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Fostering higher-order thinking skills online in higher education: A scoping review

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Fostering higher-order thinking skills online in higher education: A scoping review

OECD Education Working Paper No 306

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This working paper has been authorised by Andreas Schleicher, Director of the Directorate for Education and Skills, OECD.

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Abstract

This scoping review examines the effectiveness of online and blended learning in fostering higher-order thinking skills in higher education, focussing on creativity and critical thinking. The paper finds that whilst there is a growing body of research in this area, its scope and generalisability remain limited. Current evidence suggests that, for most students and contexts, in-person learning yields better or equivalent outcomes for higher-order thinking skills than fully online learning. However, blended and flipped learning show promise. In some cases, they may be more effective than in-person learning to develop higher-order skills. The review aims to be of use to higher education practitioners by synthesising, for the first time at such a scale, the diverse literature on what supports students to develop these skills online. This has been linked to active and interactive online learning, well-structured project-based learning, disciplined questioning, students labelling relevant dimensions of their thinking, and regular, quality instructor and peer feedback. The review calls for improved research design to understand the effectiveness of different modes of learning and address gaps in the literature, which include fostering creativity online and ensuring equitable online skills development across disciplines and teaching contexts. Policy implications include the need to integrate attention to higher-order thinking skills into professional learning, innovation funds, national networks and quality assurance to support effective online teaching of these skills across higher education systems.

1. Introduction: Online learning in the spotlight

The COVID-19 pandemic placed online learning in the spotlight as never before. The first wave of lockdowns in early 2020 catapulted higher education institutions (HEIs), staff and students into a sudden and up-close experience of online teaching and learning the world over. Subsequent waves of the pandemic saw movement between in-person, hybrid and fully online forms of delivery as social distancing restrictions periodically prevented HEIs from accommodating all students enrolled in courses in the same place at the same time (OECD, 2021[1]). This not only posed extraordinary difficulties for students, professors and administrative staff alike, it demonstrated a perhaps unexpected level of agility on the part of higher education systems. It also raised questions about future models of higher education and a possible wider role for online learning as a substitute or supplement to in-person learning.

As higher education systems and institutions navigated the pandemic period, they continued to respond to long-standing challenges around funding, competition, student numbers, changing labour markets, and new student pathways through tertiary education, among others. As HEIs emerge from the pandemic period, they continue to be faced with an uncertain climate and tasked with preparing students for an uncertain job market. HEIs provide in-depth education in specialised, and often rapidly changing academic fields. At the same time, they are expected to ready students for jobs that cannot be automated or do not yet exist, or to furnish students with the ability to create their own jobs and career pathways in face of volatile markets and possible economic shocks. This had led to increased focus on the importance of advanced higher-order and cognitive skills such as creativity and critical thinking, and on how HEIs can foster and assess these skills.

This paper examines the intersection between online learning in higher education on the one hand and the development of higher-order thinking skills on the other. An extensive but conflicted literature exists on tertiary online learning generally, most of which does not address higher-order thinking skills. There is a growing but diverse body of evidence that directly addresses the extent to which skills such as creativity and critical thinking can be fostered online and what this involves. Evidence on the emergency move to online teaching and learning during the pandemic is growing but may not be generalisable to post pandemic conditions or to skills development. In this context, this scoping review summarises the nature of existing research on the use of different forms of online learning to foster students' higher-order thinking skills. It aims to build up a picture of the extent and range of evidence and identify where there are remaining gaps and uncertainties around the question of whether, and how, remote learning can be used to support the development of higher-order thinking skills such as creativity and critical thinking.

1.1. Research questions

The scoping review therefore explores the following question:

"What evidence exists about how effectively online and blended models of higher education can be used to foster students' higher-order thinking skills, in particular creativity and critical thinking?"

This implies a number of sub-questions:

- What is the extent, range, and nature of research activity on developing higher-order thinking skills online?
- How effectively can online and blended models of higher education be used to foster students' higher-order thinking skills?

- What factors and pedagogical approaches have been associated with effective development of higher-order thinking skills online?
- What are the gaps and limitations of the evidence and where are particular areas of focus or types of evidence dominating the research?

1.2. Method

A scoping review aims to understand the range and nature of research activity on a specific topic, categorise the types of available research evidence and findings, clarify key concepts, and identify remaining gaps in the literature. Scoping reviews differ from systematic reviews in that they aim to chart a field and understand its breadth and extent rather than provide a more in-depth summary or synthesis of all existing findings and evidence (or a summary of the magnitude of effects reported in different studies, as in a meta-analysis). Scoping reviews are especially appropriate when the literature on a particular topic is at an early stage of development or features a wide range of focus points and divergent findings (Egan et al., 2017[2]; Colquhoun et al., 2014[3]). The literature on the use of online learning to develop higher-order thinking skills in higher education is wide-ranging but is yet to be well-established, despite growing attention to both online learning and skills development in higher education internationally. This raises the need to understand how much and what type of evidence is available and the implications for informed policy, practice and further research on the topic.

