Holovchuk, S. & Ryland, L. K. (2026). Digital Collaboration and Problem-Based Learning. I S. Holovchuk, G. S. Meyer & L. K. Ryland (Red.), *Problembasert læring: En utforskende lærings- og danningsstrategi* (s. 155–172). Fagbokforlaget. https://doi.org/10.55669/oa800109

9

Digital Collaboration and Problem-Based Learning

Svitlana Holovchuk & Lill Krestin Ryland

Abstract: The digital transformation in higher education demands new perspectives, flexibility, interdisciplinary collaboration, and innovative methods. Several educational programs have adopted hybrid approaches, enabling students to collaborate in both campus-based and online environments. In the Early Childhood Teacher Education Program at NLA University College, Problem-Based Learning (PBL) is employed to facilitate collaboration within tutorial groups. This study aims to explore the opportunities and challenges of digital collaboration in early childhood education, using PBL as an illustrative example. Data were collected through focus group interviews with university lecturers from the Early Childhood Teacher Education Program, drawing on their knowledge and experience of using PBL in digital settings. The main findings highlight both the possibilities and challenges of digital collaboration, particularly in relation to flexibility, communication, and the need for professional digital competence.

Keywords: Problem-based learning (PBL), digital collaboration, flexibility, communication, professional digital competences, digital formation

Introduction

The digitalization of contemporary society has introduced new requirements for education, including the need for flexibility, interdisciplinary collaboration, critical thinking, and the development of creative strategies and perspectives (Holovchuk et al., 2024). Over the past five years, online education has grown in popularity, particularly during and after the pandemic. Today, hybrid formats are widely used in higher education. Within this context, ensuring high-quality learning experiences in digital settings has become essential.

According to the Report of the European University Association, "flexible learning should entail multiple modes, methods and technologies, and grant importance to flexibility within a study programme" (Brekke & Zhang, 2024, p. 6). The integration of digital tools and flexible approaches to teaching practice are essential components in higher education (Pettersen, 2017, pp. 116–117). At the same time, it remains unclear how effectively virtual small-group environments can achieve their pedagogical goals, given the challenges presented by "limited facial cues and physical visualization" (Song & Elftman, 2024, p. 380).

The overarching aim of higher education is to support students in developing key competences, including problem-solving skills, critical thinking, and the ability to collaborate effectively (Wang & Lin, 2021, p. 1). Problem-Based Learning (PBL), as a learning strategy, can help develop these competences while also fostering student engagement and creativity (Thorndahl & Stentoft, 2020, p. 2). This study explores the opportunities and challenges of digital collaboration, using PBL as a practical example. The focus is not on PBL itself, but rather on digital collaboration as an educational phenomenon, with PBL serving as a contextual framework. Group interactions require collaboration skills from both lecturers and students, and working with PBL is no exception. In a digital setting, collaboration demands even greater skills and knowledge – technological, content, and pedagogical expertise (Mishra & Koehler, 2006).

The project is grounded in Bruner's theory of social constructivism, which emphasizes learning as an active, social process involving collaboration with others (Bruner, 1986). The social approach to collaboration is closely connected to the principles of PBL, where cognitive development within a collaborative learning environment is central (Bjørke, 2000, p. 24). PBL is defined as "…method that involved learning in ways that used problem sce-

narios to encourage students to engage themselves in the learning process" (Savin-Baden & Major, 2004, p. 3). Pettersen (1997, pp. 17–18) describes it as both a teaching method and a didactic concept, involving planning, implementation, assessment, and critical reflection. Based on this understanding of PBL as both a method and a pedagogical approach, the lecturer's role is to facilitate and stimulate students to take responsibility for their own learning processes (Hmelo-Silver & Barrows, 2006, p. 24; Brinchmann-Hansen, 1993, p. 62). In addition, PBL supports students' professional growth by offering opportunities for interaction, while also allowing them to develop their own perspectives that reflect their personal values (Ryland & Holovchuk, 2023, p. 41). This point is also supported by Pettersen (2000, pp. 11–12), who emphasizes that PBL is founded on a shared pedagogical concept, where students are responsible for sharing their own professional experiences and knowledge.

