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#### A Systematic Review of the Literature

Godsk, Mikkel; Nielsen, Birgitte Lund

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# Online Teacher Professional Development (oTPD) for Digital Competencies in Higher Education: A Systematic Review of the Literature

Mikkel Godsk<sup>1\*</sup> & Birgitte Lund Nielsen<sup>2</sup>

<sup>1</sup>Aarhus University, Denmark; <sup>2</sup>VIA University College, Denmark

## ABSTRACT

The need for professional development for digital, subject-specific competencies is increasing among educators in higher education. With online teacher professional development (oTPD), this demand can be accommodated flexibly. The article presents a systematic review of the literature and evidence on oTPD for digital competencies in higher education. The purpose of the review is to identify factors that influence the effect of an oTPD programme. A total of 661 peer-reviewed articles that included empirical studies and literature reviews related to oTPD from 2010 and onwards were identified using the EBSCO and ERIC databases and screened. 57 of these were coded and included in the analysis, and 604 articles were excluded due to wrong focus, educational level, publication type, or year. The analysis identifies sixteen underlying factors that influence the effect of oTPD related to either the institutional aspect, the design of the programme, and/or the delivery of the programme. Furthermore, the review identifies political implications for research on oTPD—the institutional context including technical solutions, the general pedagogical approach, and educator support—and methodological limitations related to the ambiguity of the oTPD concepts and the transferability of case studies, which call for more research.

**Keywords:** *teacher professional development; distance education; online learning; academic development; digital competencies; systematic review*

## Highlights

- The review provides a systematic literature overview on how digital competencies of educators in higher education can be effectively developed through online teacher professional development programmes (oTPD)
- The review identifies sixteen institutional, design, and delivery factors that influence the effect of online teacher professional development (oTPD) for digital competencies in higher education.

\*Correspondence: Mikkel Godsk, e-mail: godsk@au.dk

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- The review discusses the importance of the institutional context, including the prioritisation of educational development and perspectives on academic freedom
- The review raises concerns about the transferability of existing research and the ambiguity of the concept of online teacher professional development (oTPD)

## **Introduction**

Technology penetrates most subject areas in higher education (HE), and the need for effective professional development for educators' digital, subject-specific competencies is increasing (Basilotta-Gómez-Pablos et al., 2022; Kirkwood & Price, 2013; Lillejord et al., 2018; Lund et al., 2014, Perifanou & Economides, 2022; Wu et al., 2016). Research on teacher professional development (TPD) programmes in general has identified a series of underlying factors for effective practices. This includes institutional aspects such as ensuring coherence with other workplace initiatives (Desimone, 2009; Garet et al., 2001) and strategic, institutional support (Holt et al., 2011). Programme design and delivery aspects, such as offering an extended time-frame, supporting active participant engagement and collaboration, and focusing on specific content and challenges from their everyday teaching, also play a vital role (Boud, 1999). However, the precise definition and enactment of *digital competence* are subjects of ongoing debate. It has been suggested to transition from viewing digital competence as a generic skill set towards encompassing specialised teaching-profession skills that amalgamate content, technological, and pedagogical knowledge (Lund et al., 2014; Spante et al., 2018; Wu et al., 2016) and a wide range of specific digital skills and competencies, such as information, media, and data literacy, digital content creation, responsible use, problem-solving, communication and collaboration, and feedback (Basilotta-Gómez-Pablos et al., 2022; DigCompEdu framework, 2023).

The current literature provides limited insight into how these competencies can be effectively developed through *online* TPD (oTPD), such as online formal TPD programmes, workshops, online communities of practice, and MOOCs on digital teaching competencies, and the domain of oTPD for *educators in higher education* (HE) remains underexplored and undervalued (Dede et al., 2008; Dervenis et al., 2022; Fernández-Batanero et al., 2022). Dervenis et al. (2022) highlight in their literature review on teacher competencies in HE that this area received scant attention in prior research and was generally considered secondary before the COVID-19 pandemic, despite existing evidence indicating that inadequate digital competencies and literacy among educators may impede students' development of digital literacy (Matthews, 2021), and an early attempt at Harvard University to establish a research agenda for oTPD in 2005 (Sprague, 2006). In addition, there is a lack of clarity and consensus on the conceptualisation of educators' professional digital competence, further complicating the development and implementation of effective oTPD programmes (Skantz-Åberg et al., 2022). This gap is also underscored by preliminary searches on oTPD for digital competencies in HE on EBSCO, ERIC, and Google Scholar, which

identified only one article covering all relevant aspects and showed that articles typically do not address the online format. This, therefore, calls for a broader search in relevant literature, as carried out in this review (see Methodology).

Given these gaps in the literature, this article argues for a comprehensive investigation into the aspects that contribute to effective oTPD for digital competencies in higher education. Such an investigation is crucial to provide guidance to institutions, educational developers, and educators in order to design and deliver effective oTPD (Leary et al., 2020). While it may be tempting to organise professional development for digital, subject-specific competencies in HE based on established practices in effective face-to-face TPD programmes, online teaching and learning, or the widely used Technological Pedagogical Content Knowledge (TPACK) framework, there is a risk of oversimplifying the intricate nature of online TPD for digital competencies in HE for educators. Consequently, it is necessary to scrutinise and amalgamate the research literature on effective TPD in similar contexts—i.e., educators’ digital competencies in HE—and draw connections from related research through a systematic literature review. This leads to the following research question:

- What factors influence the effect of online teacher professional development (oTPD) for digital competencies in higher education?

## **Methodology**

To answer the research question, a literature review was carried out. The literature review was structured as a systematic literature review (Khan et al., 2003; Littell et al., 2008), guided by a PRISMA process (Moher et al., 2009; see Figure 1), supplemented with hand searches and a backward snowballing process (Wohlin, 2014). This systematic process involves five steps: (1) framing the research question; (2) searching for, screening, and identifying relevant studies; (3) assessing the eligibility of identified studies; (4) summarising and analysing the eligible studies; and (5) discussing the findings according to the research question.

### ***Searching for and identifying relevant studies***

Before deciding on the search procedure and keywords, pilot searches on the ERIC (Educational Resources Information Center), Google Scholar, and EBSCO databases combining the four concepts in the scope of the research question were carried out: the modality (i.e., online teaching and learning), the purpose (i.e., professional development of educators), the scope (i.e., a learning objective on digital competencies), and the educational level (i.e., the context of higher education). The pilot search revealed that no articles—except, to some extent, Tømte et al. (2015)—included all four concepts of oTPD for digital competencies in HE at the same time. However, some articles covered important subsets of this scope. Thus, the identification of articles was carried out in four rounds of searches in English. The first two rounds were

carried out in respectively April–May 2020 and August 2021 on EBSCO and ERIC, each looking at different subsets of the topic from the last ten years (i.e., 2010–2020): (1) oTPD in HE, (2) TPD for digital competencies (including TPACK and “digital literacy”) in HE, and (3) TPD for technology integration (blended/online) in HE. 2010 was used as the start year to increase the likelihood that the results would also be relevant to the technological context today. The third round was a more open follow-up search on ERIC in June 2023 (i.e., post COVID-19) looking for articles published between 2020 and 2023 (see Appendix A for details). EBSCO was chosen because of its ability to search across a wide range of disciplines and publication formats, while ERIC was selected because it is considered the most comprehensive educational and pedagogical bibliographic database in the world, covering all disciplines of education and other education-related literature. However, the first two search rounds showed that ERIC was much more precise regarding the focus of this review, whereas EBSCO returned a large number of irrelevant resources. Therefore, only ERIC was used for the third search round. The fourth round was a follow-up semantic search in December 2023 powered by Artificial Intelligence (AI) using Litmaps (<https://litmaps.com/>) identifying any missing articles related to the already identified key articles in the previous searches.

The pilot also revealed a highly diverse use of terms and concepts. To include as many relevant articles as possible, the searches combined a variety of keywords, of which some are used synonymously in the literature: “online,” “blended,” “technology integration,” “university,” “higher education,” “college,” “higher education staff,” and “professors” with “professional learning,” “professional development,” “professional continuing education,” “continuing education,” “faculty professional development,” “teacher professional development,” “teacher training,” “professional education,” “academic development,” “TPACK,” “technological pedagogical content knowledge,” “digital literacy,” “digital competences,” and “digital competencies.”

### ***Assessing the eligibility of the identified studies***

All identified literature from 2010 and onwards from each subset was screened (n = 661), and 131 potentially relevant articles and other publications were included for further scrutiny. Articles that were not relevant to answering the research question were excluded according to the defined set of exclusion criteria related to the target group (not higher education educators), modality (not blended or online), scope (not digital competencies), resource type (not an empirical study or literature review), year (before 2010), and educational level (not higher education) (see Table 1 and Figure 1). All 131 potentially relevant articles are included in the protocol (which can be obtained from the authors upon request) and assessed for eligibility by both researchers. In cases of doubt regarding the relevance of a given article, the two researchers discussed and reached an agreement based on the inclusion and exclusion criteria. A total of 57 articles, including hand searches and articles identified in the process, were included in the final review (see Table 2).

Table 1. Inclusion and exclusion criteria

	<b>Inclusion</b>	<b>Exclusion</b>
Scope*	Digital competencies	Not about digital competencies
Target group	Educators in higher education	Not educators in higher education
Purpose	Professional development of educators initiative	Not for professional development of educators
Modality*	Blended or online format	Not blended or online format
Educational level	Higher education	Not higher education
Resource type	Peer-reviewed empirical articles and literature reviews	Non-empirical articles, handbooks, theses, editorials, books, opinion papers etc.
Year	2010 or later	Before 2010
Language	English	Other languages than English

\*Articles that either included the correct scope or modality were also included in the review.

