]) most helpful, whereas Flipgrids (n=33 [52%]) and reading the textbook (n=27 [43%]) were not helpful (p. 6).

Titterington and Bates (2018) developed online homework activities and online quizzes to improve the PS of phonetic transcription of SLT students:

> Three key themes were apparent in the qualitative comments the students made about the technical aspects of using each online resource. Firstly, [..] 22% had difficulty downloading the UCL. […] 19% had difficulties saving the tests [and] 11% commented that presentation of the stimuli in the Field 2 and Field 3 within one sound wav file made it difficult to play back individual words. […] 15% of the students reported that WebFon worked well and that both WebFon and the 'Ulster Set' were easy to navigate (p. 17).

Ramos et al. (2015) used PowerPoint, audio, text, image, and video classes as material. The material was evaluated by the students through a questionnaire. The authors summarize that "[…] the illustration quality, and the presented contents, as well as the access and navigation on the virtual learning environment, for most students, the evaluation varied between excellent, very good, and good" (pp. 108–109).

Materials were evaluated individually through mostly qualitative data (Titterington & Bates, 2018;e; Veneri & Mongillo, 2021; Worobey et al., 2022). The results are specific and not generalizable. Some technical difficulties were mentioned (Titterington & Bates, 2018; Worobey et al., 2022).

DISCUSSION AND CONCLUSION

In this scoping review, 16 studies from 2012–2022 and from different countries were analysed to investigate the research question: "What is known about digital education for OT, PT, and SLT as described in therapeutic health care literature?"

To reflect the chosen method of the scoping review critically, it is important to mention that most studies were conducted in North American countries and Australia. This may indicate a stronger emphasis on knowledge in these countries and its health education systems but could be explained due to a longer tradition of distance learning to ensure access to education in rural areas. The publishing dates of the studies included do not suggest a particularly increasing interest in digital education for healthcare professionals between 2012 and 2022. In light of the globally heightened interest in digital-learning methods due to the COVID-19 pandemic, this initially appears surprising. Within the context of this review, it is most likely explained by the exclusion of studies that focused on student perception or well-being, in order to prevent a bias towards COVID-19-specific dynamics.

This review focused on OT, PT, and SLT, based on the assumption that similar educational principles are applied. The number of studies fulfilling the selection criteria were equally distributed among the professions, and no key differences in the main categories were found. The only minor difference due to profession was found in ***skills*** under *PK*, which can be explained due to their professional alignments.

IPE was expected to be found more often, especially between OT, PT, and SLT because IPE is described as a positive influence on later cooperation in the work field and more easily applicable online (Spaulding et al., 2021; Zwarenstein et al., 2013).

The selected studies applied a variety of scientific approaches and methods. The results show different levels in scope and quality, and thus cannot be widely generalized. This scoping review made a conscious attempt to structure this heterogeneity and to discuss the findings without synthesizing or meta-analyzing them on a broader scale.

A literature- and data-based framework was used to sort the findings into the identified main categories ***techniques***, ***skills,*** and ***technology*** (Figure 2). The interdependences in these categories will be discussed in the following.

In the category ***techniques***, feedback, TBL, FC, and asynchronous techniques were summarized. Digital feedback strategies seem to improve PS (Kelley et al., 2020; Plummer et al., 2021; Worobey et al., 2022), mentoring and facilitation (Davies et al., 2012; Doyle et al., 2016), while TBL and FC mainly promoted AS (Ng

et al., 2014; Schaber & Shanedling, 2012; Stickley & Gibbs, 2021; Veneri & Mongillo, 2021). Asynchronous techniques are used to address PK and PS (Kelley et al., 2020; Ramos et al., 2015). A systematic review by Kay and Bahula (2020) indicates that students and facilitators prefer video over text feedback and that video feedback can have a positive impact on learning outcomes, which is consistent with the findings for digital therapeutic healthcare education.