Previous studies conducted over the past five years (2020–2025) indicate that research related to online learning and PBL remains limited. Researchers have examined PBL from a range of theoretical perspectives, such as knowledge-sharing in online PBL (Wang & Lin, 2021), the use of PBL in online classes (Kim, 2021), the transformation of PBL through hybrid learning models (Scholkmann et al., 2021), and student and facilitator perspectives on online PBL (Erickson et al., 2021). However, there is still little research concerning digital collaboration (Lazareva & Tømte, 2024), and even less on the intersection of digital collaboration and PBL (Hendarwati et al., 2021). Furthermore, no studies were found that specifically address online PBL collaboration within the context of Early Childhood Teacher Education (ECTE). In light of this gap, the following research question is posed: *What are the opportunities and challenges of digital collaboration in the context of Problem-Based Learning (PBL)?*

Theory

In this section, we present theoretical perspectives relevant to the research question, focusing on two components: *PBL collaboration in online education settings* and *communication within the group.*

PBL collaboration in online education settings

Collaboration involves both knowledge-sharing and interaction between individuals (Furnes et al., 2018, p. 168). Through collaboration, students are able to share knowledge, solve problems, and address challenges collectively. In this context, PBL as a learning strategy is particularly effective in fostering meaningful collaboration and interaction between students and lecturers. Moreover, the PBL approach should be grounded in values such as respect, democracy, and responsibility (Ødegård & Røys, 2013, p. 73). Traditional classroom learning and online education offer different forms of flexibility. A key advantage of the digital environment, for example, is that it enables a more adaptable schedule for both students and lecturers. At the same time, online learning presents its own challenges. The most significant issue is the lack of face-to-face communication, which can reduce opportunities for engaging students in active learning (Kim, 2021, p. 163). To address this, integrating PBL stages into online education can enhance students' collaborative abilities and problem-solving skills (Hendarwati et al., 2021, p. 36). Furthermore, an online learning environment supports the development of professional digital competences by enabling new forms of collaboration with digital technologies. Effective collaboration in such contexts depends on both pedagogical approaches and the design of digital learning environments (Lazareva & Tømte, 2024, p. 501). In this regard, the study by Johannesen et al. (2024, p. 72) highlights the importance of evaluating the impact of digital pedagogical strategies and their adaptability. Collaboration in the online environment can also include interactive assessments that encourage students to engage actively in the learning process (Jermstad & Holovchuk, 2024, p. 264).

To ensure meaningful digital learning experiences, digital formation is essential (Bergsjø et al., 2025). This formation extends beyond professional digital competence, encompassing both digital skills and digital judgement (Dahle & Meyer, 2024, p. 21), as well as the student's individual growth through collaboration and interaction in the online environment (Gran et al., 2019). In addition, digital collaboration can facilitate the development of flexible study approaches, which are highly valued in contemporary higher education (Pettersen, 2017, p. 121). Within a PBL context, digital collaboration can meet students' needs by providing flexible and accessible educational opportunities (Erickson et al., 2021, p. 322).

Communication skills

Communication skills are a vital aspect of students' professional development (Skau, 2024, p. 110). Effective digital collaboration relies on respectful relationships, mutual dialogue, and communication (Jensen & Ulleberg, 2019). The theories of Bruner (1986) and Vygotsky (1978) emphasize the importance of interaction within a socio-cultural community and the zone of proximal development. These perspectives are crucial for facilitating effective and meaningful communication, which strengthens group development and supports collaborative problem-solving.

In any communication process, there are always at least two roles: the person who provides information and the person who receives it (Levin & Rolfsen, 2015, p. 115). Communication plays a vital role in digital collaboration and group interaction, fostering both community success and individual development. To establish effective communication within a group, particularly in a digital environment, it is essential to define roles, expectations and responsibilities. PBL tutorial groups should appoint both a leader and a secretary to ensure efficient organization and process. Furthermore, signing a learning contract is crucial.