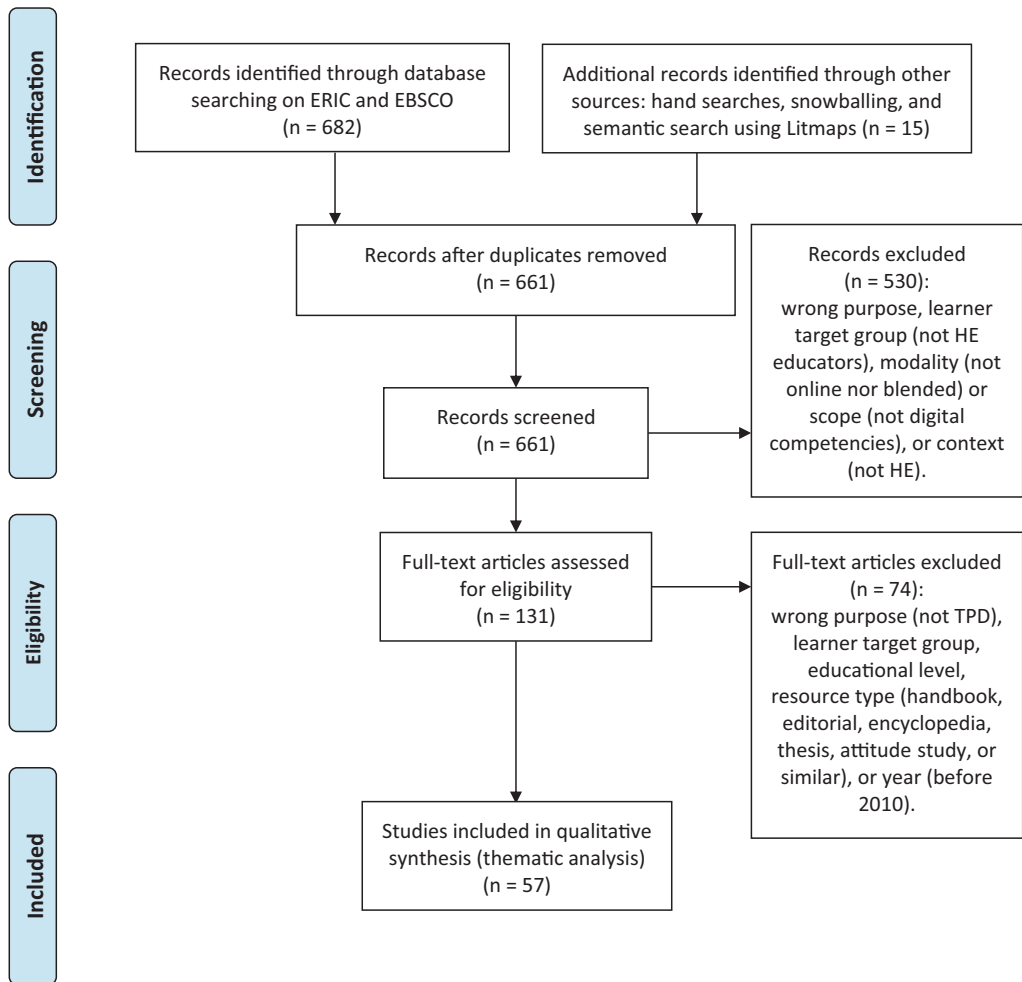


Figure 1. PRISMA flow diagram

### ***Summarising and analysing the studies***

At an early stage of the process, three overarching aspects of oTPD in HE were revealed in the literature: (1) the institutional, strategic aspect of providing oTPD; (2) the programme and module design of oTPD; and (3) the module delivery of oTPD; and that each aspect included its own set of underlying factors for effective oTPD. Thus, these three aspects were decided as the overarching themes and the 57 studies were grouped and coded accordingly (see Appendix A). Each overarching theme was iteratively described and discussed throughout the review process in order to be as precise as possible and serve as a codebook when revisiting the studies. The description of each of these themes is further unfolded in Findings. Within each overarching theme, the literature was further scrutinised for patterns of underlying factors that influence the effect of oTPD, conditions, and the context of the existing research, by using a template to code the articles according to the context, research question and methodology, and scope (i.e., online, TPD, and/or digital competencies), and a summary of the main findings related to the research question of this review was developed for each study (see Table 3, Appendix A).

Each article was then revisited in the context of the research question and overarching themes using the heterogeneity principle looking for and validating patterns of underlying factors that influence the effect of oTPD, conditions, and the context of the existing research across cases of great variation (Patton, 2015). The reasoning is that patterns occurring across two or more diverse contexts are of special interest, more valid and transferable (Patton, 2015). Each identified underlying factor was subsequently discussed and iteratively described by two researchers. Finally, the aspects and themes were discussed and the answer to the research question was drafted, reviewed, and refined.

## **Findings**

As described in the methodology, three overarching aspects of oTPD in HE were revealed at an early stage of the review: (1) the institutional, strategic aspect; (2) the programme and module design; and (3) the module delivery (Figure 2).

The institutional and strategic decisions frame the possibilities for both designing and delivering oTPD. These decisions should be regularly reviewed with regard to the experiences with the design and delivery of oTPD. Similarly, the programme and module design affect its delivery, including its flexibility and the opportunities to support participants' learning and development processes, interaction, and engagement. The design should therefore continually be developed based on the concrete experiences from the module delivery (thus the arrows point both ways).

### ***The institutional, strategic aspect***

The institutional, strategic aspect of a successful oTPD programme for HE educators was addressed in 31 articles and relates to various organisational and strategic aspects

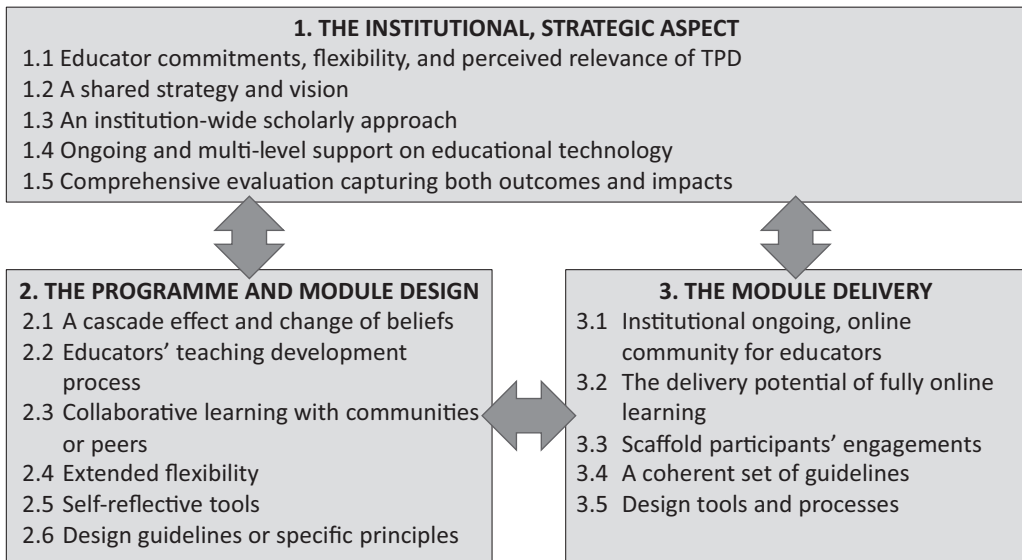


Figure 2. The three overarching aspects of oTPD and their underlying factors

and decisions, such as the role of oTPD, human resource aspects and incentives, timing, offering, evaluation, support, and staff expectations and careers. This aspect is usually handled by senior staff, such as educational leaders, heads of departments, and others responsible for educational development, budgets, quality assurance, and hiring. The analysis revealed five themes of underlying factors that influenced the effect oTPD associated with the institutional, strategic perspective described in the sections below.

*Educator commitments, flexibility, and perceived relevance of TPD (1.1)*

Addressing the specifics of providing TPD for educators in HE is crucial, as emphasised in the literature. This involves considering their available time for professional development, the perceived relevance of TPD programmes, and the complex teaching situations and syllabi (Alsofyani et al., 2012; Cook et al., 2023; Wu et al, 2016). In general, research shows that TPD is most effective with a duration of one semester or more (Desimone, 2009; Garet et al., 2001); however, often, educators have little time to participate in professional development or work on improving their teaching (Laurillard et al., 2011; Wu et al., 2016). Thus, condensed, part-time flexible programmes organised as blended or fully online learning over three to six weeks (with e.g., a one-hour commitment per day) or as multiple complementary programmes are preferred by educators (Alsofyani et al., 2012; Marin et al., 2018; Mirriahi et al., 2015; Roman et al., 2010). To cater to “hard-to-reach” educators, such as workplace supervisors and educators on short-term contracts, it may be necessary to operate with even shorter programmes, such as 5-minute online workshops (Quinn, 2010).



*A shared strategy and vision (1.2)*

Beyond earmarking funds, an organisational strategy on TPD should ideally include a pedagogical vision aligned with strategic decisions. When educators experience strong organisational support for their needs, they tend to identify more with shared goals and become more involved in the professional development process (Mohr & Shelton, 2017). This involvement extends to initiatives embedding technology-enhanced teaching with a focus on flexible, student-centred teaching and learning (Flavell et al., 2019; Levesque-Bristol et al., 2019). Establishing an institutional culture with a shared vision requires collaboration between management and educators (AlMutlaq et al., 2017; Cook et al., 2023; Mohr & Shelton, 2017). This culture should align with goals for teaching and research stated in national and institutional plans (Lillejord et al., 2018) and raise awareness of the importance of TPD for digital competencies (Dervenis et al., 2022).

*An institution-wide scholarly approach (1.3)*

Recommendations for an institution-wide scholarly approach to TPD, encompassing digital competencies and technology implementation in higher education, are prevalent in various studies (Alexiou-Ray & Bentley, 2015; Lillejord et al., 2018; Mishra et al., 2019). This approach involves TPD at all levels of the organisation: the organisers and administrators, the programme designers, and the participants (Barnard et al., 2019; Washington et al., 2020). In addition, Dysart and Weckerle (2015) propose a model of continuing professional development with three phases: designing instruction, teaching a course, and beyond teaching, where research-based methods can be applied to each phase. Additionally, Barnard et al. (2019) suggest that educators are already familiar with the digitally mediated, interdisciplinary approach from research and, thus, readily embrace the modality.

