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Health service user participation in interprofessional collaborative learning — a systematic review on the use of digital solutions

Die Teilnahme von Gesundheitsdienst-Nutzenden an interprofessionell kollaborativem Lernen — ein systematischer Review über den Gebrauch digitaler Lösungen

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Abstract

Background: Interprofessional collaborative learning is the interaction of health and/or social care professionals and/or students who are learning from service users' clinical data. Digital solutions in primary care facilitate interactive communication. This systematic review aims to identify which digital solutions can facilitate the participation of health service users in collaborative learning for interprofessional service providers, and how service users can participate with the use of digital solutions.
Methods: The databases CINAHL, Cochrane Trials, PubMed, Science Direct and Scopus were searched for original studies in October 2022 using keywords related to health, functioning, interprofessional relations, learning, digitalization, communication and collaboration. Studies chosen had to involve one service user and service providers from at least two health and social care professions.
Results: Eighteen qualitative and quantitative studies published between 2000 and 2022 met all of the inclusion criteria. Studies were situated in educational (n = 7), outpatient (n = 7), and home-based settings (n = 4) and involved two to 10 professions. Digital solutions provided service-user information via video or digital records, and supported simulated encounters via videoconferencing, virtual reality and avatars, or high-fidelity simulation. In this way, these methods and others facilitated the participation of service users in interprofessional learning, via either collaboration on data or general communication.
Conclusion: Several types of digital solutions facilitate active participation of service users in interprofessional collaborative learning, while some facilitate indirect participation. Overall, there is potential to increase the use and implementation of digital solutions in collaborative learning. In future research, the usability of digital tools could also be evaluated.

Abstract

Hintergrund: Interprofessionelles kollaboratives Lernen ist die Interaktion von Gesundheits- und Sozialfachkräften oder Studierenden, um über und von klinischen Daten der Servicenutzenden zu lernen. Digitale Lösungen in der Primärversorgung erleichtern die interaktive Kommunikation. Dieser systematische Review zielte darauf ab herauszufinden, welche digitalen Lösungen die Teilnahme von Gesundheitsdienst-Nutzenden am kollaborativen Lernen interprofessioneller Dienstleistender erleichtern können und wie die Teilnahme über den Gebrauch digitaler Lösungen erfolgt.
Methode: Die Datenbanken CINAHL, Cochrane Trials, PubMed, Science direct und Scopus wurden im Oktober 2022 nach Schlüsselwörtern zu Gesundheit, Funktionsfähigkeit, interprofessionellen Beziehungen, Lernen, Digitalisierung, Kommunikation und Zusammenarbeit durchsucht, um Originalstudien zu identifizieren. Servicenutzende und Dienstleistende aus mindestens zwei Gesundheits- und Sozialberufen mussten beteiligt sein.
Ergebnisse: Achtzehn qualitative und quantitative Studien, die zwischen 2000 und 2022 veröffentlicht wurden, erfüllten alle Einschlusskriterien. Die Studien fanden in pädagogischen (n = 7), ambulanten (n = 7) oder häuslichen Settings (n = 4) statt und umfassten zwei bis zehn Berufe. Digitale Lösungen stellten Servicenutzenden Informationen über Video oder digitale Aufzeichnungen bereit und unterstützten simulierte Begegnungen über Videokonferenzen, virtuelle Realität und Avatar oder High-Fidelity-Simulation. Digitale Lösungen erleichterten die Teilnahme von Gesundheitsdienst-Nutzenden am interprofessionellen Lernen über Zusammenarbeit zu Daten oder über allgemeine Kommunikation.
Fazit: Mehrere Arten digitaler Lösungen erleichtern die aktive Teilnahme von Gesundheitsdienst-Nutzenden am interprofessionellen kollaborativen Lernen, während einige eine indirekte Teilnahme ermöglichen. Einsatz und Implementierung digitaler Lösungen im kollaborativen Lernen haben Potential zu steigen. In zukünftiger Forschung könnte die Nutzbarkeit digitaler Werkzeuge evaluiert werden.

Keywords
collaboration – communication – community network – digital – interprofessional relations – patient participation – primary care

Keywords
Zusammenarbeit – Kommunikation – Community Netzwerk – digital – interprofessionelle Beziehungen – Patienten/-innenteilnahme – Primärversorgung

INTRODUCTION

In response to increased life expectancy and an increase of chronic diseases, the global need for primary health care is rising (World Health Organization, World Bank, 2011). Services in the community (i.e. outpatient, ambulatory and home-based settings) require participative, interprofessional interaction (Frenk et al., 2010). Interprofessional interaction is participative when service providers from different health and social care professions actively engage with patients, families and caregivers, whom we define as 'service users' (Ekman et al., 2011; World Health Organization, 2010). Service providers support users in their self-reflection of knowledge or performance and include them as equal contributors to solutions (Leino-Kilpi et al., 2005). They coordinate and network when users seek health services or proceed to further providers (Reeves et al., 2010).

Health service users and providers from different professions transfer and transform knowledge to assess, judge, and treat clinical data in a consensual approach (Edwards et al., 2004). This is defined as interprofessional collaborative reasoning (Blondon et al., 2017) and includes 1) assessment of expectations and functioning, as defined by the International Classification of Functioning, Disability and Health (ICF; Fifty-Fourth World Health Assembly, 2001); 2) interprofessional shared decision-making, as defined by Légaré et al. (2011), around a commitment point (Land et al., 2017); 3) procedural reasoning, e.g. care and action planning, implementing and progressing treatment (Edwards et al., 2004). Collaborating with health service users is relevant for considering their individual and contextual factors and key to their empowerment (Leino-Kilpi et al., 2005; World Health Organization, 2022).