One of the principal benefits of PBL is that students with diverse skills and knowledge collaborate on a shared group assignment (Edmondson, 2012, p. 200). This collaborative process demands active participation and interaction. Nevertheless, collaboration in digital settings may present challenges to both individual development and effective communication (Skau, 2024, pp. 24–25). Communication skills are fundamental for building trust, supporting self-development and enhancing collaboration in a digital context. Individuals also send out various signals that must be interpreted accurately by others in the group. Misunderstandings and confusion may occur when these signals are unclear. Emotional reactions can influence communication and may be expressed through both verbal and nonverbal means (Tveiten, 2013, p. 125). Communication skills encompass the choice of words, an appropriate tone of voice, facial expressions and body language, as well as "our life experience and our knowledge, our maturity and our wisdom" (Skau, 2024, p. 113).

Strong communication skills and active engagement are indispensable for effective collaboration, especially in digital environments. Passive participation by students in PBL may hinder professional development and could indicate challenges such as demotivation or a lack of interest in the topic under

discussion. One strategy to promote students' participation and effective communication in the digital context is to make rounds in the group, allowing each student to speak in turn. Students' personal insights and active involvement can significantly enhance digital collaboration.

Method

Data collection was conducted through two focus group interviews (Hoyle et al., 2002, p. 401) with six university lecturers in the Early Childhood Teacher Education Program at NLA University College. The data materials focused on digital collaboration and PBL. Participants were selected based on their experience with PBL in a digital collaborative setting (Flick, 2006, p. 198). Group interaction and reflection served as important sources for data generation (Halkier, 2010, pp. 13–14). We employed top-down coding during the analysis, using a theory-driven and deductive approach guided by our research question (Anker, 2020, p. 79). The coding process was informed by theoretical perspectives on digital collaboration and PBL. Drawing on the theoretical framework, we developed a list of codes that included working from anywhere, easy scheduling, students' responsibility, active participation, camera and engagement, body language, communication, relationship, collaboration, digital skills and platforms. After coding the data, we explored the connections between these codes. Similar and related codes were grouped together, and through this process, three categories were identified. The data materials were interpreted using content analysis (Bakken & Andersson-Bakken, 2021).

The study has several limitations. Firstly, the small and homogeneous group of participants affects the generalizability of our findings. Secondly, during the focus group interviews, participants were aware of each other's identities, which reduced confidentiality. The informants may have influenced each other during the interviews, potentially affecting data collection. Thirdly, the use of top-down coding carries a potential risk of bias, as our experience with digital collaboration and PBL may influence the interpretation of the data materials. Additionally, the focus group interviews were conducted in Norwegian, whereas the study is written in English. We acknowledge that

some nuances may have been lost in translation, as interpretation had already begun during data collection.

The study was conducted in accordance with the Guidelines for Research Ethics in the Social Sciences and Humanities (NESH, 2021). Participation in the focus group interviews was voluntary, and informed consent was obtained from all participants. The study was reported to the Norwegian Agency for Shared Services in Education and Research (Ref. 937039).

Result and discussion

Drawing on the results of focus group interviews with lecturers in ECTE, the findings are organized into three categories. The first is *flexibility* in virtual settings. The second concerns *communication* and *relationship building* as core elements of digital collaboration. Finally, the third addresses the significance of *professional digital competence* for digital collaboration.

Flexibility

The results underscore flexibility as a key advantage of collaboration in virtual settings. Several informants highlight how digital platforms enable students to work from various locations and according to their own schedules. One informant observed: "Flexibility is a practical approach… it's easy to find time and work with PBL from different places…", "We [are] rational people, and we want [to] save the time". Another added that collaboration in online settings "can make meeting easy and quick", "students can meet across campuses …" and "the students have the opportunity to meet more often". These comments point to two crucial aspects of digital collaboration. First, the flexibility of digital environments facilitates collaboration across geographical boundaries. Students can join from anywhere, as illustrated by one comment: "Students can be in Spain, but at the same time they can come if the meeting is online". However, this same flexibility introduces challenges. When students attend meetings from unsuitable locations, such as waiting rooms or public transport, it can hinder their ability to engage fully. The lack of engagement makes

it difficult to facilitate active participation – one of the core principles of both digital collaboration and PBL as a learning strategy.