*Ongoing and multi-level support on educational technology (1.4)*

The literature emphasises that educational technology support should be available on various institutional levels, including educational developers, moderators, and participants in oTPD (AlMutlaq et al., 2017; Flavell et al., 2019; Podorova et al., 2019), and ongoing (Vaill & Testori, 2012; Washington et al., 2020)—not least in response to emergent needs caused by the COVID-19 pandemic (VanLeeuwen et al., 2020). Cook et al. (2023), Handal et al. (2013), and Washington et al. (2020) found that educators requested and/or needed more professional development, pedagogical, and technical support and that institutional support such as policy and workload considerations on technology in education is essential. In addition, Adi et al. (2022) and Vaill and Testori (2012) stress the need for ongoing pedagogical and technical support after a professional development programme stops, in addition to mentoring and pedagogical introduction to the online format. This is further illuminated by Trevisan et al. (2023), who document that some educator profiles were more positive

towards online teaching in the context of COVID-19 than others, but also that their enthusiasm declines over time without institutional support and professional development. Cutri and Mena (2020) and Dorfsman and Horenczyk (2022) highlight the importance of a nuanced understanding of educators' transition to online learning during COVID-19 that takes their academic identity, digital literacy (before COVID-19), their student-centeredness, and affective perspectives into consideration in professional development initiatives. In addition, complex tools such as learning analytics dashboards need follow-up support to educators (Rienties et al., 2018). Podorova et al. (2019) reveal an often-overlooked organisational level of educational developers. Often, there is an institutional lack of awareness about academic support and TEL educational developers, despite their diverse and complex roles as consultants, and thereby Podorova et al. (2019) identify a need for professional development of educational developers.

*Comprehensive evaluation capturing both outcomes and impacts (1.5)*

The overall decision about how to evaluate the outcomes of TPD is also typically made at the institutional level. In the literature, these issues are discussed with reference to outcomes at various levels: what teachers know, what they do in their teaching, or what their students learn (Koh et al., 2015). However, most evaluations of TPD on ICT focus only on participants' satisfaction and often overlook educators' learning outcomes, the long-term impacts on students' learning, and the impact on the organisation (Wu et al., 2016). Thus, to obtain a more comprehensive perspective on new educators' ICT professional development, Wu et al. (2016) suggest evaluating at four levels: the participants' perception of the TPD, the learning outcomes in terms of knowledge and skills taught in the programme, the effects on work performance, and productivity gains of the whole organisation. The key point is that institutional decisions when implementing TPD programmes must include decisions about various levels of evaluation. This is not to say that all projects and initiatives need to be evaluated at all the mentioned levels. However, there needs to be alignment between the aims and purposes of a specific programme and the evaluation, as well as a transparent rationale for the decisions about the evaluation.

***The programme and module design***

The programme and module design aspects were addressed in 42 articles and relate to the implementation of the module, including the development process, its pedagogical model and values, the included learning activities, content, and module structure, the use of educational technology, and the modality (i.e., fully online or blended). This perspective is usually handled by instructional designers, educators responsible for the module, or educational developers. The analysis revealed six themes of underlying factors.

*A cascade effect and change of beliefs (2.1)*

Several studies directly or indirectly refer to a cascade effect. This notion is, for example, used to describe a setup where participants are trained first and then used as co-trainers later in the programme (Edmond & Burns, 2005). In the context of oTPD, this is actualised when faculty learning communities continue with new participants (Levesque-Bristol et al., 2019), best practices are collected and shared (Cho & Rathbun, 2013; Mohr & Shelton, 2017), or participants serve as future workshop facilitators and mentors for other faculty and students (Jaipal-Jamani et al., 2015; Jaramillo-Baquerizo et al., 2021).

The notion of “a cascade model” is also used to describe the impact on participants’ teaching practice and their students’ learning. Additionally, Rienties et al. (2013b) recommend designing TPD to fit teaching practice rather than designing a training module on how to use specific technologies. In general, the educators’ beliefs are emphasised as central to such a cascade. Although one might expect that TPD leads to changes in knowledge and beliefs, followed by changes in teaching practice and student learning, in reality, there is often a potential discrepancy between the educators’ beliefs and their actual practice. Therefore, a change in beliefs will often come later when educators see the relevance and experience positive student learning outcomes of their new teaching approaches and experiments and become digital practitioners (Bennett, 2014; Ecclesfield et al., 2012; Owens, 2012; also see Guskey, 2000). In addition, relevance can also be promoted through an authentic online learning experience that demonstrates the benefits of the online modality (Mirriahi et al., 2015), rewarding design-oriented collaborations (Marín et al., 2018), providing TPD on relevant teaching aspects just in time for the educators (Roman et al., 2010), and by contextualising the TPD to the educators’ individual teaching environments and pedagogic goals (Bennett, 2014).

Mishra et al. (2019) highlight the temporal aspect and recommend that there should be time for participants to develop or adapt curricular materials and plan for the implementation of their new materials during TPD programmes. This is further unfolded by Dysart and Weckerle (2015), who describe the practice of teaching as three distinct and reflective phases: (1) designing instruction, (2) teaching a course, and (3) beyond teaching. All three phases of participants’ practice should be included in the TPD programme, for instance, as described in 2.2.

*Educators’ teaching development process (2.2)*

The articles include various examples where educators plan, design, and evaluate their own teaching as part of the TPD programme. Rienties et al. (2013a; 2013b), for example, describe how each educator was to implement the redesign of a module in his or her teaching practice. Many of the studies refer to a specific learning design model or a design methodology (Dysart & Weckerle, 2015; Jaramillo-Baquerizo et al., 2021; Koh et al., 2015; Laurillard et al., 2011; Laurillard et al., 2018; Mishra et al., 2019; Wu et al., 2016). Wu et al. (2016) adopted a learning-by-design strategy with

seven steps, covering the process from introduction to ICT and design of courses to implementation, reporting, and reflection. However, there are also examples of other project-oriented and methodological approaches. Chen et al. (2015) refer to participants' action research approach to the development and evaluation of TPD. Marín et al. (2018) refer to online learning co-design in oTPD and Laurillard et al. (2018, p. 1045) state that the “collaborative sharing of scholarship-informed, practitioner knowledge could be the key to reconfiguring teaching as a design science”. Other studies emphasise the importance of being explicit about, sharing, and negotiating the principles for effective online learning used to inform the design of TPD with all educators, and in that way ensure perceived relevance (Jeffrey et al., 2011; Mirriahi et al., 2015; You, 2011) (see also item 2.6). Providing educators with the flexibility to address their particular needs increases the likelihood that they will integrate technology into their teaching (Sullivan et al., 2018).

### *Collaborative learning with communities or peers (2.3)*

Collaborative learning is frequently recommended in the literature (Dalby & Noyes, 2022; Desimone, 2009; Garet et al., 2001) in the form of communities or peer learning. Various kinds of communities are mentioned, such as communities of practice, communities of inquiry, personal learning networks (Schalk et al., 2022), communities of learning, and (online) teacher-designer communities (Laurillard et al., 2018). According to Mirriahi et al. (2015), the threefold strategy they applied provided educators with an opportunity to interact, mentor, and share knowledge. The model from Seufert et al. (2018) includes an online professional learning community consisting of a communication platform, a webinar series, and blended learning courses, and Sullivan et al. (2018) state that there is evidence that learning communities can be utilised to promote a particular behavioural change among faculty that at first seems difficult to achieve. Jaipal-Jamani et al. (2015) refer to a collaborative learning and research community of faculty members around TEL, and Marín et al. (2018) include inter-university teams for online codesign.

Concerning ongoing online communities, Gray and Smyth (2012) conclude that the online community they provided proved to be effective in supporting small groups dedicated to specific purposes and activities, but also highlight the problem of being engaged in “multiple online spaces” at the same time. For an online community to be meaningful beyond the TPD programme, it is essential to achieve a “critical mass” of frequent users (Gray & Smyth, 2012). Mitchell et al. (2019) emphasise that an online community (with blogging) can support the use of technology and reflection on this. They highlight that blogging served as a conduit for meaningful technology use and that participants demonstrated shifts in purposes of the use of digital tools as well as higher self-efficacy during the process. Besides the academic outcome, Jaramillo-Baquerizo et al. (2021) highlight the importance of “relatedness”—described as “experiencing a sense of connection or warm relationships” (p. 316)—as key to successful TPD.

Several studies refer to programmes using peer learning or peer coaching. Barnard et al. (2019) apply a threefold peer learning model with a participatory approach to collaborative learning, including peer-to-peer skills exchange. Rienties et al. (2013a; 2013b) describe how educators discussed their teaching and learning challenges with peers from different institutions. Thomas and Thorpe (2019) stress that peer facilitation may be used best to encourage participation, whereas Schalk et al. (2022) conclude that personal learning networks were crucial in the context of COVID-19 and future practices.

#### *Extended flexibility (2.4)*

Ongoing support after the end of the programme is emphasised under the institutional aspect above and is also an issue for designing oTPD (Adi et al., 2022). Roman et al. (2010) concluded that an online training programme should emphasise both technological and pedagogical skill development, evaluate participants' training needs before the training, and provide ongoing resources and support mechanisms after the training. Likewise, several studies recommend providing flexibility in terms of pace, content, time, and place, including access to the material after the programme has been completed (Mackey & Evans, 2011; Wynants & Dennis, 2018). Testers et al. (2019) state that if design interventions are a part of the programme, this should be considered a longitudinal process that takes time to allow for transfer. The results from their research confirm that transfer is a longitudinal process in which various aspects may influence learners' intention to transfer new learning, not only after but also before the actual intervention. From a lifelong learning perspective, educational developers need to pay attention to the participants' contexts, be it study, work or private life, that might be relevant to the transfer process (Testers et al., 2019). Another aspect of the extended flexibility is the actual content. Alexiou-Ray and Bentley (2015) suggest that advanced participants with high information literacy could benefit from an inquiry-based learning design supported by WebQuest in which they are given the freedom to identify and decide some of their own learning resources and argue for their relevance and quality. Less advanced educators may benefit from training in basic digital literacy and competencies as well as an introduction to the concept of student-centred learning (Dorfsman & Horenczyk, 2022). The inquiry ideas, as well as the associated flexibility and skills, are in line with Ungerer (2016), who makes a strong case for the importance of incorporating digital curation competencies into oTPD.