The need for OT, PT, and SLT professionals to be analytically and practically highly skilled is described broadly (OHCHR, 2008). The results of our review underline this need, and show possible positive effects of digital education on PK, PS, and AS. All strategies were evaluated positively, indicating that digital education works on skill development on every level. Moreover, comparisons between online and face-to-face settings (Ng et al. 2014; Power et al., 2020) showed no difference. This is consistent with the findings of McCutcheon et al. (2015), who described online learning as no less effective than face-to-face learning in a systematic review about the impact of online or blended learning versus face-to-face learning of clinical skills in nursing education.

VC seems to be the easiest way to realize traditional teaching formats remotely (Davies et al., 2012; Divanoglou et al., 2018; Doyle et al., 2016; Furness & Kaltner, 2015; Ng et al., 2014; Stickley & Gibbs, 2021). VC was reported as effective for giving feedback (Doyle et al., 2016), ensuring TBL (Furness & Kaltner, 2015; Ng et al., 2014; Stickley & Gibbs, 2021), and to support the development of AS. This corresponds to findings in related professions. In a systematic review of five studies on digital medical and nursing education, Chipps et al. (2012) conclude that VC-based digital education seems to be effective. They do, however, recommend designing guidelines for assisting educators in using VC effectively.

Although the literature indicates that online materials have the potential to specifically promote students' engagement and activity (Choppin & Borys, 2017), the results of this review do not permit conclusions in this regard. Scientific data from the selected studies on learning materials in the reviewed studies were mostly qualitative, highly specific, and not easily generalizable.

A variety of digital technologies have been applied in the selected studies (Table 1, Appendix); however, they are not evaluated on a larger scale. Relevant technical difficulties are reported, but not further explained (Titterington & Bates, 2018; Worobey et al., 2022). Nevertheless, the identification of certain technical issues may contribute to the enhancement of the technologies in question.

Summarizing the results, the selected studies indicate that digital education has benefits for therapeutic healthcare professionals on different levels. Due to the differences in methods and research quality, a direct comparison of the presented strategies is not possible. Despite these limitations, the following key messages can be drawn:

1. Skills, namely, PK, PS, and AS are important factors in digital education for OT, PT, and SLT, indicating that digital education works on skill development on every skill level.
2. Digital feedback has a positive effect and is important for the development of PS. It enhances mentoring or facilitation, no matter whether it is given asynchronously, synchronously, or both.
3. VC serves different purposes positively; connection to facilitators via VC or ensuring TBL are to be named.

To fulfill the right to health (OHCHR, 2008), well-trained healthcare professionals are needed. Digital education plays an important role in the education of future therapeutic healthcare professionals, as it can support the acquisition of PK, PS, and AS. To ensure high quality in digital education for therapeutic healthcare professionals, further research must be done to conduct and evaluate didactical concepts, and to formulate guidelines for digital education through meta-syntheses and analyses.

STRENGTHS AND LIMITATIONS

Through the variety of the included methods in the articles, in combination with the literature and data-based framework and the resulting three main and subordinate subcategories, this scoping review can contribute to future research, practice, and education. It generates a structured overview of relevant aspects to be considered in didactical planning for digital education for therapeutic healthcare professionals. The structure is necessarily quite open, as the interdisciplinary field is diversified in health-related, pedagogical, didactical, as well as technological dimensions.

As explained in the discussion, the exclusion of studies that focused exclusively on students' perception or well-being influences during COVID-19 may be a limiting factor. The fact that most selected studies are from North America could indicate a certain publication bias.

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Ethical considerations, registration

No ethical approval was necessary.

Conflicts of interest

None.

APPENDIX

Table 1: Studies included in synthesis.