Interprofessional collaborative reasoning is already used as a conceptual framework in learning (Gummesson et al., 2018). Thus, interprofessional collaborative learning occurs when health and social care professionals or students interact with each other to learn about and from their (future) service users' clinical data in a consensual approach (Barr & Waterton, 1996; Edwards et al., 2004). The term 'collaborative' stands for collaboration between learning service providers from multiple professions and users. It refers to helping others to attain a goal (Castañer et al., 2020), by considering the service users' and providers' reasoning (Blondon et al., 2017). Collaborative teams or networks form, with more or less shared identity and responsibility, integration or independence, that solve tasks with varying clarity of roles and goals (Reeves et al., 2010).

Digital solutions can enhance health service interaction between learners by facilitating ways of communication (World Health Organization, 2020) regarding records of service users' clinical data (Schouten et al., 2021), or remotely (Rosen & Leone, 2022). Digital technologies may, for example, include images, videos, speech and text systems such as collaborative documents or live online scenarios, messaging, applications or portable systems (Arntz et al., 2023). The COVID-19 pandemic increased the use of digital solutions in primary health care (Fahy et al., 2021; Kumpunen et al., 2022) as well as the transformation to digitally enhanced collaborative learning (Coleman et al., 2023; Gaebel et al., 2021). To extend this potential, quality improvement through training of service providers (Fahy et al., 2021), interdisciplinarity and civic engagement could be promoted (European University Association, 2021).

It remains unclear how digital solutions are currently used in interprofessional collaborative learning to facilitate service user participation. The transition of learners from knowing to performing collaborative interaction with the use of digital solutions affords bridging the gap of knowledge between undergraduate and continuous professional development (Connell et al., 2021; Lawn, 2016). Learning interactions in this process may vary in their technological, temporal, spatial or pedagogical planning, depending on the task, individuals and context (CAST, 2018; Joosten et al., 2021). When health service users and providers apply interprofessional collaborative learning, specific settings may influence their way of interaction (Reeves et al., 2010) and choice of digital solutions. Therefore, this research merges the existing knowledge on the use of digital solutions in collaborative learning between multiple professions and service users.

Objectives

This systematic review aimed to identify which digital solutions can facilitate service users to participate in an interprofessional learning process of service providers, who reflect on the users' health in a consensual approach. A systematic review was conducted to answer the following

questions: (1) Which digital solutions can facilitate the participation of health service users in collaborative learning of interprofessional service providers? (2) How do service users participate in collaborative learning of interprofessional health teams or networks with the use of digital solutions?

METHODS

In this systematic review, we followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework recommendations (Page et al., 2021).

Eligibility Criteria

Included studies met all of the following criteria: 1) English language, 2) original empirical work, 3) involving a service user and service providers from a minimum of two professions, 4) any health caring profession, including teachers and technicians involved in digital health services, 5) interprofessional collaborative learning in the range of team or network interaction, 6) identified or applied digital solutions used in a learning process.

We excluded studies that were: 1) proceedings, posters, books, protocols, frameworks, dissertations, reviews, editorials or comments, 2) focused on patient education or safety, inpatient, critical, veterinary or dental care, 3) without evaluation.

Reasons for these eligibility criteria were: 1) English being an international, scientific language, 2) to identify primary research with outcome measures and to exclude grey literature. 3) According to the aim and rationale of this review, the involvement of service users was mandatory, and for interprofessional interaction at least two professions are needed. 4) Any caring profession was included based on the definition of Ellis & Hogard (2021) to consider a broad range of stakeholders that contribute to delivering primary health care. 5) The concept of interprofessional collaborative learning and interaction by means of teams or networks applied as defined in the introduction (CAIPE, 1997; Edwards et al., 2004; Reeves et al., 2010). 6) To avoid a selection bias of research methods, not only the application, but also an identification of digital solutions were included. Finally, some exclusion criteria were used to support the focus on primary care of people's overall health, while the exclusion of patient education was added as an amendment to the study protocol to clarify the focus on learning of service providers.

Search Query, Restrictions and Information Sources

Search terms (displayed in Table 1) were synonymised within their PICO criteria (Centre for Evidence-Based Medicine, 2020) and evaluated in Medical Subject Headings (MeSH). Terms and synonyms were combined within their categories with OR and categories with each other using AND, as Table 1 describes. Some terms were excluded by being combined with NOT. Where possible, language (English), and species (humans) were applied, justified by the eligibility criteria. For the terms (communicat* OR collaborat* OR teamwork OR network OR coordinat*) the limitation [Title/Abstract/Keywords] was used. The terms 'function, functioning or ICF' were used to emphasise publications with the International Classification of Functioning, Disability and Health (ICF) as a common framework and language (Leonardi et al., 2022), yet this was not included in the eligibility criteria.

The databases CINAHL (via EBSCOhost), MEDLINE and PubMed Central (via PubMed), ScienceDirect (www.sciencedirect.com), Scopus (www.scopus.com) and the register Cochrane Trials (via Cochrane Library)

Table 1: Search Terms Clustered per PICO Criteria (Centre for Evidence-Based Medicine, 2020).

Category	Search terms
Population	(profession OR profession* OR employee OR staff OR student OR provider) AND (interprofessional relations[MeSH Terms]) AND (health OR medic* OR care) AND (community OR client OR patient OR person OR family OR user) AND
Intervention	(communicat*[Title/Abstract] OR collaborat*[Title/Abstract] OR teamwork[Title/Abstract] OR network[Title/Abstract] OR coordinat*[Title/Abstract]) AND (educat* OR lecture OR course OR learn* OR train* OR teach OR taught) AND (ICF OR function OR functioning) AND (digital OR technology OR mail OR video OR speech OR text messaging OR app OR application OR platform OR wearables OR connected OR computer* OR interface OR ehealth OR e-health OR electronic) AND
Outcome	(expect* OR needs OR reason* OR deci* OR decision-making OR prevent* OR rehabilitat* OR therap* OR monitor*) AND (activ* OR interven* OR interact* OR exchange OR discuss* OR practice OR understand* OR behavi* OR support OR empower* OR participat* OR cent*)
Limits	NOT veterinary NOT dental NOT dentist* NOT safety NOT critical NOT resuscitation
Filters	Humans, English