#### *Self-reflective tools (2.5)*

As described in the introduction, the TPACK model is one way of conceptualising educators' professional digital competencies and may be used as a reflective tool for participants during TPD. Kennedy (2015), Foulger et al. (2012), and Tømte et al. (2015) explored how participants can interrogate, reflect, practice, and evaluate their (online) teaching practices using the TPACK model. In Kennedy's study, this

involved identifying and reflecting upon instances in which their professional digital competencies were evident in their design and facilitation of an undergraduate online course. The studies suggest that educators' confidence and TPACK scores increased and that online teaching can be improved based on increased metacognitive awareness (Foulger et al., 2012; Kennedy, 2015). Koh (2019) describes how TPACK can scaffold educators' conceptions of pedagogical change using lesson design heuristics, TPACK activity types, a learning rubric with five scales: the time students use ICT to work with content; ICT support for higher order thinking; ICT tools to present authentic problems; ICT tools for self-reflection and assessment; and ICT support for the social construction of knowledge. Chen et al. (2015) examined what teachers knew (using TPACK), what they did, and their comfort level with working with design, emphasising that this created an opportunity to analyse teachers' perceptions of the how and what of their ICT knowledge development more comprehensively. In the literature review by Matthews (2021), digital literacy competency frameworks are identified as effective self-evaluation tools for improving educators' and subsequently the students' digital literacy in the context of healthcare education.

*Design guidelines or specific principles (2.6)*

This theme concerns how specific sets of guidelines or pedagogical principles can be applied when designing oTPD. Some of the included studies refer to sets of principles for effective oTPD. There are studies where guidelines are presented as the basis for a specific design (Jacobs, 2013), as well as cases where results are condensed into a set of guidelines (Marin et al., 2018). Moreover, there are examples of guidelines for designing oTPD (Cho & Rathbun, 2013; Mohr & Shelton, 2017) and guidelines for oTPD aimed at training participants to design online learning for students (You, 2011). Hence, guidelines are used in many ways, and they can, according to the literature, be useful in the design process to discuss and qualify the features and pedagogical principles of the oTPD. If principles are not made explicit during the design process, tacit "guidelines" will guide the design anyway. Therefore, negotiating guidelines and principles can be a process of making the tacit assumptions explicit and thereby qualifying the decisions in the design phase. Guidelines can also be shared (and negotiated) with participants in the oTPD programme.

In the literature, pedagogical guidelines are presented with various degrees of specificity and various focuses. For instance, Jeffrey et al. (2011) refer to three educational principles from Dewey argued to have particular relevance in online learning: (1) learning through experience, (2) activities of personal relevance, and (3) collaborative learning. Rienties et al. (2013a), however, identify three principles for designing oTPD with a more institutional perspective, such as that programmes should acknowledge that changing teaching practice takes time, be designed to reflect that learning is a social construct, and fit the teaching practice of teachers instead of introduce specific technologies. Furthermore, there is a range of programme delivery guidelines that will be further elaborated on in item 3.4.

### ***The module delivery***

Module delivery relates to the actual teaching and delivery of the module and was addressed in 16 articles. Module delivery includes communication on the module, moderation of learning activities, feedback on participant activity, handling participation, and provision of teaching and learning support. The module educators usually handle this perspective; however, for self-study and highly scripted modules with predefined activities and feedback, this aspect may be addressed in the module design process. This brings attention to the facilitation of delivery and the participants' learning process, including the educator's role, the participants' engagement, the pace of activities, the interaction and communication, and the use of technology.

#### *Institutional ongoing, online community for educators (3.1)*

As described in item 2.3, online communities hold important educational and effectiveness potential if critical mass can be achieved (Dalby & Noyes, 2022; Gray & Smyth, 2012). Based on the ideas of communities of practice (Lave & Wenger, 1991), an online professional development and social networking community was introduced at Edinburgh Napier University and integrated into their blended and online education programme for educators; it was also available to educators more generally. The study shows that the community had the potential to support both the ongoing processes of educational development in terms of supporting the sharing of educational knowledge and resources, the educators' sense of belonging to the educator community and "keeping abreast" of the teaching and learning initiatives at the institution as well as their continuous self-governed, informal professional development. The study suggests that the key to making an online professional development and social networking community is to achieve critical mass, provide easy access and sign-up, and allow users to create their own groups across modules (Gray & Smyth, 2012). A similar, cross-institutional professional development programme in the Netherlands to support the participants in sharing and learning from peers continuously and flexibly through recurring, online video conferences and discussions, further stresses the importance of a peer community (Rienties et al., 2013a; 2013b). The study shows that peer communities are also useful for fine-tuning specific learning designs and finding practical solutions as well as encouraging other educators to reflect on their teaching and learning. The study also stresses the importance of utilising the partner institutions' expertise when designing a cross-institutional programme but, at the same time, building mutual ownership of the programme by not using institutional platforms.

#### *The delivery potential of fully online learning (3.2)*

In the context of a short, blended professional development programme, Alsofyani et al. (2012) identified a relationship between the affordances of online learning and the participants' satisfaction and preferences. In particular, the flexibility of online technical support and the use of international experts as distance educators played a significant role in the participants' positive evaluation and their technology

acceptance. The study suggests that this delivery flexibility potential of online learning may help increase quality and satisfaction and lower costs. Additionally, Rienties et al. (2013b) and Quinn (2010) identify the time and pace flexibility provided by fully online learning as contributing to the success of oTPDs. With reference to Lawless and Pellegrino (2007), Rienties et al.'s (2013) rationale is that it takes time to change teaching practice and that this can be supported by a flexible, online delivery format that conveniently fits the busy schedule and autonomy of the participants.

### *Scaffold participants' engagements (3.3)*

Based on a literature review, Alexiou-Ray and Bentley (2015), as well as Kennedy (2015), identify the e-moderator role (as described by Salmon, 2012) as a critical component of the "online classroom." To ensure students' learning, the engagement between educators, participants, and learning resources needs to be scaffolded (Alexiou-Ray & Bentley, 2015; Jaramillo-Baquerizo, 2021).

### *A coherent set of guidelines (3.4)*

As described in item 2.6, it may be both effective and practical to adopt a set of pre-defined pedagogical guidelines for the design and delivery of oTPDs, and they may serve as a way of making tacit ideas explicit to co-educators and participants in the programme. Various sets of guidelines were identified, including Cho and Rathbun's (2013) "Lessons learned for successful oTPD implementation in higher education;" Thomas and Thorpe's (2019) six tips regarding the educator role in oTPD; Mirriahi et al.'s (2015) five design principles for redesigning face-to-face delivery to blended and online teaching; Mohr and Shelton's (2017) guidelines for online faculty support on roles, design, learning processes, and legal issues; Marín et al.'s (2018) six identified aspects for effective collaboration; and You's (2011) best practice themes of distance learning course design and delivery in general.

The guidelines may not be relevant in all contexts and may need to be adjusted. Nevertheless, some recurring guidelines across the sets mentioned above can be identified for the delivery (and design) of oTPD: (1) communication should be clear and explicit as well as support an understanding and awareness of online presence; (2) participants must have clear roles and responsibilities distributed; (3) the educator should act as a guide, ensure e-moderation and scaffolding of learning activities, and provide process facilitation; (4) a reasonable workload must be provided together with clear objectives and expectations about participation and time commitment; (5) tools for group facilitation and peer learning should be supported (if applicable); (6) authenticity, i.e., that participants obtain first-hand experience of online learning; and (7) transparency about the underlying pedagogical rationale.

### *Design tools and processes (3.5)*

Learning design may serve as a methodology embedded in both the oTPD design (see the section above) and its delivery aspects. In the context of oTPD delivery,



Marín et al. (2018) document how scenario-based learning design processes are useful to support participants in online, cross-institutional collaboration on the codesign and integration of technology in education. To support the participants’ learning and design process, a novel online community platform (“Integrated Learning Design Environment”) was introduced in which learning designs could be described, shared, and discussed. The study identified that collaboration was particularly effective when communication was explicit, roles and responsibilities were clear, and feedback and ideas about learning resources and solutions to problems were provided. A similar approach and finding are documented in Laurillard et al. (2011, 2018). Laurillard documents how the “Learning Designer” platform together with its underlying conversational framework (Laurillard, 2013) serves as a useful tool for building an online knowledge community of educators and letting them reflect on their pedagogy. The idea was to invite the educators to represent and provide feedback on their teaching ideas according to the conversational framework—and thus also to make the educators articulate and share their extensive knowledge and experiences in a suitable format with peers. However, as stressed by Jaramillo-Baquerizo et al. (2021) some design processes may challenge the flexibility of the programme and the educators’ academic freedom.

## Discussion

### *Implications for practice: How to design effective oTPD for digital competencies in higher education*

The analysis identified a total of sixteen underlying factors that influence the effect of oTPD, of which five were related to institutional, strategic aspects, six were related to the design of the programme, and the last five were related to the delivery of the programme (phrased as imperative mood recommendations in Table 2). Under similar conditions, these factors potentially influence the effect of oTPD.

Table 2. Factors that influence the effect of oTPD phrased as recommendations

Item	Institutional, strategic factors	Supporting literature
1.1	Explicitly address educator commitments, flexibility, and perceived relevance of TPD	Alsofyani et al., 2012; Cook et al., 2023; Desimone, 2009; Garet et al., 2001; Marín et al., 2018; Mirriahi et al., 2015; Quinn, 2010; Roman et al., 2010; Wu et al., 2016;
1.2	Establish a shared strategy and vision (aligned with national and institutional strategies)	Cook et al., 2023; Dervenis et al., 2022; Flavell et al., 2019; Levesque-Bristol et al., 2019; Lillejord et al., 2018; Mohr & Shelton, 2017;
1.3	Enable an institution-wide scholarly approach	AlMutlaq et al., 2017; Alexiou-Ray & Bentley, 2015; Barnard et al., 2019; Dysart & Weckerle, 2015; Lillejord et al., 2018; Mishra, 2019; Washington et al., 2020.