No.	Author (year)	Students, semester, N	Profession	Technology	Country	Taught Subject	Study Design
1	Davies et al. (2012)	Master, N = 16	PT	VC	Canada	Clinical reasoning	Qualitative design: focus groups
2	Divanoglou et al. (2018)	UndergraduateN ≈ 75	PT	VC	Australia,UK	Bachelor curriculum	Qualitative design: focus groups & evaluation
3	Doyle & Jacobs (2013)	Post professional graduate, N= 8	OT	Materials	USA	Learning styles	Online survey
4	Doyle, Jacobs & Ryan (2016)	Doctoral, N = 48 faculty, N = 9	OT	Multi-modal	USA	e-mentoring	Retrospective mixed-methods design
5	Furness & Kaltner (2015)	Undergraduate, N = 22	OT	VC	Australia	Practical training and reflection	Mixed-methods design
6	Kelley et al. (2020)	Undergraduate, N = 21	SLT	Materials	USA	Teaching vocabulary, shared storybook reading	Comparison study
7	Ng et al. (2014)	Third-year undergraduate, N = 8	SLT	VC	Hong Kong	Case studies	Pilot study, comparison study face-to-face vs. online
8	Plummer et al. (2021)	Undergraduate, N = 72	PT	Materials Video	USA	Psychomotor skills	Cohort study
9	Power et al. (2020)	First-year undergraduate N = 30	OT	Materials	Australia	Aphasia communication partner training	Pilot RCT
10	Pulga et al. (2014)	Fourth-year students, N =60	SLT	Materials	Brazil	Therapeutic procedure phonological disorders	Comparison study
11	Ramos et al. (2015)	Undergraduate, N = 30	IPE (SLT & Dentist)	Materials	Brazil	Interdisciplinary practice	Pre- and postcourse evaluation
12	Schaber & Shanedling (2012)	N = 86	OT	Materials	USA	OT theory	Mixed-methods Questionnaires, focus groups
13	Stickley & Gibbs (2021)	PT PhD, N = 37HIM Master's, N = 7	IPE (PT & HIM)	Materials	USA	IPC	Two-group pre/ post survey
14	Titterington & Bates (2018)	First-year, N = 27	SLT	Materials	UK	Phonetic transcription	Mixed-methods observational design
15	Veneri & Mongillo (2021)	First-year, N = 63	PT	Materials	USA	EBP	Pre- and postassignments
16	Worobey et al. (2022)	Clinicians and students, N = 41	IPE (PT & OT)	Multi-modal	USA	Wheelchair skills	Cohort study with pre- vs. posttraining comparison

References

Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology: Theory and Practice 8*(1), 19–32. https://doi.org/10.1080/1364557032000119616

Bloom, B. (1956). *Taxonomy of educational objectives. Vol. 1: Cognitive domain.* McKay.

Car, J., Carlstedt-Duke, J., Car, T. L., Posadzki, P., Whiting, P., Zary, N., Atun, R., Majeed, A., Campbell, J. & Digital Health Education Collaboration. (2019). Digital education in health professions: The need for overarching evidence synthesis. *Journal of Medical Internet Research, 21*(2), e12913. https://doi.org/10.2196/12913

Chipps, J., Brysiewicz, P., & Mars, M. (2012). A systematic review of the effectiveness of videoconference-based tele-education for medical and nursing education. *Worldviews on Evidence-Based Nursing, 9*(2), 78–87.

Choppin, J., & Borys, Z. (2017). Trends in the design, development, and use of digital curriculum materials. *ZDM Mathematics Education 49*, 663–674. https://doi.org/10.1007/s11858-017-0860-x

Davies, R., Yeung, E., Mori, B., & Nixon, S. A. (2012). Virtually present: The perceived impact of remote facilitation on small group learning. *Medical Teacher, 34*(10), e676–e683. https://doi.org/10.3109/0142159X.2012.687490

Divanoglou, A., Chance-Larsen, K., Fleming, J., & Wolfe, M. (2018). Physiotherapy student perspectives on synchronous dual-campus learning and teaching. *Australasian Journal of Educational Technology, 34*(3), 88–104. https://doi.org/10.14742/ajet.3460

Doyle, N., Jacobs, K. & Ryan, C. (2016). Faculty mentors' perspectives on e-mentoring post-professional occupational therapy doctoral students. *Occupational Therapy International, 23*(4), 305–317. https://doi.org/10.1002/oti.1431

Doyle, N. W., & Jacobs, K. (2013). Accommodating student learning styles and preferences in an online occupational therapy course. *Work, 44*(3), 247–253. https://doi.org/10.3233/WOR-121501

Fischer, H. (2014). *E-Learning im Lehralltag: Analyse der Adoption von E-Learning- Innovationen in der Hochschullehre.* Springer.