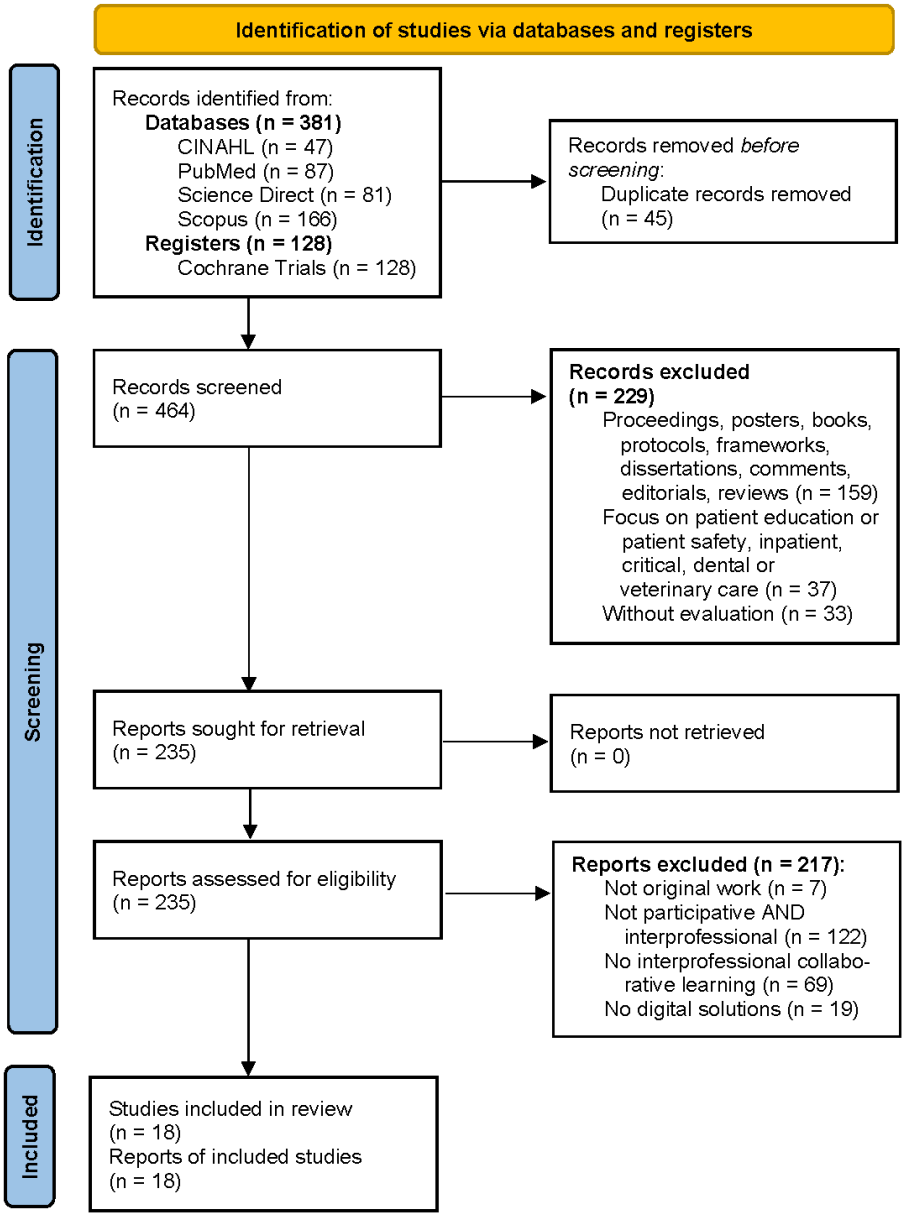

Figure 1: Search Strategy PRISMA Flow Diagram (adapted Page et al., 2021).

were searched on October 13 2022. Each search number was protocolled with its search query and results.

The query was adapted to the respective structure of the search function in the relevant data resources. The ScienceDirect interface did not support wildcards and allowed a maximum of eight Boolean characters per field. Thus, search terms were limited to the MeSH term interprofessional relations and the terms health, medical or care, combined with educate, learn, train, or teach, function, functioning or ICF and digital or technology. In the field "title, abstract or author-specific keywords" the terms communication, collaboration, teamwork, network or coordination were used. At Cochrane library, a maximum of five fields were allowed. Thus, the terms interprofessional, health and function were combined with communicat*, collaborat*, teamwork, network or coordinat* as terms in title, abstract and keywords.

Selection Process

The PRISMA flow diagram (Figure 1, adapted from Page et al., 2009) shows the steps of selecting relevant publications. The results of database and register searches were imported into the literature management tool 'Zotero

version 6.0.19'. The first author removed duplicates as proposed by 'Zotero' and screened each record and full text report based on the eligibility criteria. First the ex- and then the inclusion criteria were applied, all criteria in their described hierarchical order. The last author dealt with arising conflicts (n = 24). We used 'Microsoft Excel' as a data management tool and for exchange about conflicts. Figure 1 shows when publications were excluded and for what reason.

Data Collection and Analysis

The first author collected data from each report into the data management tool based on the following predefined domains (under consideration of Li et al., 2022): 1) year 2) country, 3) setting, 4) aim, 5) study design, 6) participants, 7) the use of digital solutions in interprofessional collaborative learning, 8) the participation of service users in the collaborative learning process. In line with the research questions, the last two domains were the most relevant, while other details from reported interventions or outcome measures were not considered in further detail.