(Continued)

Table 2. (Continued)

<b>Item</b>	<b>Institutional, strategic factors</b>	<b>Supporting literature</b>
1.4	Provide ongoing and multi-level support on educational technology	Adi et al., 2022; AlMutlaq et al., 2017; Cook et al., 2023; Cutri & Mena, 2020; Dorfsman & Horenczyk, 2022; Flavell et al., 2019; Handal et al., 2013; Podorova et al., 2019; Rienties et al., 2018; Trevisan et al., 2023; Vaill & Testori, 2012; VanLeeuwen et al., 2020; Washington et al., 2020.
1.5	Ensure comprehensive evaluation capturing both outcomes and impacts (together with a transparent rationale)	Koh et al., 2015; Wu et al., 2016.
<b>Item</b>	<b>Programme and module design factors</b>	<b>Supporting literature</b>
2.1	Design for a cascade effect and change of beliefs	Bennett, 2014; Cho & Rathbun, 2013; Edmond & Burns, 2005; Jaipal-Jamani et al., 2015; Jaramillo-Baquerizo et al., 2021; Levesque-Bristol et al., 2019; Mishra et al., 2019; Mohr & Shelton, 2017; Owens, 2012; Rienties et al., 2013b
2.2	Support educators' individual teaching development process	Chen et al., 2015; Dysart & Weckerle, 2015; Jaramillo-Baquerizo et al., 2021; Jeffrey et al., 2011; Koh et al., 2015; Laurillard et al., 2011; 2018; Marin et al., 2018; Mirriahi et al., 2015; Mishra et al., 2019; Rienties et al., 2013a, 2013b; Sullivan et al, 2018; Wu et al., 2016; You, 2011
2.3	Support collaborative learning with communities or peer learning	Barnard et al., 2019; Dalby & Noyes, 2022; Desimone, 2009; Garet et al., 2001; Gray & Smyth, 2012; Jaipal-Jamani et al., 2015; Jaramillo-Baquerizo et al., 2021; Laurillard et al., 2018; Marin et al., 2018; Mirriahi et al., 2015; Mitchell et al., 2019; Rienties et al., 2013a, 2013b; Schalk et al., 2022; Seufert et al., 2018; Sullivan et al., 2018; Thomas & Thorpe; 2019
2.4	Provide extended flexibility (with ongoing support)	Adi et al., 2022; Alexiou-Ray & Bentley, 2015; Dorfsman & Horenczyk, 2022; Mackey & Evans, 2011; Roman et al., 2010; Testers et al., 2019; Ungerer, 2016; Wynants & Dennis, 2018
<b>Item</b>	<b>Programme and module design factors</b>	<b>Supporting literature</b>
2.5	Use self-reflective tools	Chen et al., 2015; Foulger et al., 2012; Kennedy, 2015; Koh, 2019; Matthews, 2021; Tømte et al., 2015
2.6	Utilise design guidelines or specific principles	Cho & Rathbun, 2013; Jacobs, 2013; Marin et al., 2018; Mohr & Rienties et al., 2013a; Shelton, 2017; You, 2011
<b>Item</b>	<b>Module delivery factors</b>	<b>Supporting literature</b>
3.1	Establish an institutional ongoing, online community (exclusively) for educators	Dalby & Noyes, 2022; Gray & Smyth, 2012; Rienties et al., 2013a, 2013b
3.2	Benefit from the delivery/flexibility potential of fully online learning	Alsofyani et al., 2012; Lawless & Pellegrino, 2007; Quinn, 2010; Rienties et al., 2013

<b>Item</b>	<b>Institutional, strategic factors</b>	<b>Supporting literature</b>
3.3	Scaffold participants' engagements (using e-moderating techniques)	Alexiou-Ray & Bentley, 2015; Jaramillo-Baquerizo et al., 2021; Kennedy, 2015
3.4	Adopt a coherent set of guidelines to inform the design and delivery of the programme.	Cho & Rathbun, 2013; Marín et al., 2018; Mirriahi et al., 2015; Mohr & Shelton, 2017. Thomas & Thorpe, 2019; You, 2011.
3.5	Adopt design tools and processes for developing, representing, and sharing learning designs	Jaramillo-Baquerizo et al., 2021; Laurillard, 2013; Laurillard et al., 2011; 2018; Marín et al., 2018

However, this also draws attention to the conditions and contexts of the identified factors as well as any implicit, underlying factor not documented in the studies. On the one hand, the included literature represents a large variety of contexts and conditions, and each identified factor is supported by at least three studies from various institutional contexts. This serves as validation as well as—to some extent—a generalisation of the factors according to the heterogeneity principle (Patton, 2015). On the other hand, a closer look at the identified factors reveals some recurring, implicit themes or conditions that should be taken into account, which are not always addressed in the literature. These include (1) the institutional context and provided technical solutions and (2) the general pedagogical and teaching approach and syllabus. The institutional and technical context relates to the culture and the general view on and prioritisation of educational development, how this is supported in the institution by the management, visions, strategies, IT systems, and incentives, the educators' academic freedom, and educational development practice and evaluation methodologies. The general pedagogical approach relates to the view on teaching and learning, the typical delivery format, and pedagogical values within the institution or subject area. As for the academic freedom of educators in HE and how this aligns with promoting professional development within an institution, this may have a decisive role. This aspect is reflected in the many identified factors that seek to convince or accommodate the participation of educators, such as providing educational visions, rationale, participant flexibility, and extensive support. Educators are often free to decide on how to teach their courses, and one may argue that professional development initiatives, pedagogical principles, involvement in communities, and incentive structures are potential violations of this freedom. This is an important implication, as promoting the identified factors for oTPD may not be well-received or effective in all contexts. On the other hand, the included articles from before 2020 (i.e., prior to COVID-19) mostly addressed the design aspect (35 of 45 articles), whereas the articles from 2020 and onwards to a larger degree addressed the institutional perspective of oTPD (7 of 11 articles). This may suggest that researchers and authors have become more aware of the institutional perspective of oTPD for digital competencies due to COVID-19, as well as how the institution must engage in the educators' perspective. For instance, Dervenis et al. (2022) pinpoint that digital

competencies were considered “secondary” prior to COVID-19, and both Trevisan et al. (2023), Cutri and Mena (2020), Dorfsman and Horenczyk (2022), and Jaramillo-Baquerizo et al. (2021) stress the importance of supporting the educators’ affective perspectives. Both academic freedom, strategic priority, and affective support highlight the importance of addressing the institutional and political perspectives on professional and educational development. In practice, this means that the factors that influence the effect of oTPD may differ in relevance and meaning between subject areas and that it may be relevant to further concretise or supplement the list with discipline-specific factors. In addition, only a limited number of studies have addressed the delivery aspect of oTPD. To qualify this aspect, it may be relevant to look into the literature on online teaching and learning more generally.

Thus, to design effective oTPD of digital competencies, it is recommended to first and foremost consider the conditions and context of the oTPD—that is, the characteristics of the institutional context and provided technical solutions, as well as the general pedagogical and teaching approach and syllabus. With these conditions in mind, the identified factors may serve as a starting point for the development of the design or, vice versa, serve as a checklist for existing designs or the development of a design based on other educational development processes and methodologies. Used as a design guide, the identified themes of factors may serve as a to-do list describing the various institutional, design, and delivery perspectives that need to be addressed. Used as a checklist, the factors and recommendations (Table 2) may be used later in the development process or for the assessment of an existing oTPD practice. For instance, the recommendations can be used to refine existing oTPD practices and pedagogical ideas as well as identify potential weaknesses.

### ***Limitations and implications for research on effective oTPD***

The methodological implications relate to the concept of oTPD and its designation as well as the common research methodologies. The search revealed that TPD has different designations depending on geography and that the terms “teacher,” “educational technology,” and “online” are ambiguous. These ambiguities present a challenge for research on oTPD, as important results are easily overlooked or misinterpreted. Thus, a common and more unambiguous conceptualisation of “(online) teacher professional development (in higher education)” as well as of “digital, subject-specific competencies” would help researchers build on the work of others. This is further complicated by the fact that the concept may have different designations in languages other than English and that this review only includes articles in English.

Similarly, digital competencies may consist of competencies related to specific technologies and thus be referred to as such. Another methodological limitation relates to the research methodologies and their reliability. The available, empirical research is dominated by isolated case studies. Although case studies may provide valuable insights into professional development initiatives, their transferability is limited. In addition, isolated case studies are difficult to compare due to diverse contexts, methodologies,

and focus, and thus also a complex basis for a systematic literature review. This raises concerns about the reliability of these findings and calls for more research based on methodologies that provide more robust and comparable data and results.

Finally, the review builds on peer-reviewed articles that address subsets of the posed research question, as none of the identified literature—with the exception of, to some extent, Tømte et al. (2015)—addressed its scope. This involves a transfer of results that can be deficient. In addition, it assumes that knowledge about oTPD is published in peer-reviewed journals (but may, for instance, be shared in theses, book chapters, and reports instead).

## **Conclusions**

Based on the systematic literature review, a range of institutional, design, and delivery factors that potentially influence the effect of oTPD for digital (subject-specific) competencies for HE educators have been identified. The findings are discussed based on five themes related to institutional aspects, six related to programme and module design, and five related to module delivery. The institutional aspect includes ensuring personal and professional relevance, establishing a shared vision, enabling an institution-wide scholarly approach, providing ongoing support, and aligning evaluation to levels of intended outcomes. The module design aspect includes considering a cascade model, applying a project-oriented approach, supporting collaborative learning, providing extended flexibility, using self-reflective tools, and referring to a set of pedagogical guidelines. The module delivery aspect includes establishing an online community, benefitting from the potential of fully online learning, scaffolding participants' engagements, adopting a coherent set of guidelines, and including learning design tools and processes for developing and sharing learning designs. The discussion elaborates on the importance of considering these aspects and factors in a concrete context and emphasises methodological and political implications for research.

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## **Author biographies**

**Mikkel Godsk** is an educational developer and part-time researcher at the Centre for Educational Development, Aarhus University, Denmark. Mikkel has worked with professional development and digital higher education for two decades as an

educational developer, technologist, leader, lecturer, and researcher. In addition, Mikkel is co-founder and editor of the Danish academic journal Learning and Media. Mikkel holds an EdD in Educational Technology and Learning Design and a MSc in IT and Multimedia Science.

**Birgitte Lund Nielsen** is a research leader and senior associate professor at VIA University College, Denmark. Her research focuses on teaching and learning in higher education and professional development for teachers. Birgitte holds a PhD in Educational Research, a MSc in Geoscience, and a MA in Science Education.