Although digital collaboration in PBL presents certain challenges, it also creates new opportunities. Digital platforms provide the chance to meet more frequently, which supports relationship-building and the development of collaborative skills. Increased interaction, even in a digital environment, can enhance relationship-building and foster collaborative skills. This aligns with Bruner's (1986) theory that social interaction fosters cognitive growth, and that the learning environment should support meaningful collaboration. In this context, flexibility becomes a practical expression of Bruner's ideas for creating a safe learning environment. Various digital platforms and tools can help establish such spaces, making learning more dynamic and promoting interaction across time and place. In many ways, students create their own digital learning environment, as Kim (2021) also notes.

While flexibility brings many benefits to online learning, it also presents certain challenges. Two of the core principles of PBL are responsibility and active student participation (Hmelo-Silver & Barrows, 2006; Pettersen, 2000). One informant remarked: "In PBL it's important that everyone participates". If students do not take online meetings seriously, for example by joining from a bus, this could undermine these PBL principles. Another challenge concerns the use of cameras. If students keep their cameras off, it becomes more difficult to foster active engagement and collaboration. For digital collaboration, it is crucial that every student is responsible and participates actively. We will discuss this further in the next category.

Communication and relationships as core elements of digital collaboration

Online education offers both opportunities and challenges, particularly in terms of digital collaboration. One of the key findings of our study is the role of communication and relationship-building as core elements of effective collaboration in a digital learning environment. Within a PBL learning strategy, group interaction involving these elements is essential. Drawing on the theories of Bruner and Vygotsky, learning is most meaningful in a social context – whether local-based or digital.

A major limitation of digital collaboration, as reported by informants, is the absence of face-to-face communication and social interaction. The informants highlight that "it can be difficult to identify body language in digital collaborations, and this is much easier in a traditional physical setting". In particular, eye contact is crucial for communication and interaction, even in an online environment. In this context, it is important for students to use a camera while collaborating in a small group. One informant points out: "If we don't use cameras, it will be difficult". When students switch off their cameras, collaboration can become more challenging. The informant adds: "If the camera is not on, we don't know if the students are present". According to one of the informants, students use their cameras when working in small groups, but not during lectures: "My experience is that the students use a camera in smaller groups, while it is off during teaching in the whole class. It's easier to engage everyone in the conversation… see everyone…". While this may be understandable from a student's perspective, it is important to emphasize that using a camera in a small group plays a key role in promoting digital collaboration. Visuality can support students' active participation and contribute to building relationships and trust. Furthermore, cameras can be used strategically to improve interaction. For example, group discussions related to PBL tasks can be organized with mandatory camera use. As Tveiten (2013) underlines, effective communication is closely linked to the ability to interpret non-verbal communication, which may be impossible when the camera is turned off.

Another key finding is the importance of holding the first meeting on campus rather than online. One of the informants explains: "The first meeting should be physical to get to know each other and discuss our expectations. Then we can meet digitally…". The initial campus-based meeting allows students to build relationships, discuss expectations, and distribute roles – all of which are crucial for future digital collaboration and for studies using PBL. Moreover, a physical kick-off is essential for fostering trust and creating emotional well-being. As Edmondson (2012) points out, psychological safety and trust are central to group dynamics. Supporting this, another informant states: "If the group has good relations and cooperates well, then PBL can be used online as well." In contrast, establishing a collaborative climate in a digital setting can be more challenging. Several informants mentioned that it can be difficult to perceive the atmosphere and collaborative climate in a

digital meeting room: "We don't know the atmosphere in the digital room, as in physical meetings. We get closer to the students in physical meetings and get to know the students more easily". Informants also express concerns regarding the flow of communication in digital meetings, noting that it is easy to interrupt each other. The lecturers tend to take up more space here than in physical meetings. According to Skau (2024), the ability to both express oneself and listen to others is a crucial factor in effective communication. If the digital environment hinders this balance, it could present a significant challenge to creating good collaboration.