Tabulation methods were used to present the results of individual studies and synthesis following the order of their publication. No statistical synthesis methods were used and therefore no effect measures were calculated. To be eligible for synthesis, data had to be reported in the respective domain. The first author synthesised data by clustering the described domains thematically. Countries were clustered per continent, study design was clustered in qualitative, quantitative and mixed methods. Settings were distinguished by whether participants accessed digital solutions from classrooms, from service provider facilities (outpatient or ambulatory care), or from the service users' permanent living environment (home-based care). Furthermore, the number of service users and service providers involved and the participants' professions were summarised.

To synthesise interventions and outcomes, the first author used the data management tool to identify the use of digital solutions and the participation of service users in interprofessional collaborative learning. The prepared synthesis was then reviewed by the co-authors. Due to the diversity of aims and methodology, tools to assess risk of bias could not have been evaluated in overall across findings. Thus, risk of bias in the included studies was not assessed by using any instrument or tool.

RESULTS

The database and register search led to a total of n = 509 results. The PRISMA flow diagram (Figure 1, adapted from Page et al., 2009) shows the screened records and the number of excluded records and reports. For all reports, full text availability was given. Ultimately, eighteen reports met all the eligibility criteria.

Several studies appeared to meet the inclusion criteria but were excluded, for example because the help to attain a goal was only directed towards the service user (Castañer et al., 2020) and thus focusing on patient education, or because interprofessional collaborative learning was not given (Table 2).

Study Characteristics and Settings

Eligible studies were published between 2000 and 2022, although we did not restrict our search to these years. Seven studies were conducted in North America (Bluml et al., 2000; Byerly et al., 2021; Javadi et al., 2018; Lempicki & Holland, 2018; McGilton et al., 2011; Sabus et al., 2011; Shorten et al., 2015), six in Europe (Andersson et al., 2021; Korstjens et al., 2021; Metzelthin et al., 2013; Poss-Doering et al., 2020; Saia et al., 2020; Swallow et al., 2016), three in Asia (Liaw et al., 2020; Uslu-Sahan & Terzioglu, 2020; Yang et al., 2017) and two in Oceania (Darlow et al., 2015; Lucas et al., 2020). In Table 3, the origin countries of each study and the order of publication year are described.

In seven studies, participants accessed digital solutions from classrooms located either in higher education facilities (n = 5) or training centres in hospitals (n = 2). All other studies were either situated in outpatient and ambulatory (n = 7) or in home-based settings, which include continuing care facilities such as nursing homes (n = 4).

Aim and Study Design

The aims and study designs of the reports are displayed in Table 3. By using digital solutions, two reports aimed at understanding the collaboration between service users and providers (Andersson et al., 2021; Korstjens et al., 2021) and three studies explored how to improve patient's care (Bluml et al., 2000; Poss-Doering et al., 2020; Saia et al., 2020). Five studies described the development and testing of the collaborative use of a digital solution (Sabus et al., 2011; Shorten et al., 2015; Swallow et al., 2016; Javadi et al., 2018; Lempicki & Holland, 2018). Eight studies evaluated a collaborative learning intervention that uses digital solutions (Byerly et al., 2021; McGilton et al., 2011; Metzelthin et al., 2013; Darlow et al., 2015; Liaw et al., 2020; Lucas et al., 2020; Uslu-Sahan & Terzioglu, 2020; Yang et al., 2017).

Seven studies applied qualitative methods, including observations (Bluml et al. 2000; Byerly et al., 2021), individual (Saia et al., 2020) and focus group interviews

Table 2: Excluded Studies.