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## **Appendix A: Searches and included studies**

The identification of articles was carried out in two rounds of the following three searches and two later follow-up searches. The (1) oTPD in HE on ERIC (peer-reviewed), search string: (“online professional learning” or “online professional continuing education” or “online faculty professional development” or “online teacher professional development” or “online teacher training” or “online professional education” or “academic development”) and (“higher education” or “university” or “college”); (2) TPD on digital competencies (also including TPACK) in HE on EBSCO, search string: (“professional development” or “professional learning” or “continuing education” or “academic development”) AND (“tpack” or “technological pedagogical content knowledge” or “digital literacy”) AND (“university” or “college” or “higher education”); (3) TPD on technology integration (blended/online) in HE, search string: (“professional development” or “professional learning” or “continuing education” or “academic development”) AND (“online” or “blended”) AND (“higher education staff” or “professors”) AND “technology integration”. In both the ERIC and EBSCO searches, the searches were conducted in titles, author names, sources, abstracts, and descriptors.

A follow-up search for peer-reviewed articles published from 2020 to June 2023 was carried out on ERIC using the search string: (“online professional learning” or “online professional continuing education” or “online faculty professional development” or “online teacher professional development” or “online teacher training” or “online professional education”) AND (“higher education” or “university” or “college”) AND (“digital competences” OR “digital competencies” OR “TPACK”). In contrast to the previous searches, the aspect of technology integration (i.e., blended/online) was not specified in the search string to obtain more results of potential relevance. This search returned 117 articles, of which eleven were included in the review. The rest of the articles were primarily excluded due to wrong focus, e.g., development of student competencies (not educators) or other aspects of students’ learning, wrong educational level, e.g., primary school teachers, or no focus on digital competencies and/or the online format.

Finally, a semantic search was carried out December 2023 using the AI-powered tool Litmaps using six key articles identified in the first round of searches as “seeds” (i.e., Alexiou-Ray & Bentley, 2015; Cho & Rathbun, 2013; Dysart & Weckerle, 2015; Jaramillo-Baquerizo et al., 2021; Seufert et al., 2018; Tømte et al., 2015). After duplicates were removed, seven potentially relevant records remained. However, none of these records ended up being included, as two were too old, two were of wrong resource type (thesis and book chapter), two were non-English, and one had the wrong scope and target group (not educators in higher education or digital competencies).

A list of the articles included is provided in Table 3, including details on their scope, research context, methodology, oTPD aspects in focus, and the main findings.

Table 3. Overview of the 57 included articles

Reference	Research context (country)	Methodology	Main findings	(Online) TPD aspect(s) in focus		
Adi et al. (2022)	Teacher participants of the Digital Educator Series (Malaysia)	Surveys and interviews	The article discusses the preliminary findings of the Digital Educator Series conducted by Swinburne University of Technology Sarawak, aimed at equipping teachers with effective online teaching skills. The findings indicate mixed familiarity with online teaching, positive perceptions of the courses, and a need for pedagogical and technological support. The study emphasises the importance of continuous professional development and infrastructure improvement to ensure equitable access to online education in Sarawak.	x	x	x
Alexiou-Ray & Bentley (2015)	Postsecondary faculty development on online teaching (USA)	Literature review	Critical elements of an effective online classroom include well-designed organisation, ease of navigation, multiple entry points, and appropriate embedded elements. Best practices involve faculty as facilitators, active engagement, clear communication, and reciprocal interactions. Building learning modules focus on content organisation and creating a sense of community. Faculty development courses utilise these elements and allow instructors to experience online learning firsthand.	x	x	x

Reference	Research context (country)	Methodology	Main findings	(Online) TPD aspect(s) in focus
AlMutlaq, A. et al. (2017).	Academics' views and encouraging factors to engage in TEL Continuing Professional Development (Saudi Arabia)	Qualitative with interviews	Academics adopt TEL, professional development based on their experiences and views. Motivations include interest, staying up-to-date, career advancement, and improving education. Personal goals and voluntary involvement play a role. Obstacles include time, workload, programme quality, and resource availability. Policy decisions and management support affect involvement. A positive organisational culture is needed for effective TEL development.	x
Alsofyani et al. (2012)	Short Blended Online Training (N/A)	Technology Acceptance Model (TAM) survey	The collected quantitative data using the TAM questionnaire reveals a high acceptance of SBOT. Faculty members greatly accepted SBOT for TPACK development, with the highest ratings for training usefulness (4.3), ease of use (4.3), and behavioural intention to join SBOT in the future (4.7). The importance of organisational support for joining SBOT was highlighted. Participants displayed high technical knowledge, rating computer experience at 4.0 and lacking computer self-efficacy at 1.1. Online faculty training, including the involvement of international experts, is supported based on arguments and references such as Wolf (2006).	x
Barnard et al. (2019)	Digital skills training programme for early career researchers (UK)	Reflections on participatory training programme	This article introduces a threefold peer learning model used in a digital skills training programme for early career researchers. The programme facilitated the development of organisers, content designers, and workshop participants. The participatory approach responded to the changing needs of interdisciplinary researchers and can be applied to other fields and learning contexts.	x
Bennett (2014)	Study of lecturers in HE making use of learning technologies (UK)	Qualitative: phenomenological study with interviews	The study found that lecturers were motivated by their pedagogical goals rather than a desire to become digital practitioners. The development of a new model called "The Digital Practitioner Framework" highlighted the importance of starting with good practice experiences. Lecturers' adoption of technology-enhanced learning (TEL) practices was primarily driven by a commitment to improving student learning. Although not initially interested in the technology itself, they recognised the need to invest time to understand and assess its potential. Successful experimentation with TEL practices led to increased confidence and a growing identity as a digital practitioner.	x

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Table 3. (Continued)

Reference	Research context (country)	Methodology	Main findings	(Online) TPD aspect(s) in focus
Chen et al. (2015)	In-service teachers' professional development (Taiwan)	Qualitative coding based on TPACK	The study explored the integration of a wiki-based model in a graduate-level course to enhance the Technological Pedagogical Content Knowledge (TPACK) of science teachers. The findings showed that the use of wiki facilitated collaborative learning, leading to improved design of teaching content and the generation of creative instructional strategies when it was supported by an action research methodology. The study highlighted the significance of wiki and collaborative learning in the professional development of in-service teachers' TPACK.	x
Cho & Rathbun (2013)	Implementation of teacher-centred oTPD programmes in HE (USA)	Case study, mixed methods	Lessons learned from designing teacher-centred online teacher professional development (oTPD) programmes include the importance of clear communication about activities and expectations, using staff members as facilitators for timely assistance, the significant role of the facilitator in engaging participants and providing feedback, considering the timing of workshops to accommodate participants' workload, recognising the differences between online and face-to-face TPD, and balancing programme goals with faculty workload. The study aimed to create effective teacher-centred oTPD programmes that allow active participation and immediate application of knowledge.	x
Cook et al. (2023)	University teachers in emergency remote teaching (ERT)	Literature review	This study aimed to understand university teachers' digital competence during the COVID-19 pandemic and how it aligns with existing digital competency frameworks. The findings indicated variations in alignment between normative statements of digital competence and university frameworks. The study emphasised the importance of contextual and iterative development of teachers' digital competence, including technical, pedagogical, and discipline-specific aspects. It suggested revising frameworks to explicitly address digital possibilities, assess time requirements, and prioritise teacher well-being. Future research can further explore and refine digital competence in university settings.	x

Cutri & Mena (2020)	COVID-19 pandemic	Literature review	<p>The literature review examines faculty readiness to teach online from the perspective of professional vulnerability. The study identifies affective dimensions and identity disruption as key themes associated with faculty readiness. Structural and cultural forces that influence faculty's experiences in online teaching are also explored, including financial concerns and clashes between traditional academia and emotional responses. The review emphasises the need for a nuanced understanding of faculty's experiences in transitioning to online teaching. Future research should develop an instrument to measure affective and identity disruption variables, which can inform faculty development efforts without evaluating or shaming faculty members.</p>	x	
Dalby & Noyes (2022)	FE colleges in England	Case study based on interviews	<p>This study focuses on improving the professional learning of mathematics teachers in Further Education (FE) colleges. It emphasises the need for cost-effective models of professional development to enhance classroom practice and student outcomes. The study highlights the importance of building communities of practice among mathematics teachers within colleges but acknowledges the challenges posed by organisational structures and power struggles. The creation of cross-structural communities and a shared vision of best practices are recommended. Clear sector guidance on professional standards and a better understanding of best practices are needed to establish effective communities of practice.</p>	x	x
Dervenis et al. (2022)	Teaching staff roles and competencies in higher education	Literature review	<p>In this literature review, 39 documents were analysed to identify teacher competencies in higher education. The study revealed a multidimensional approach with six main dimensions: "Personality," "Professionalism," "Educational," "Scientificity," "Communication," and "Digitality." While certain competencies received significant attention, others were overlooked, suggesting that some competencies are not considered essential. The research emphasised the importance of digital competence, which was previously undervalued but became crucial during the COVID-19 pandemic. The study aims to raise awareness about the significance of these competencies and calls for ongoing scientific research to redefine teacher competencies to adapt to future challenges.</p>	x	

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Table 3. (Continued)

Reference	Research context (country)	Methodology	Main findings	(Online) TPD aspect(s) in focus
Dorfsman & Horenczyk (2022)	COVID-19 pandemic, Israel	Mixed methods	The major contribution of this article is the development of a typology based on a conceptual model that allows for the identification of three teacher profiles that emerged during the CRTS: “Experienced” teachers, “Enthusiastic” teachers, and “Cautious” teachers. The study found that the main variable affecting a teacher’s fit into one of these profiles is the level of digital literacy before the crisis.	x x
Dysart & Weckerle (2015)	Continuing professional development on integration of technology with support for developing TPACK. (N/A)	Theoretical, based on the literature	Many professional development (PD) programmes in higher education (HE) focus on teaching faculty-specific technology applications, rather than integrating technology into their discipline. TPACK has potential in HE PD, and practice-based approaches can enhance faculty’s comfort and self-efficacy. By linking PD to the three phases of instructional design, teaching, and follow-up, and incorporating research on learning by design, peer-coaching, and communities of practice, institutions can enable sustained integration of technology through peer-coaching and foster greater faculty buy-in.	x
Flavell et al. (2019)	Attitudes and experiences relating to technology use in teaching and learning in a multidisciplinary approach to academic development (Australia)	Quasi-experimental, exploratory case study with TAM surveys and interviews	The study found that the agile teaching approach to professional development had a positive impact on academic attitudes and confidence in educational technologies. Participants reported increased confidence, perceived ease of use, and cognitive, emotional, and practical changes. However, individual and organisational factors, such as workload and supportive culture, need to be considered for successful technology integration.	x
Foulger et al. (2012)	Ed Tech Course in Preservice Teacher Education (USA)	Mixed methods	Arizona State University reformed its Teacher Education (TE) programme by removing standalone educational technology courses and integrating technology into methods courses. They conducted a benchmarking study on the standalone course, finding increased confidence and TPACK scores among candidates. The study’s findings will guide the development of new technology-infused courses transitioning to technology-infused instructional approaches.	x