Furness, L., & Kaltner, M. (2015). Facilitating student education and support using videoconference. *Australian Journal of Rural Health, 23*(4), 249–253. https://doi.org/10.1111/ajr.12148

Guo, J.-W., Keeshin, B. R., Conway, M., Chapman, W. W., Sward, K. A. (2022). Scoping review and content analysis of common depressive symptoms of young people. *The Journal of School Nursing; 38*(1), 74–83. https://doi.org/10.1177/10598405211012680

Kay, B., & Bahula, T. (2020). A systematic review of the literature on video feedback used in higher education. *Edulearn20 Conference*, 1890–1896.

Kelley, E. S., Hull, G., Eubank, A., & Roettgen, G. (2020). Teaching undergraduate clinicians empirically supported practices for preschool vocabulary instruction. *Language, Speech, and Hearing Services in Schools, 51*(2), 353–370. https://doi.org/10.1044/2019_LSHSS-19-00061.

Kergel, D., & Heidkamp-Kergel, B. (2020). *E-Learning, E-Didaktik und digitales Lernen.* Springer.

Kyaw, B. M., Saxena, N., Posadzki, P., Vseteckova, J., Nikolaou, C. K., George, P. P., Divakar, U., Masiello, I., Kononowicz, A. A., Zary, N., & Car, T. L. (2019). Virtual reality for health professions education: Systematic review and meta-analysis by the Digital Health Education Collaboration, *Journal of Medical Internet Research 21*(1), e12959. https://doi.org/10.2196/12959

McCutcheon, K., Lohan, M., Traynor, M., & Martin, D. (2015). A systematic review evaluating the impact of online or blended learning vs. face-to-face learning of clinical skills in undergraduate nurse education. *Journal of Advanced Nursing, 71*(2), 255–270.

Ng, M. L., Bridges, S., Law, S. P., & Whitehill, T. (2014). Designing, implementing and evaluating an online problem-based learning (PBL) environment: A pilot study. *Clinical Linguistics and Phonetics, 28*(1–2), 117–130. https://doi.org/.org/10.3109/02699206.2013.807879

Peters, M. D. J., Marnie, C., Colquhoun, H., Garritty, C. M., Hempel, S., Horsley, T., ... & Tricco, A. C. (2021). Scoping reviews: Reinforcing and advancing the methodology and application. Systematic Reviews *10*(1), 263. https://doi.org/10.1186/s13643-021-01821-3

Pfingsten, A., & Borgetto, B. (2022). *Vorteile einer vollständigen Akademisierung der therapeutischen Gesundheitsberufe für die Versorgung.* In U. Repschläger, C. Schulte, N. Osterkamp (Eds.), Gesundheitswesen aktuell 2022 (pp. 130-149). Barmer Institut für Gesundheitssystemforschung.

Plummer, L., Smith, L., Cornforth, E., & Gore, S. (2021). Teaching psychomotor skills in a virtual environment: An educational case study. *Education Sciences, 11*(9), 537. https://doi.org/10.3390/educsci11090537

Power, E., Falkenberg, K., Barnes, S., Elbourn, E., Attard, M., & Togher, L. (2020). A pilot randomized controlled trial comparing online versus face-to-face delivery of an aphasia communication partner training program for student healthcare professionals. *International Journal of Language & Communication Disorders, 55*(6), 852–866. https://doi.org/10.1111/1460-6984.12556

Pulga, M. J., Spinardi-Panes, A. C., Lopes-Herrera, S. A., & Maximino, L. P. (2014). Evaluating a speech-language pathology technology. *Telemedicine and e-Health, 20*(3), 269–271. https://doi.org/10.1089/tmj.2013.0052

Ramos, J. S., Silva, L. K., Pinzan, A., Rodrigues, A. C., & Berretin-Felix, G. (2015). Distance learning: effectiveness of an interdisciplinary course in speech pathology and dentistry. *Interdisciplinary Journal of e-Skills and Lifelong Learning, 11*, 101–121.