Argument for exclusion	*Studies*
Focus on patient education	Hjelle, K. M., Skutle, O., Førland, O., & Alvsvåg, H. (2016). The reablement team's voice: A qualitative study of how an integrated multidisciplinary team experiences participation in reablement. *Journal of Multidisciplinary Healthcare*, *9*, 575–585. https://doi.org/10.2147/JMDH.S115588 Ho, P., Lambert-Kerzner, A., Carey, E., Fahdi, I., Bryson, C., Melnyk, S., Bosworth, H., Radcliff, T., Davis, R., Mun, H., & et al. (2014). Multifaceted intervention to improve medication adherence and secondary prevention measures after acute coronary syndrome hospital discharge: A randomized clinical trial. *JAMA Internal Medicine*, *174*(2), 186–193. https://doi.org/10.1001/jamainternmed.2013.12944 Knoop, J., de Joode, J. W., Brandt, H., Dekker, J., & Ostelo, R. W. J. G. (2022). Patients' and clinicians' experiences with stratified exercise therapy in knee osteoarthritis: A qualitative study. *BMC Musculoskeletal Disorders*, *23*(1), 559. https://doi.org/10.1186/s12891-022-05496-2 Noviani, L., Diantini, A., & Subarnas, A. (2020). Collaboration between interprofessional healthcare and patients to improve quality of life type 2 diabetes via smartphone application. *International Journal of Pharmaceutical Research*, *13*(1), 645–650. https://doi.org/10.31838/ijpr/2021.13.01.126 Richards, D., Hill, J., Gask, L., Lovell, K., Chew-Graham, C., Bower, P., Cape, J., Pilling, S., Araya, R., Kessler, D., & et al. (2013). Clinical effectiveness of collaborative care for depression in UK primary care (CADET): Cluster randomised controlled trial. *BMJ*, *347*, f4913. https://doi.org/10.1136/bmj.f4913
No learning interventions for service providers	Blackstone, S. W., Wilkinson, K. M., Luo, F., Canchola, J., & Roman-Lantzy, C. (2021). Children with cortical visual impairment and complex communication needs: Identifying gaps between needs and current practice. *Language, Speech, and Hearing Services in Schools*, *52*(2), 612–629. https://doi.org/10.1044/2020_LSHSS-20-00088 Bradshaw, A. B., Bonnecaze, A. K., Burns, C. A., & Beardsley, J. R. (2021). Impact of an interprofessional collaborative quality improvement initiative to decrease inappropriate thyroid function testing. *Hospital Pharmacy*, *56*(5), 481–485. https://doi.org/10.1177/0018578720920795 Heiden, S. M., Holden, R. J., Alder, C. A., Bodke, K., & Boustani, M. (2017). Human factors in mental healthcare: A work system analysis of a community-based program for older adults with depression and dementia. *Applied Ergonomics*, *64*, 27–40. https://doi.org/10.1016/j.apergo.2017.05.002 Pariser, P., Pham, T. N. T., Brown, J. B., Stewart, M., & Charles, J. (2019). Connecting people with multimorbidity to interprofessional teams using telemedicine. *The Annals of Family Medicine*, *17*(Suppl 1), S57-S62. https://doi.org/10.1370/afm.2379 Van Dongen, J. J. J., Lenzen, S. A., Van Bokhoven, M. A., Daniëls, R., Van Der Weijden, T., & Beurskens, A. (2016). Interprofessional collaboration regarding patients' care plans in primary care: A focus group study into influential factors. *BMC Family Practice*, 17, 58. https://doi.org/10.1186/s12875-016-0456-5 Wu, R., Appel, L., Morra, D., Lo, V., Kitto, S., & Quan, S. (2014). Short message service or disService: Issues with text messaging in a complex medical environment. *International Journal of Medical Informatics*, *83*(4), 278–284. https://doi.org/10.1016/j.ijmedinf.2014.01.003
Interaction with (simulated) service users was not part of the learning process	Carroll, J. C., Talbot, Y., Permaul, J., Tobin, A., Moineddin, R., Blaine, S., Bloom, J., Butt, D., Kay, K., & Telner, D. (2016). Academic family health teams: Part 1: Patient perceptions of core primary care domains. *Canadian Family Physician*, *62*(1), e23–e30. MacNeill, H., Telner, D., Sparaggis-Agaliotis, A., & Hanna, E. (2014). All for one and one for all: understanding health professionals' experience in individual versus collaborative online learning. *Journal of Continuing Education in the Health Professions*, *34*(2), 102-111. https://doi.org/10.1002/chp.21226 Meystre, C., Bourquin, C., Despland, J.-N., Stiefel, F., & De Roten, Y. (2013). Working alliance in communication skills training for oncology clinicians: A controlled trial. *Patient Education and Counseling*, *90*(2), 233–238. https://doi.org/10.1016/j.pec.2012.10.013 Petersen, L., Birkelund, R., & Schiøttz-Christensen, B. (2020). Challenges to cross-sectoral care experienced by professionals working with patients living with low back pain: A qualitative interview study. *BMC Health Services Research*, *20*(1), 164. https://doi.org/10.1186/s12913-020-4988-y Shoemaker, M., de Voest, M., Booth, A., Meny, L., & Victor, J. (2015). A virtual patient educational activity to improve interprofessional competencies: A randomized trial. *Journal of interprofessional care*, *29*(4), 395–397. https://doi.org/10.3109/13561820.2014.984286 Tempest, S., Harries, P., Kilbride, C., & De Souza, L. (2012). To adopt is to adapt: The process of implementing the ICF with an acute stroke multidisciplinary team in England. *Disability and Rehabilitation*, *34*(20), 1686–1694. https://doi.org/10.3109/09638288.2012.658489 Walker, L. E., Cross, M., & Barnett, T. (2019). Students' experiences and perceptions of interprofessional education during rural placement: A mixed methods study. *Nurse Education Today*, *75*, 28–34. https://doi.org/10.1016/j.nedt.2018.12.012
Digital solutions did not support interprofessional collaborative learning	Conti, G., Bowers, C., O'Connell, M. B., Bruer, S., Bugdalski-Stutrud, C., Smith, G., Bickes, J., & Mendez, J. (2016). Examining the effects of an experiential interprofessional education activity with older adults. *Journal of Interprofessional Care*, *30*(2), 184–190. https://doi.org/10.3109/13561820.2015.1092428 Floren, L., Mandal, J., Dall'Era, M., Shin, J., Irby, D., Cate, O., & O'Brien, B. (2020). A Mobile Learning Module to Support Interprofessional Knowledge Construction in the Health Professions. *American Journal of Pharmaceutical Education*, *84*(2), 847519. https://doi.org/10.5688/ajpe847519 O'Connell, M. B., Fava, J. P., Gilkey, S. J., Dereczyk, A. L., Higgins, R., Burke, C. A., Lucarotti, R. L., & Gaggin, P. E. (2021). Using community pharmacies and team observed structured clinical encounters (TOSCEs) for interprofessional education and training. *Currents in Pharmacy Teaching & Learning*, *13*(1), 19–28. https://doi.org/10.1016/j.cptl.2020.07.018 Posenau, A., & Peters, T. (2016). Communicative positioning of one's own profession in interprofessional settings. *GMS Journal for Medical Education, 33*(2), Doc27. https://doi.org/10.3205/zma001026 Thomson, K., Gripton, J., Lutchmiah, J., & Caan, W. (2007). Health facilitation in primary care seen from practice and education. *British Journal of Nursing*, *16*(18), 1156–1160. https://doi.org/10.12968/bjon.2007.16.18.27514 Watt-Watson, J., McGillion, M., Lax, L., Oskarsson, J., Hunter, J., MacLennan, C., Knickle, K., & Victor, J. C. (2019). Evaluating an Innovative eLearning Pain Education Interprofessional Resource: A Pre-Post Study. *Pain Medicine*, *20*(1), 37–49. https://doi.org/10.1093/pm/pny105

Table 3: Characteristics of Included Studies.