Gray & Smyth (2012)	Implementation of social networking site to support professional development activity in HE (UK)	Mixed methods	The ENEE platform effectively helps users stay updated on educational practices and supports specific groups. However, challenges include ease of use, managing multiple spaces, and achieving meaningful engagement. Participants value connecting with others but struggle with multiple online spaces and learning to use rich environments like ELGG.	x	x
Handal et al. (2013)	Factors impacting the adoption of mobile learning in a tertiary learning environment (Australia)	Mixed methods with survey	This qualitative study examined the factors affecting the adoption of mobile learning in a higher education institution. Academics shared their views on various educational issues impacting the effectiveness of the innovation. Teachers requested more professional development in integrating technology and resolving key issues such as workload and equitable access. Technical issues like connectivity, support, and device limitations were highlighted. The study identified alternative perceptions and misconceptions regarding effective mobile learning pedagogies and provided recommendations to align these with best practices.	x	
Jacobs (2013)	Continuing education and re-education, including adapting teachers to online teaching (USA)	Theoretical	The article presents a set of guidelines described as 'components' or 'steps' for successful online programmes.		x
Jaipal-Jamani et al. (2015)	Professional development for teacher educators based on TPACK (Canada)	Mixed methods	The study focuses on a professional development initiative for teacher educators. It aimed to enhance faculty knowledge of technology-enhanced teaching, foster a collaborative learning and research community, and enable faculty to become workshop facilitators and mentors. Findings suggest that the initiative was effective due to its alignment with faculty needs, TPACK-based workshop model, and incorporation of research collaboration for self-reflection on teaching practices.		x

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Table 3. (Continued)

Reference	Research context (country)	Methodology	Main findings	(Online) TPD aspect(s) in focus
Jaramillo-Baquerizo et al. (2021)	Ecuadorian university authorities	Interview of university authorities	This study examined the design features of professional development programmes in higher education and their impact on teachers' motivation. Based on the Self-Determination Theory, the study found that while there was attention given to autonomy and competence needs, little consideration was given to the need for relatedness. The study suggested that strategies such as autonomy support, active participation in the design process, support for competence development, and establishing a sense of relatedness could enhance teachers' motivation during training. The study highlighted the importance of aligning institutional and individual needs in professional development and called for a holistic approach to programme design.	x
Jeffrey et al. (2015)	Development of digital information literacy in HE (N/A)	Mixed methods case study	Dewey's learning principles offer strategies to support the development of digital information skills. Collaboration and sharing, facilitated by online communities, experiential learning, and personal relevance through Web 2.0 tools, were found to empower participants, reduce obstacles, and foster personal growth in reflective journals documenting their learning journey.	x
Kennedy (2015)	Meta-cognitive awareness of TPACK for distance learning professional development (USA)	Theoretical on TPACK for self-reflection	Several key findings were made regarding the TPACK framework and its application to online learning. To enhance the learning experience, recommendations include fostering diverse perspectives, incorporating more readings and cases, considering future technologies, creating explicit connections between concepts and supporting reflection, refining discussion prompts and moderating, adapting group size to pedagogy, and aligning prompts with course goals. The course content was then restructured accordingly.	x

Koh et al. (2015)	Pre-service teachers (Singapore)	TPACK survey	The survey instrument from this study can be utilised by teacher educators and institutions to monitor teachers' perceptions of the underlying processes in their TPACK development. Incorporating these survey questions in ICT course evaluations can provide a comprehensive analysis of teachers' knowledge (TPACK), actions (LDP), and comfort with design (DD). This data can help improve ICT course design and enhance understanding of teachers' learning behaviours and performance.	x	x
Koh (2019)	Graduate course in educational technology (school and HE teachers) (Singapore)	TPACK survey	The TPACK framework's effectiveness in guiding teachers' lesson design has been questioned. However, the use of scaffolds helped teachers articulate and assess desired outcomes, enhancing the prescriptive value of TPACK for student-centred ICT integration.	x	
Laurillard et al. (2011)	Learning design support environment to support and scaffold teachers' engagement with and development of technology-enhanced learning (UK)	Qualitative with interviews	This article highlights the need for a learning design support environment to assist teachers in developing effective technology-enhanced learning. Teachers often lack time and support for innovation, resulting in the replication of existing practices in a digital context. The Learning Design Support Environment project aims to provide theory-informed tools for representing pedagogical characteristics and optimising learning technologies. The project addresses various challenges, including building on previous work, balancing structure and free expression, and aligning learning design elements. User requirements for the collaborative construction of learning designs are emphasised.	x	x
Laurillard et al. (2018)	Evaluation of the Learning Designer tool to develop and support a knowledge-building teaching professional community (29 different countries)	Design-based research with surveys, interviews, observations, and statistical data	This article presents the findings of an iterative design-based research project that developed an online design tool called the Learning Designer. The tool aimed to support teachers as designers and foster a knowledge-building teaching community. Evaluation through online events and MOOCs showed that the Learning Designer facilitated the creation and sharing of learning designs, but further functionality for collaboration and peer review was desired. The research highlights the potential of digital technology for large-scale improvements in teacher professional development in technology-enhanced learning. Teacher evaluations indicated positive experiences with the tool and its reflection support for pedagogy	x	x

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Table 3. (Continued)

Reference	Research context (country)	Methodology	Main findings	(Online) TPD aspect(s) in focus
Levesque-Bristol et al. (2019)	Campus-wide faculty development programme ("IMPACT"), (USA)	Faculty interviews and focus groups	The IMPACT initiative at Purdue University aims to create student-centred learning environments by incorporating student-centred teaching practices. A core aspect of the programme is a Faculty Learning Community (FLC) that is used to enhance and sustain the initiative by adding new fellows each year.	x x
Lillejord et al. (2018)	Professional development and active learning in HE (N/A)	Literature review	A systematic mapping of ICT effects on learning outcomes highlights that pedagogical implementation, not the technology itself, is crucial. To foster active student learning, a scholarly approach to teaching across institutions is recommended. However, many academics lack professional development (PD) and incentives to stay updated with teaching research. PD provision is often under-resourced and disconnected from disciplinary activities. The review emphasises the need for a scholarly, goal-aligned, evaluated, and collaborative approach to technology implementation in higher education institutions.	x
Mackey & Evans (2011)	Communities of practice in online professional learning (New Zealand)	Case study	Indicates that a Community of Practice can be a useful approach to creating an online forum for oTPD, but also that people participate according to their own needs and learning objectives. Similarly, it is important that it is flexible and can fit into one's career (e.g., with a less predefined curriculum and homework).	x
Marin et al. (2018)	Interuniversity online collaborative learning design process based on discipline integrating ICT (Spain)	Mixed methods with surveys	This study focuses on online collaborative design in teacher professional development, specifically in interuniversity teams. The aim was to support teachers in fully collaborating online throughout the learning design process using an ICT community platform called ILDE. The findings suggest that effective collaboration was achieved by explicitly communicating design changes, distributing tasks, providing ideas for learning resources, seeking clarifications, discussing feedback, and offering solutions. Overall, participants reacted positively to the support provided by ILDE in their ICT-enhanced co-designs.	x x x

Matthews (2021)	UK Health Education	Literature review	The study found that academics globally recognise the importance of digital literacy for health students. Different institutions had unique approaches to digital literacy, influenced by their location and computer ownership rates. The majority of research articles focused on medical perspectives, indicating the need for more research in other health disciplines. The study highlighted the importance of considering all areas of digital literacy in curriculum design, not just information literacy and technical skills. Personalisation of the curriculum was evident, but incorporating digital literacy as a core component could pose challenges. A process curriculum model with self-evaluation was suggested for personalised learning. Overall, further research is needed to optimise the implementation of digital literacy in health education.	x	x
Mirriahi et al. (2015)	Academic development initiatives for HE teaching staff (Australia)	Case study	This article discusses an Australian institution's experience in designing online learning. Three professional development (PD) initiatives were implemented, promoting interaction, mentorship, and knowledge sharing among teaching staff. Five principles for effective PD in blended and online learning are outlined, emphasising understanding, authentic experiences, constructivist approaches, alignment with standards, and multiple programme options.	x	x
Mishra et al. (2019)	Professional development workshop (USA)	Case study with TPACK interviews	This study emphasises the importance of professional development (PD) workshops in enhancing teachers' technological, pedagogical, and content knowledge (TPACK) in life science education. The study highlights the role of PD in familiarising teachers with current research trends and technology as well as the importance of having time for and enabling them to incorporate research and ideas into their classrooms effectively. The findings highlight the value of such workshops in educating teachers about research opportunities and equipping them with the necessary tools and resources.	x	x

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Table 3. (Continued)

Reference	Research context (country)	Methodology	Main findings	(Online) TPD aspect(s) in focus
Mitchell et al. (2019).	Technology integration by preservice teachers (USA)	Case study with TPACK	This study examined the experiences of preservice teachers (PSTs) engaging in collaborative blogging and technology integration. The findings highlighted the value of digital connections for working together, sharing ideas, and discussing challenges related to technology integration. PSTs recognised the importance of developing TPACK and valued the opportunity to apply technological practices learned from coursework and peers. Collaborative blogging facilitated the development of TPACK practices and provided a forum for learning about literacy instruction and diverse digital tools. PSTs implemented ideas learned from peers' blog posts and expressed eagerness to incorporate blogging into their future classrooms. The study emphasised the importance of ongoing professional conversations and collaboration.	x
Mohr & Shelton (2017)	Best practices for professional development for faculty teaching online (USA)	Delphi surveys	Using best practices is necessary for developing oTPD (online teacher professional development). Establishing a community among educators is crucial for skill development. Leaders should build and foster a shared vision of the role of online teaching and cultivate it. It is important to address teachers' perceived needs for motivation. Teachers should feel obligated to participate in PD.	x x
Owens (2012)	Learning and teaching development programmes in universities (UK)	Survey	The study highlights a gap between lecturers' pedagogical beliefs and their actual practices when teaching online. Although interactive teaching is considered essential, lecturers are less likely to facilitate student interaction online. The study emphasises the need for specific pedagogical and technological staff development to ensure the effective use of online teaching methods. Lecturers with teaching qualifications and training in online learning are more likely to use these environments effectively. General forms of learning and teaching development have limited impact on effective practice in this area.	x