Many of our findings point to challenges related to digital communication. However, the informants emphasize that PBL collaboration can function well in digital settings if the group members have already established a relationship. The informant's suggestion to have the first PBL meeting on campus is therefore well founded. Meeting in person helps team members build relationships, establish trust, and discuss expectations. This process can lead to more effective and dynamic digital collaboration in the future. Ødegård & Røys (2013) support this perspective by highlighting the importance of respect, active participation and democratic dialogue in collaboration, which requires trust and a common understanding. Furnes et al. (2018, p. 169) further highlight that to meet the challenges of learning online, educational institutions should develop innovative pedagogical approaches and prepare students for digital interaction.

Significance of Professional Digital Competence

To achieve successful digital collaboration, both students and lecturers must develop digital skills and competences (Holovchuk et al., 2024). Lecturers play a crucial role in supporting students throughout this process. In addition, fostering a digital culture among both students and lecturers ensures that technology is used effectively in PBL contexts. Digital formation requires active engagement and critical reflection on the role of technologies in the learning process.

Our findings also indicate that successful digital collaboration depends on professional digital competence. One informant points out: "One of the challenges associated with online PBL is the lack of digital competence", while another adds: "Both students and staff must have an introduction course

related to online teaching and how to use different digital tools in education". These viewpoints can be interpreted in light of Dahle & Meyers (2024) conceptualization of professional digital competencies. According to them, such competences are not merely "technical skills" but also encompass digital judgement and the strategic use of technological resources in education. A lack of digital competence among both students and lecturers can hinder successful digital collaboration and reduce students' active participation. As one informant emphasized: "PBL in a digital environment can work well if we have professional digital competencies".

Pedagogical approaches and knowledge related to the use of digital technology are essential for promoting effective digital collaboration (Lazareva & Tømte, 2024). The results suggest that professional digital competence can be developed through three key steps.

The first step involves an introductory course for both students and lecturers. The course should cover three equally important aspects: *technological* – use of different digital tools and platforms; *pedagogical* – group dynamics, collaboration skills and problem-solving; and *digital ethics* and *critical reflection*. One informant mentioned that technological knowledge plays a crucial role, noting that a lack of such knowledge leads to insufficient time to achieve pedagogical goals. Informants also point out that this course should be provided before students begin working with PBL. One of them states: "When we are using PBL in a digital environment, preparation in advance is important". Another notes: "The preparation and knowledge can secure us that the digital tools are used in a pedagogically acceptable way". Without such preparation, digital tools could become distractions rather than learning resources. Furthermore, informants highlight the value of technical support for digital collaboration. For example, they point out that "the students can write in a common document at the same time and if everyone is sitting on their own screen, it's easier to pass the ball".

The second step involves creating a digital pedagogical forum where lecturers and students can share knowledge and experience. Such forums can promote active student participation and provide interactive, dynamic learning experiences. Establishing digital pedagogical forums supports a culture of ethics and engagement with digital tools. Lecturers emphasize the importance of sharing best practices: "We should have knowledge of several digital tools that can engage students in active learning, for example Kahoot, Padlet…" and "it is

important to share knowledge and experience related to using digital tools with each other". Such an "idea-bank" can help disseminate best practices for using digital tools. The use of engaging digital tools in the collaboration process can be understood in light of Vygotsky's theory of the zone of proximal development, where supervision supports the development of new skills. By facilitating knowledge-sharing and critical reflection, a digital forum promotes the digital formation of both students and lecturers. The digital pedagogical forum can include a range of digital tools, and it is important to critically evaluate them in teaching practice. Common digital tools allow students to share knowledge and ideas, foster valuable collaboration, and support project management communication. Pettersen (2017) emphasizes the significance of flexible and diverse approaches to digital collaboration, but this requires institutional support in the form of infrastructure and competence development.