Study		Setting	Aim	Study design	Participants (n)		Digital solution
Authors, Year	Country				User	Provider	
Bluml et al., 2000	USA	Ambulatory care	Improve patients' care	Qualitative	397	26	Point-of-care testing
McGilton et al., 2011	Canada	Continuing care facility	Assess implementation	Mixed methods	9	18	Videos before role play
Sabus et al., 2011	USA	University	Understand tool's utility	Quantitative	1	69	Virtual reality, avatar
Metzelthin et al., 2013	Netherlands	Ambulatory practices	Examine implementation	Qualitative	13	45	Digital record forms
Darlow et al., 2015	New Zealand	University	Evaluate a programme	Quantitative	1	83	E-learning, videos
Shorten et al., 2015	USA	Urban outpatient clinics	Outline creation process	Qualitative	9	21	Interactive web site
Swallow et al., 2016	UK	Home-based care	Report users' feasibility	Quantitative	21	23	Web application
Yang et al., 2017	Taiwan	Hospital simulation lab	Evaluate a programme	Quantitative	1	88	E-learning, videos, high-fidelity simulation
Javadi et al., 2018	Canada	Home settings	Test exercise feasibility	Mixed methods	21	106	Tablet, web application
Lempicki & Holland, 2018	USA	University	Evaluate feasibility	Quantitative	2	6	Video conferencing
Liaw et al., 2020	Singapore	University	Evaluate a programme	Quantitative	1	120	Virtual reality, avatar
Lucas et al., 2020	Australia	Hospital simulation lab	Explore perceptions	Mixed methods	2	60	Videos at a simulation
Poss-Doering et al., 2020	Germany	Primary care networks	Explore contributions to antibiotic prescribing	Mixed methods	1	354	E-learning, tablet, digital records
Saia et al., 2020	Estonia	Social rehabilitation	Investigate perceptions	Qualitative	13	9	Communication tools
Uslu-Sahan & Terzioglu, 2020	Turkey	University	Determine effectiveness of simulation methods	Quantitative	2	84	Power-point before a high-fidelity simulation
Andersson et al., 2021	Sweden	Primary care center	Explore partnership when using the system	Qualitative	22	15	Device, mobile phone, database, web portal
Byerly et al., 2021	USA	Nursing home	Explore role fluidity	Qualitative	5	47	Computer, records
Korstjens et al., 2021	Netherlands	Ambulatory practices and hospitals	Understand maternity care collaboration	Qualitative	26	62	Video-clips, pictures in reflective meetings

(Andersson et al., 2021), reflective ethnography (Korstjens et al., 2021), an iterative, participative design and development process (Shorten et al., 2015) and a process evaluation (Metzelthin et al., 2013). Four studies used mixed methods, specifically a development and feasibility study (Javadi et al., 2018), two pre-posttest designs, one supplemented with a focus group interview (McGilton et al., 2011), the other with a thematic analysis of reflective statements (Lucas et al., 2020). Poss-Doering et al. (2020) applied thematic analysis to interview data and a descriptive analysis to survey results. From the seven studies which applied quantitative methods, Sabus et al., (2011) also applied a descriptive analysis to survey results, Yang et al. (2017) a pre-post comparative cross-sectional study, Darlow et al. (2015) applied a controlled trial, and four studies used randomised controlled trials (Lempicki & Holland, 2018; Liaw et al., 2020; Swallow et al., 2016; Uslu-Sahan & Terzioglu, 2020).

Participants

The investigated studies reported on a total of 1,236 service providers (n = 18; MS = 53.5; 2-354), 537 service users (n = 11; MS = 13; 1-397) and additional ten simulated service users (n = 7; MS = 1; 1-2), which were either video recordings to be followed by encounters with real service users (Darlow et al., 2015), patient avatars (Liaw et al., 2020; Sabus et al., 2011), mannequins (Uslu-Sahan & Terzioglu, 2020; Yang et al., 2017), standardised patient actors (Lempicki & Holland, 2018), or both of

Table 4: Frequency of Involved Professions.

Profession	Frequency	Studies
Medicine	13	Andersson et al., 2021; Bluml et al., 2000; Byerly et al., 2011; Darlow et al., 2015; Javadi et al., 2018; Korstjens et al., 2021; Liaw et al., 2020; Metzelthin et al., 2013; Poss-Doering et al., 2020; Shorten et al., 2015; Swallow et al., 2016; Uslu-Sahan & Terzioglu, 2020; Yang et al., 2017
Nursing	12	Andersson et al., 2021; Javadi et al., 2018; Korstjens et al., 2021; Liaw et al., 2020; Lucas et al., 2020; McGilton et al., 2011; Metzelthin et al., 2013; Saia et al., 2020; Shorten et al., 2015; Swallow et al., 2016; Uslu-Sahan & Terzioglu, 2020; Yang et al., 2017
Pharmacy	6	Bluml et al., 2000; Byerly et al., 2011; Javadi et al., 2018; Lempicki & Holland, 2018; Lucas et al., 2020; Yang et al., 2017
Physiotherapy	6	Byerly et al., 2011; Darlow et al., 2015; Javadi et al., 2018; Lempicki & Holland, 2018; Metzelthin et al., 2013; Sabus et al., 2011
Occupational therapy	4	Javadi et al., 2018; Lempicki & Holland, 2018; Metzelthin et al., 2013; Sabus et al., 2011
Dietetics / Nutrition	3	Darlow et al., 2015; Javadi et al., 2018; Uslu-Sahan & Terzioglu, 2020
Social work	3	Javadi et al., 2018; Saia et al., 2020; Uslu-Sahan & Terzioglu, 2020
Midwifery	2	Korstjens et al., 2021; Shorten et al., 2015
Unspecified health profession	2	Poss-Doering et al., 2020; Swallow et al., 2016
Health insurance agency	1	Poss-Doering et al., 2020
Lactation consultation	1	Javadi et al., 2018
Osteopathy	1	Lempicki & Holland, 2018
Physical assistance	1	Javadi et al., 2018
Primary health care network management	1	Poss-Doering et al., 2020
Psychology	1	Saia et al., 2020
Radiation therapy	1	Darlow et al., 2015
Social pedagogy	1	Saia et al., 2020
Special education	1	Saia et al., 2020
Speech language pathology	1	McGilton et al., 2011
System navigation	1	Javadi et al., 2018
Web development	1	Shorten et al., 2015

the latter (Lucas et al., 2020). In some studies, simulated service users were accompanied by standardised actors playing family members, a caring husband (Lucas et al., 2020), daughter (Uslu-Sahan & Terzioglu, 2020), or not further specified (Yang et al., 2017). Family members were counted as service users, organised volunteers (Javadi et al., 2018) as service providers. Service users or providers were not counted if their exact number was not reported (Darlow et al., 2015; Javadi et al., 2018; Yang et al., 2017) or if they were not reported as participants in the study (Metzelthin et al., 2013). From the 11 studies that involved real service users, some involved them as stakeholders, e. g. from a self-help organisation (Poss-Doering et al., 2020).