Schaber, P., & Shanedling, J. (2012). Online course design for teaching critical thinking. *Journal of Allied Health, 41*(1), 9E–14E.

Scharff Rethfeldt, W. & Heinzelmann, B. (2014). United in Diversity–das NetQues-Projekt zur Logopädieausbildung in Europa–Europaweite Zusammenarbeit zur Vergleichbarkeit der Ausbildungsprogramme und der logopädischen Berufsqualifikation als Beitrag zur Implementierung des Bologna-Prozesses auf hochschul- und fachspezifischer Ebene. *Forum Logopädie 28*(2), 28–33.

Spaulding, E. M., Marvel, F. A., Jacob, E., Rahman, A., Hansen, B. R., Hanyok, L. A., ... & Han, H. R. (2021). Interprofessional education and collaboration among healthcare students and professionals: A systematic review and call for action. *Journal of Interprofessional Care*, *35*(4), 612–621.

Stickley, L., & Gibbs, D. (2021). Physical therapy and health information management students: Perceptions of an online interprofessional education experience. *Perspectives in Health Information Management*, *18*(Winter), 2–12.

Titterington, J., & Bates, S. (2018). Practice makes perfect? The pedagogic value of online independent phonetic transcription practice for speech and language therapy students. *Clinical Linguistics & Phonetics*, *32*(3), 249–266. https://doi.org/10.1080/02699206.2017.1350882

Tudor, C. L., Poon, S., Kyaw, B. M., Cook, D. A., Ward, V., Atun, R., Majeed, A., Johnston, J., van der Kleij, R. M., Molokhia, M., … & Car, J. (2022). Digital education for health professionals: An evidence map, conceptual framework, and research agenda. *Journal of Medical Internet Reserch*;*24*(3), e31977. https://doi.org/10.2196/31977

United Nations. Office of the High Commissioner for Human Rights (OHCHR). (2008). *The right to health.* https://www.refworld.org/docid/48625a742.html

Veneri, D., & Mongillo, E. M. (2021). Flop to flip: Integrating technology and team-based learning to improve student engagement. *Internet Journal of Allied Health Sciences and Practice*, *19*(2), 1–10.

Wilson, N. W., Couper, I. D., De Vries, E., Reid, S., Fish, T., & Marais, B. J. (2009). A critical review of interventions to redress the inequitable distribution of healthcare professionals to rural and remote areas. *Rural Remote Health*, *9*(2), 1–21.

Wissenschaftsrat. (2022). *Empfehlungen zur Digitalisierung in Lehre und Studium.* Wissenschaftsrat.

World Federation of Occupational Therapists. (2022). *WFOT approved education programmes.* www.wfot.org/programmes/education/wfot-approved-education-programmes

World Physiotherapy. (2022). *What is the minimum qualification required to practice?* (Reference year 2021). https://world.physio/membership/profession-profile

Worobey, L. A., Kirby, R. L., Cowan, R. E., Dyson-Hudson, T. A., ... & Boninger, M. L. (2022). Using remote learning to teach clinicians manual wheelchair skills: A cohort study with pre- vs post-training comparisons. *Disability and Rehabilitation: Assistive Technology*, *17*(7), 752–759, https://doi.org/10.1080/17483107.2020.1804633

Zwarenstein, M., Reeves, S., Barr, H., Hammick, M., Koppel, L., & Atkins, J. (2013). Interprofessional education: effects on professional practice and healthcare outcomes *Cochrane Database of Systematic Reviews 3*, 1–8. https://doi.org/10.1002/14651858.CD002213