The third step in enhancing professional digital competence is evaluation. Informants emphasize that "it is important to evaluate which tools facilitate active learning and successful collaboration" and "in evaluation we should have a critical perspective". The evaluation of the PBL process in a digital setting focuses on its impact on learning outcomes and students' professional growth. Johannesen et al. (2024) highlight that sustainable pedagogical evaluation of digital tools contributes to improving teaching practice and promoting high-quality education. Engaging in such reflection is crucial for supporting digital formation and digital collaboration, particularly regarding pedagogical approaches and ethical issues in the learning process.

Conclusions

This study has explored the opportunities and challenges of digital collaboration within Problem-Based Learning in Early Childhood Teacher Education. The findings indicate that online learning environments offer flexibility, promote collaboration, and can adapt to meet the individual needs of students. However, they also require high digital proficiency, effective communication, and a strategic approach to using digital tools. A key task in higher education is to establish a learning environment that fosters deeper understanding of

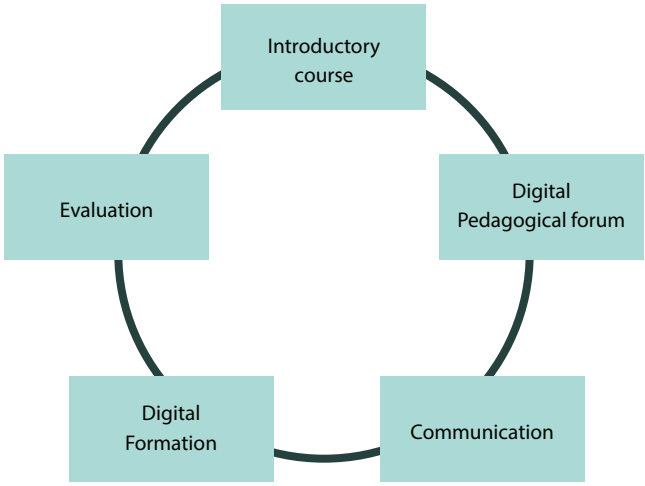
how to combine different digital tools and pedagogical approaches to engage students in active learning. Online education provides a flexible approach, enabling students and lecturers to acquire knowledge and skills via digital platforms from various locations. Despite these benefits, online education also presents challenges, such as limited face-to-face interaction, the need for self-discipline, demotivation, and reduced active participation among students. A core issue underlying these challenges is the limited professional digital competence among both lecturers and students.

Our findings suggest that effective digital collaboration practice – including training, tool selection, and institutional support – is essential to address the challenges associated with digitalization. By connecting findings with theory, we gain a deeper understanding of the potential digital skills that can be used for collaboration and creative problem-solving. Implementing PBL as a learning strategy in a digital environment requires both an understanding of the PBL approach and professional digital competences.

Drawing on the theoretical approach and findings of this study, we have developed *a Model for Digital Collaboration* (Figure 9.1), which we plan to test and evaluate with our students and colleagues, with the aim of implementing it in future online-based teaching programs. The model comprises five core elements: an introductory course, a digital pedagogical forum, communication, digital formation, and evaluation. The introductory course will provide knowledge about different digital tools and platforms, aiming to improve professional digital competencies. The digital pedagogical forum serves as a platform for both students and lecturers to share their experiences of learning in a digital environment. Communication skills are essential in digital collaboration and play a central role in relationship building. Safety in a digital learning environment is paramount. In this context, digital formation—which encompasses digital ethics and digital judgment, is crucial for both students and lecturers. Finally, evaluation is essential to ensure the quality of higher education. In our view, these five elements are central, and we hope that the model will support the development of effective routines for digital collaboration, particularly in the context of Problem-Based Learning.

Figure 9.1

Model for Digital collaboration



References

Anker, T. (2020). *Analyse i praksis. En håndbok for masterstudenter*. Cappelen Damm Akademisk.