In total 21 professions participated in the results (n = 18; MS = 3; 2-10). Table 4 displays the involved professions in the order of their frequency.

Javadi et al. (2018) included other non-specified consulting specialists and non-paid volunteer pairs of undergraduate students and retired professionals or other experienced community members. Metzelthin et al. (2013) reported invitations to team meetings (providing a social worker, homecare provider or pharmacist as examples) and referrals to further disciplines (e. g. nutritionist, speech therapist) that were not interviewed and thus not counted as participants.

Use of Digital Solutions

We provide a descriptive overview of the digital solutions used in the 18 included articles (Table 3). Digital solutions were used, on the one hand, to facilitate the interprofessional collaborative learning process, and on the other hand, to facilitate interactive communication between service users and interprofessional providers, which fostered learning about and from service users in a consensual approach. Several studies used more than one digital solution.

The following digital solutions facilitated interprofessional collaborative learning: Two studies applied avatars in a virtual reality environment, one was role-played by an instructor to teach interprofessional home assessment (Sabus et al., 2011), and the other was based on a prepared script and accompanied by a facilitator avatar

located in a ward (Liaw et al., 2020). In one study, video recordings and pictures were used to engage reflection of communication in previous collaborative interaction (Korstjens et al., 2021), while four other studies used video demonstrations that were followed by live interaction, specifically a role-play on communication (McGilton et al., 2011), contact with a simulated service user (Lucas et al., 2020; Yang et al., 2017), or the visit of a person living in the community (Darlow et al., 2015). Two of these video demonstrations were part of a more extensive e-learning intervention (Darlow et al., 2015; Yang et al., 2017), while another e-learning intervention on communication did not report any video usage (Poss-Doering et al., 2020). One study reported the usage of a power-point-presentation to be followed by a simulation intervention (Uslu-Sahan & Terzioglu, 2020). In total, three studies applied high-fidelity simulation, yet only one, a SimMan® 3G simulator (Yang et al., 2017), could be identified as a mannequin that was equipped with digital technologies. The study of Uslu-Sahan & Terzioglu (2020) used a scenario template that described digital technologies, but did neither describe digital technologies in their simulation applications nor specify the terms high-fidelity and hybrid simulations any further. Lucas et al. (2020) used medium and high-fidelity simulators to apply nasogastric tube insertion, which was rated as mechanical simulation.

Interactive communication between service users and interprofessional providers formed the basis of learnings in studies that used the following digital solutions: Lempicki & Holland (2018) applied the web-based video conferencing service Zoom in comparison to a face-to-face encounter. Saia et al. (2020) identified the need to develop information and communications technology for information sharing, and to use the latest technology to communicate, e.g. by social media solutions, according to the service users' preferences. In addition, clinical service user data was exchanged in a consensual approach in eight studies: Digital records were exchanged between service users and providers via web site (Shorten et al., 2015), web portal (Andersson et al., 2021) and web applications that were designed to be used on a mobile device in general (Swallow et al., 2016) or on a tablet (Javadi et al., 2018). Poss-Doering et al. (2020) used tablets for displaying digital material to service users and identified the use of shared digital records as supportive to continuity of primary care in networks. Two further studies recommended (Metzelthin et al., 2013) and applied (Bluml et al., 2000) documentation and exchange systems, without specifying them in any detail. Data of digital records was collected manually from digital devices that measured cholesterol (Bluml et al., 2000) and blood-pressure (Andersson et al., 2021). In the study of Byerly et al. (2021), live exchange between learning service providers on digital records in front of a local computer system was followed by a face-to-face encounter.

Participation of Service Users

Digital solutions facilitated participation of service users in interprofessional learning via collaboration on their data (n = 5; Andersson et al., 2021; Bluml et al., 2000; Javadi et al., 2018; Shorten et al., 2015; Swallow et al., 2016) or via general communication (n = 3; Korstjens et al., 2021; McGilton et al., 2011; Saia et al., 2000). In three studies, digital solutions were identified as facilitators of interprofessional interaction, but service users participated at a different moment of the reported study (Byerly et al., 2021; Metzelthin et al., 2013; Poss-Doering et al., 2020).

In five studies, interprofessional learners interacted with played or digitally simulated service users (Lempicki & Holland, 2018; Liaw et al., 2020; Sabus et al., 2011; Uslu-Sahan & Terzioglu, 2020; Yang et al., 2017). In addition, four studies used videos as a solution to train learners on how to interact with service users (Darlow et al., 2015; Lucas et al., 2020; McGilton et al., 2011; Yang et al., 2017).

DISCUSSION

This systematic review aimed to identify digital solutions that can facilitate the participation of health service users in collaborative learning of interprofessional service providers who reflect on the users' health in a consensual approach. It was further investigated how service users participate in collaborative learning of interprofessional health teams or networks with the use of digital solutions. This may support the technological, temporal, spatial or pedagogical planning (Joosten et al., 2021) in digitally enhanced interprofessional collaborative learning among health service providers. By using digital solutions to facilitate the participation of service users, the gap between theory and reality may be bridged and quality in primary health care could be improved (Connell et al., 2021; Fahy et al., 2021).