Podorova et al. (2019)	Professional development for Academic Language and Learning educators in HE (Australia)	Mixed methods participatory action research	This study addresses the need for digital literacy among Academic Language and Learning (ALL) practitioners. The authors conducted a mixed-method participatory action research study to explore ALL practitioners' preferences, competencies, and confidence in the digital learning space. The findings aim to inform the development of strategies and resources for upskilling ALL staff and promoting effective digital literacy in higher education.	x	
Quinn (2010)	Concise online e-clips in an academic development programme (Australia)	Mixed methods	The study examined the use of concise online presentations called "e-clips" as a form of academic development for faculty, including 5-minute workshops. The findings showed that e-clips were effective in reaching faculty members who are typically difficult to engage, such as sessional faculty, and in motivating faculty to engage in teaching improvements. E-clips were found to be a valuable addition to traditional academic development approaches, complementing them and contributing to broader improvements in teaching and learning outcomes.	x	x
Rienties et al. (2013a)	Online teacher training programme (The Netherlands)	TPACK and Teacher Beliefs survey	The study emphasises the need for teachers to update their skills using cost-effective methods. The five-step MARCHET training programme embedded within daily practice proved effective. Positive learning experiences were observed, but challenges included peer and teacher contributions. TPACK-based training improved teachers' overall skills, with some limitations. Institutional differences and online training opportunities should be explored further. Teacher educators should reflect on the design and adapt it to local contexts. The modules are available for free download and customisation.		x
Rienties et al. (2013b)	Online teacher training programme (The Netherlands)	TPACK and Teacher Beliefs survey	Academics from nine higher educational institutions participated in a cross-institutional online teacher professional development (TPD) programme. The programme consisted of four online modules focused on collaborative knowledge building, educational applications of Web 2.0, assessing knowledge and understanding, and distance learning supervision. The academics engaged in small group discussions, online meetings, and asynchronous forums. The training aimed to enhance teaching practices rather than focusing on specific technologies. The study found significant improvements in TPACK skills but noted that factors such as disciplines, institutional cultures, time commitment, and beliefs about employability influenced training retention and thus highlighted the importance of organising TPD according to educators' actual and present teaching obligations.		x

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Table 3. (Continued)

Reference	Research context (country)	Methodology	Main findings	(Online) TPD aspect(s) in focus
Rienties et al. (2018)	Analytics4Action learning analytics workshop for teaching staff in HE (UK)	TAM survey	This study explores teachers' readiness for learning analytics visualisations in online learning. The findings reveal that while participants appreciated the interactive approach, they were sceptical about the ease of use of the tools. Teachers expressed a need for additional training and support in using the tools and thus also emphasised the importance of professional development for learning analytics.	x
Roman et al. (2010)	Fully online training programme for online instructors in HE (USA)	Survey	The majority of participants found the six-week online training course, Preparing Online Instructors (POI), useful. They reported increased technological skills, pedagogical abilities, and exposure to new teaching methods. POI instructors received praise for their effective training and feedback. Some participants expressed concerns about the course's suitability for their experience level, timing, length, and depth of specific topics covered, which suggests a need for evaluating the participants' needs prior to and resources after the programme.	x
Schalk et al. (2022)	Digital Education module, TU Dublin	Interview questions in an online questionnaire	The study examined how participating in an online Digital Education module and experiencing the shift to emergency online teaching during the COVID-19 pandemic affected lecturers' academic identities. The findings suggest a potential growth in confidence and integration of digital technologies into their identities. This opens opportunities for flexible working practices and pedagogical enhancements. Geographical isolation and limited communication impacted academic communities, emphasising the need for coordination and collaboration. Strong academic leadership and the development of personal learning networks are crucial for future practices. Further research is needed to inform and strengthen future practices in this exceptional time.	x
Seufert et al. (2018)	Development of digital competencies of teachers and professional learning communities (Switzerland)	Literature review, expert interviews, surveys	This study focuses on developing the digital competencies of teachers in the context of digital transformation. A framework was developed based on a literature review and expert interviews. The framework will be used to establish online professional learning communities for the effective development of these competencies.	x



Sullivan et al. (2018)	Online professional development model with a peer-learning community (USA)	Qualitative: text analysis of posts	The Tools of Engagement Project (TOEP) offers online professional development for faculty, promoting innovative uses of technology. Participants benefit from peer learning, integrating technology into their courses according to their needs, and expressing a desire for ongoing learning. TOEP fosters a supportive community, and behavioural change, and encourages self-directed exploration of tools to enhance teaching and engage students.	x
Testers et al. (2019)	Digital course in information literacy for students and adult learners (The Netherlands)	Quantitative: survey and structural equation modelling	The study examined the influence of organisational variables on students' intention to transfer learning in study and work contexts. Supervisor support and feedback were identified as the strongest predictors of intention to transfer learning in both contexts. The findings suggest the importance of involving former students in course design and highlight the significance of feedback and supervisor support for the effective application of new learning in educational settings.	x
Thomas & Thorpe (2018)	Equipping academics to facilitate online groups (N/A)	Literature review	Educators need to be trained in handling online groups and thus the focus of professional development for online group facilitators should be on pedagogy rather than technology. Clear objectives and roles, along with effective communication strategies, are essential. Facilitators should develop pedagogical awareness and understand the power of educator presence. It is important to address personal vulnerability and shortcomings.	x
Trevisan et al. (2023)	COVID-19 pandemic	Snapshot surveys	The study examined faculty in higher education during the transition to online teaching (OT) due to the COVID-19 pandemic. Four different profiles were identified based on the faculty's reactions to the transition. Three profiles showed positive dispositions towards OT, while one profile lacked preparation and enthusiasm. Institutional support played a crucial role in faculty's perceptions of OT. Enthusiasm for OT declined over time, indicating potential burnout and stress. The study highlights the importance of tailored institutional support and professional development for faculty during online teaching.	x

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Table 3. (Continued)

Reference	Research context (country)	Methodology	Main findings	(Online) TPD aspect(s) in focus
Tømte et al. (2015)	Online teacher education programmes for student teachers in Norway	Case-study involving TPACK	The study explored online teachers' practices of digital competence and their impact on student teachers. Most teachers had a tool-oriented and teacher-centred approach, but practising Technological Pedagogical Content Knowledge (TPACK) made them recognize the value of technology in teaching. Few teachers emphasised the importance of being role models for digital competence. The integration of digital competence in online teacher education programmes was found to be limited. The disconnect between discourses on online education and digital competence needs to be addressed to fully exploit the potential of digital competence in online teacher education.	x
Ungerer (2016)	Professional development of academic staff in digital literacy and curation (N/A)	Theoretical	The findings suggest that digital curation is crucial in the learning process and supports inquiry-based pedagogy, student engagement, and multimodal literacy comprehension. Both students and teachers should become digital curators to enhance digital literacy and become responsible citizens.	x
Vaill & Testori (2012)	Faculty development programme on teaching online (USA)	Descriptive case study	Bay Path College has implemented a three-tiered approach to faculty development for online teaching: orientation, peer mentoring, and ongoing support. Feedback from faculty who completed the programme showed that 84% felt more prepared to teach online. Thus, the study highlights the importance of peer interaction and ongoing support after the programme.	x
VanLeeuwen et al. (2020)	Faculty Development for Digital Education in Canada	National Survey of Online and Digital Learning	The study focuses on the importance of professional development (PD) for faculty teaching in digital education contexts, particularly in response to the rapid shift to remote teaching during the COVID-19 pandemic in Canadian postsecondary institutions. The lack of available data on faculty orientation and ongoing PD in Canada led to a systematic analysis of narrative comments from the Canadian Digital Learning Research Association surveys. The findings emphasise the need for ongoing PD to address emergent needs and ensure excellence, equity, and success in digital education efforts.	x

Reference	Research context (country)	Methodology	Main findings	(Online) TPD aspect(s) in focus
Washington et al. (2020)	Effective use of computer labs at community college (USA)	Qualitative with interviews	The study examined the integration of technology into instruction at a community college. Findings showed that the computer labs added to literacy classes were not used effectively, and there was insufficient exposure to technology. Instructors were comfortable with technology but failed to integrate it effectively. Students desired more exposure to learning technology. Recommendations included increased professional development for faculty and organisational support for the college's change initiative.	x
Wu et al. (2016)	ICT module for HE teachers (China)	Survey based on Kirkpatrick's evaluation model	The study indicates that ICT professional development positively affects new HE teachers' perception of ICT, TPACK competence, teaching practice, and student learning. The use of blended learning impressed teachers and department heads, also resulting in increased student engagement and performance. Letting the participants design an online course proved to be an effective learning strategy. Evaluation should take place at four levels.	x
Wynants & Dennis (2018)	Professional development of effective, evidence-based instructional strategies in an online context (USA)	Qualitative: thematic analysis of interviews	The Community of Inquiry (CoI) model for online professional development is interesting. Participants valued the program's flexibility, control over pacing, and ongoing access to resources, which facilitated optimal learning by allowing them to learn at their own pace and review material as necessary.	x
You (2011)	Distance learning faculty members' perception of best practice (USA)	Self-report survey	This study examined the adoption of best practices in distance learning courses by faculty members through a self-report survey. The findings revealed a gap between the existing best practices and those used by faculty members. Twelve themes of best practices were identified and categorised into content-centric, instructor-centric, and learner-centric levels. This information can guide faculty support and development activities in distance learning.	x
<b>Total (57)</b>				<b>31</b>
				<b>42</b>
				<b>16</b>