Bakken, J., & Andersson-Bakken, E. (2021). Innholdsanalyse. In E. Andersson-Bakken & C. Pedersen Dalland (Eds.), *Metoder i klasseromsforskning. Forskningdesign, datainnsamling og analyse* (pp. 305–326). Universitetsforlaget.

Bergsjø, L. O., Eilifsen, M., Tonheim Tønnesen, K., & Vestbøstad Vik, L. G. (2025). *Barn og unges digitale dømmekraft – et verdiløft i barnehage og skole*. (2. ed.). Universitetsforlaget.

Bjørke, G. (2000). Problembasert læring. En innføring for profesjonsutdanningene Universitetsforlaget.

Brekke, M., & Zhang, T. (2024). *Flexible learning and teaching* (Thematic Peer Group Report). European University Association. https://www.eua.eu/publications/reports/flexible-learning-and-teaching.html

Brinchmann-Hansen, Å. (1993). *Prosjekt- og problembasert læring* Universitetsforlaget.

Bruner, J. S. (1986). *Actual minds, possible words*. Harvard University Press.

Dahle, M. S., & Meyer, G. S. (2024). Digital danning i barnehage, skole, hjem og fritid – en innledning. In M. S. Dahle & G. S. Meyer (Eds.), *Danning i digitale praksiser. Digital danning i barnehage, skole, hjem og fritid* 19–28). Fagbokforlaget. https://doi.org/10.55669/oa380302

Edmondson, A. C. (2012). *Teaming. How organisations learn, innovate, and compete in the knowledge economy*. Jossey-Bass.

Erickson, S., Neilson, C., O'Halloran, R., Bruce, C., & McLaughlin, E. (2021). "I was quite surprised it worked so well": Student and facilitator perspectives of synchronous online problem based learning. *Innovations in Education and Teaching International*, 58:3, 316–327 https://doi.org/10.1080/14703297.2020.1752281

Flick, U. (2006). *An introduction to qualitative research*. Sage Publications.

Furnes, G. H., Saeverot, H., & Torgersen, G.-E. (2018). Digital samhandling in education for the unforeseen future. In G.-E. Torgersen (Ed.), *Interaction: "Samhandling" under risk. A step ahead of the unforeseen* (pp. 167–186). Cappelen Damm Akademisk. https://doi.org/10.23865/noasp.36.ch9

Gran, L., Petterson, D., & Mølstad, E. C. (2019). Digital Bildung: Norwegian students' understanding of teaching and learning with ICT. *Nordic Journal of Digital Literacy*, 14(01-02), 23–36. https://doi.org/10.18261/issn.1891-943x-2019-01-02-03

Halkier, B. (2010). *Fokusgrupper* Gyldendal Akademisk.

Hendarwati, E., Nurlaela, L., Bachri, B. S., & Sa'ida, N. (2021). Collaborative problem based learning integrated with online learning. *International Journal of Emerging Technologies in Learning (iJET)*, *16*(13), 29–39. https://doi.org/10.3991/ijet.v16i13.24159

Hmelo-Silver, C. E., & Barrows, H. S. (2006). Goals and strategies of a problem-based learning facilitator. *Interdisciplinary Journal of Problem-Based Learning*, 21–39. https://doi.org/10.7771/1541-5015.1004

Holovchuk, S., Jermstad, L. K., & Jokstad, G. S. (2024). Student creativity and collaboration during digital learning: Glocal theoretical perspective. In B. E. H. Nordheim & S. Weber (Eds.), *Glocal theological education: Teaching and learning theology in the light of crisis* (pp. 128–141). Wipf and Stock Publishers.

Hoyle, R. H., Harris, M. J., & Judd, C. M. (2002). *Research methods in social relations* (Focus groups), pp. 401–408.

Jensen, P., & Ulleberg, I. (2019). *Mellom ordene. Kommunikasjon i profesjonell praksis.* Gyldendal.