No study that was published before 2000 was eligible, which could be related to the inclusion of 'patient-centredness' as a health care quality goal (Committee on Quality of Health Care in America, 2001), the establishment of the ICF classification (Fifty-Fourth World Health Assembly, 2001), or to internet connectivity and digital transformation (Lin & Wu, 2022). The latter relates to the fact that none of the eligible studies were conducted in low- or middle-income countries.

Settings seemed to influence access to service users and professions: In educational settings, the digital

solutions used focused on interprofessional learning and used simulated service users to facilitate collaborative reasoning (Blondon et al., 2017). This may have resulted from a lack of access to real service users, ethical considerations or served educational standardisation (Luck & Peabody, 2002). In primary care settings, interprofessional communication between providers with and about service users was identified or applied, which led to learning but might not have been planned as learning. Caring family or community members were considered in some studies, but could receive more attention in research methodologies and reporting (Arksey & Hirst, 2005).

Communication occurs in diverse settings and can be supported by various technologies (World Health Organization, 2020), which is also reflected in the findings. Digital solutions can facilitate the participation of health service users in collaborative learning of interprofessional service providers as a relevant factor in multiple ways (Van Dongen et al., 2016). For example, videos were either used to prepare for a service user encounter or to reflect on it. At four universities and in a hospital simulation lab, interaction with service users was played or digitally simulated. These studies were not excluded, because the actors or digital solutions were considered being service users. According to Towle et al. (2010), involvement of patients may range from focus of an electronic case and standardised patients to involving patients at the institutional level. Whether a technology enhances interprofessional communication between service users and providers depends on whether it is accessible to all parties and on how communication takes place. Holistic and flexible approaches will facilitate meeting communities' diverse needs (European University Association, 2021).

How service users participate in collaborative learning of health teams or networks with the use of digital solutions differs between the level of the learners (students vs. professionals) and the settings (university or simulation lab vs. applied care). This may relate to a discrepancy of systems possibilities and desired functions or design ideas (Schouten et al., 2021). In several studies, the application or identification of digital solutions was not the aim. It could be that further studies had used digital solutions but did not explicitly report them. The focus on digital solutions may lead to underestimating the usage of analogue solutions or risk implying that digital solutions could be superior. Participation of service users in interprofessional collaborative learning may as well take place without any digital solution.

In all studies, the facilitation of interaction depended on a person engaging and/or leading interprofessional collaborative learning. Land et al. (2017) also point out the importance of engagement, focusing on a commitment point. As a possibly facilitating role, a decision coach is introduced by Légaré et al. (2011) in the model of interprofessional shared decision-making. As shown by Kienlin et al. (2022), collaborative interaction can be trained and assessed throughout collaborative reasoning. Thus, the use of a digital solution and not the technology itself influences, how service users participate. This is supported by the literature which indicates that digital skills influence the success of digital solutions' use (Rosen & Leone, 2022).

A major limitation of this study lies in one cluster of the search terms: The terms 'ICF', 'function' or 'functioning' were used to emphasise studies with ICF as a common language and holistic view (Leonardi et al., 2022). Yet, to avoid selection bias, ICF was not defined among the eligibility criteria. As a coincidence, the term 'function' is related to design (Andersson et al., 2021; Shorten et al., 2015; Swallow et al., 2016) and further, a 'function' or 'functioning' of professionals, teams and organisations as service providers were described (Darlow et al., 2015; Lempicki & Holland, 2018; Lucas et al., 2020; Metzelthin et al., 2013; Poss-Doering et al., 2020; Yang et al., 2017). Thus, the included studies may have used the terms for various purposes, while other records which did not use one of these three terms were not identified. However, the term 'functioning' was used in relation to service users in five of the 18 eligible studies, even if the identified digital solutions did not explicitly refer to applying the ICF framework (Byerly et al., 2021; Javadi et al., 2018; McGilton et al., 2011; Sabus et al., 2011; Saia et al., 2020).

This review did neither assess the quality nor the risk of bias of the included studies. Only the synthesis was reviewed by more than one author. Imprecision of the included reports may have limited the quality of the synthesis. Specifically, Lempicki & Holland (2018) did not clearly describe the aim of their work, while Lucas et al. (2020) differed in their description between abstract and text. The number of participants was not clearly described in some studies (Darlow et al., 2015; Javadi et al., 2018; Yang et al., 2017). The authors were contacted via email, but did not respond. The included reports had different aims, study designs, interventions and outcomes. However, this review did not aim to identify the intended outcomes of the reports, but for identifying the use of digital solutions as part of their interventions or outcomes, as well as the participation of service users in these studies.

To conclude, the heterogeneity of the selected studies reflects lack of coherence in the use of digital solutions and clear conclusions cannot be drawn. Some of the identified digital solutions facilitate an active participation of service users in interprofessional collaborative learning, while some facilitate participation indirectly, with the

service users being simulated or involved at a different moment. In educational settings, service users were simulated. The engagement of self-care groups in the education of service providers may be a relevant resource to interprofessional collaborative learning. Several types of digital solutions were identified that enabled students to engage in interprofessional collaborative learning, but neither digital assessments tools nor games were used. Findings from this review indicate that digital solutions are appropriate for being used and implemented in interprofessional collaborative learning, and future research could evaluate their usability. Further review of the literature may reveal recent developments and explore the influence of COVID-19 on the use of digital solutions, especially in educational settings. Directive roles may be needed that take the lead in facilitating the process of interprofessional collaborative learning. Low- or middle-income countries may need specific facilitation in using digital solutions.

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Ethical Approval, Registration

No ethical approval was needed since this work did not collect data. The review was not registered.

Conflicts of Interests

We have no conflicts of interest to disclose.

Data Availability Statement

Study protocol, template data collection form and data extracted from included studies are available from the corresponding author upon reasonable request.

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