Jermstad, L. K., & Holovchuk, S. (2024). Skjermen som klasserom: Utforsking av involvering i digital undervisning. In G.-E. Torgersen, H. Sæverot, & L. K. Jermstad (Eds.), Samfunn og samhandling under press: Betydning for pedagogisk praksis og teori pp. 255–270). Cappelen Damm Akademisk. https://doi.org/10.23865/cdf.227.ch16

Johannesen, M., Øgrim, L. & Hatlevik, O. E. (2024). Teachers' Professional Digital Competence: – The Neglected Management of Technology-rich Classrooms? *Nordic Journal of Digital Literacy, 19*(2), 64–81. https://doi.org/10.18261/njdl.19.2.2

Kim, Y. (2021). The problem/project-based learning (PBL/PjBL) at online classes. *International Journal of Advanced Culture Technology*, *9*(1), 162–167. https://doi.org/10.17703/IJACT.2021.9.1.162

Lazareva, A., & Tømte, C. E. (2024). Flexible learning spaces as an arena for developing professional digital competence through small group collaboration. *Teachers and Teaching*, *30*(4), 489–508. https://doi.org/10.1080/13540602.2024.2308893

Levin, M., & Rolfsen, M. (2015). *Arbeid i team i barnehagen. Læring og utvikling i team* (2. ed.). Fagbokforlaget.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054, https://doi.org/10.1111/j.1467-9620.2006.00684.x

NESH. (2021). Guidelines for research ethics in the social sciences and the humanities. Guidelines for Research Ethics in the Social Sciences and the Humanities | Forskningsetikk.

Pettersen, R. C. (1997). *Problemet først: Problembasert læring som pedagogisk ide og strategi*. Tano Aschehoug.

Pettersen, R. C. (2000). *Problembasert læring for studenter.* Universitetsforlaget.

Pettersen, R. C. (2017). *Problembasert læring for studenter og lærere.* Universitetsforlaget.

Ryland, L. K., & Holovchuk, S. (2023). "Fit for fight" – med et pedagogisk credo i bagasjen? På vei til å bli barnehagelærer. In I. M. Thorjussen & U. S. Goth (Eds.), *Verdier, holdninger og kompetanseutvikling i et utdanningsperspektiv* (pp. 39–53). Fagbokforlaget. https://doi.org/10.55669/oa211002

Savin-Baden, M., & Major, C. H. (2004). *Foundations of problem-based learning.* Open University Press.

Scholkmann, A., Telléus, P. K., Ryberg, T., Hung, W., Andreasen, L. B., Kofoed, L. B., Christiansen, N. L. S., & Nielsen, S. R. (Eds.) (2021). *Transforming PBL through hybrid learning models: Timely challenges and answers in a (post)-pandemic perspective and beyond*. Aalborg Universitetsforlag. International Research Symposium on PBL.

Skau, G. M. (2024). *Gode fagfolk vokser. Personlig kompetanser i arbeid med mennesker* (6. ed.). Cappelen Damm.

Song, X., & Elftman, M. (2024). Beyond collaborative learning: A comparison of small groups in face-to-face- and online settings. *Medical Science Educator.* https://doi.org/10.1007/s40670-024-01983-4

Thorndahl, K. L., & Stentoft, D. (2020). Thinking critically about critical thinking and problem-based learning in higher education: A scoping review. *The Interdisciplinary Journal of Problem-based Learning*. 1–21. https://doi.org/10.14434/ijpbl.v14i1.28773

Tveiten, S. (2013). *Veiledning mer enn ord* (4. ed.). Fagbokforlaget.

Vygotsky, L. S. (1978). *Mind in society: Development of higher psychological processes*. Harvard University Press.

Wang, W. T., & Lin, Y-L. (2021). Evaluating factors influencing knowledge-sharing behavior of students in online problem-based learning. *Frontiers in Psychology. Educational Psychology.* https://doi.org/10.3389/fpsyg.2021.691755

Ødegård, E., & Røys, H. (2013). *Å dra sammen. Samhandling som strategi for pedagogisk ledelse i barnehagen*. Cappelen Damm.