Arksey and O'Malley (2005[4]) provide a 6-stage method for scoping reviews, involving 1) identifying the research question; 2) identifying relevant studies; 3) study selection; 4) extracting and charting the data; 5) collating, summarising and reporting the results; and an optional stage 6) consultation with stakeholders to identify further references and insight. Further studies provide more details of what is involved at each stage, for example, emphasising the importance of establishing the scope of the review with reference to its rationale (Levac, Colquhoun and O'brien, 2010[5]; Daudt, Van Mossel and Scott, 2013[6]). The current paper focusses on how effectively higher-order thinking skills such as creativity and critical thinking, sometimes also referred to as a sub-category of 21st century skills, can be developed as outcomes in online, blended, and flipped forms of learning in higher education (see research questions in section 1.1 above). The author used Arksey and O'Malley's method, as follows, to identify a total of 94 papers which fall within scope according to the inclusion and exclusion criteria listed below.

1.2.1. Identifying relevant studies

Four databases (Science direct, Scopus, Springer and Taylor & Francis) were initially searched with the following search terms:

Table 1.1.Search terms

Search term	Total identified (before screening)
"developing skills" AND "critical thinking" AND "online learning" AND "higher education" AND (effective OR outcomes)	**245**
"developing skills" AND creativity AND "online learning" AND "higher education" AND (effective OR outcomes)	**248**
"developing skills" AND "higher-order thinking skills" AND "online learning" AND "higher education" AND (effective OR outcomes)	**66**
"developing 21st century skills" AND "online learning" AND "higher education" AND (effective OR outcomes)	**29**
Additional searches and databases	**181**
TOTAL IDENTIFIED	**769**

In line with Arksey and O'Malley's (2005[4]) method, the initial search was iterative; search terms were regularly refined, reference lists of included studies were checked, additional databases such as Google Scholar were used for supplementary searches, and relevant journals were hand-searched to be as comprehensive as possible. This produced an additional 181 papers for screening. As the paper was drafted, additional publications outside of the set of 94 reviewed papers were cited as needed to provide context, for example, about the general effectiveness of online learning. The search took place in April 2023 and was updated in December 2023 to include papers published in 2023.

1.2.2. Inclusion and exclusion criteria

After duplicates were removed, the remaining papers were screened for inclusion, first by title and abstract and then by full text, according to the criteria below. Research studies were included that:

- explicitly address the development of higher-order thinking skills in online, blended or flipped models of higher education, in either undergraduate or graduate programmes. Literature that only covers student skills or only covers online, blended or flipped education was excluded.
- address higher education in any discipline (papers that address only primary or secondary education were excluded).
- are written in English.
- were published within the last 21 years, between 2002 and 2023 inclusive. Papers published after December 2023 or before January 2002 were excluded for reasons of feasibility.
- were published in peer-reviewed scholarly journals (conference presentations, book reviews and grey literature were excluded).
- address learning outcomes, effectiveness or success factors for online learning in relation to skills development.
- address programmes and courses that are either permanently or temporarily taught online, with students who choose to study online for all or part of their programme, were randomly assigned to study online for part of their course or programme, or studied online as a result of social distancing requirements during the COVID-19 pandemic.

In an effort to be as comprehensive as possible, this scoping review includes studies with a broad range of methodological approaches, including research that is empirical or

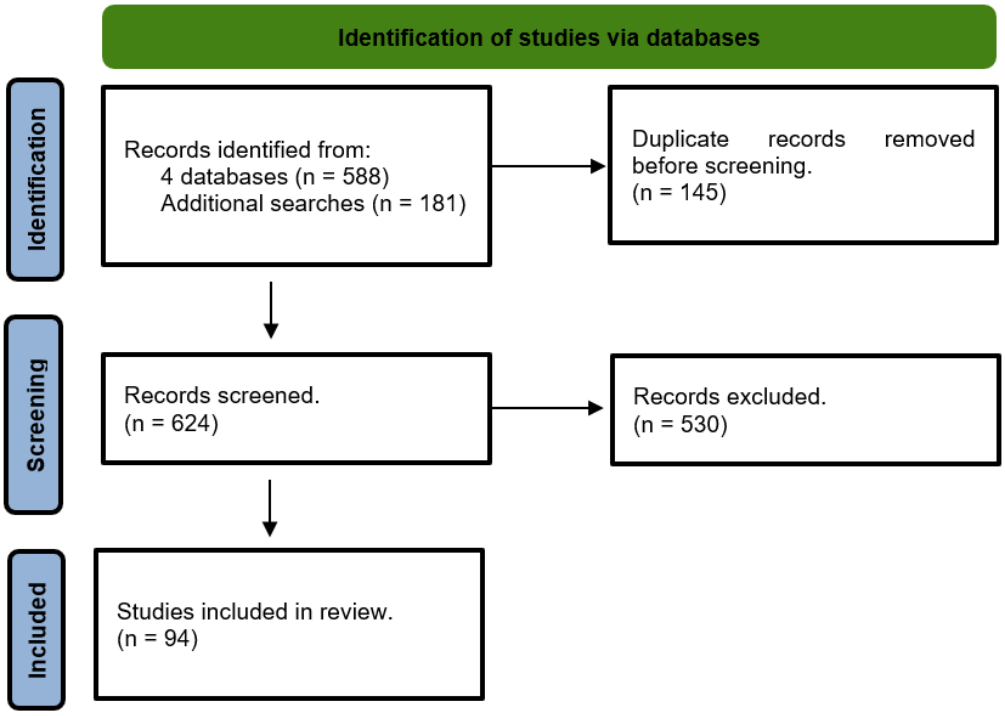
descriptive and quantitative or qualitative in nature, as well as reviews of literature and practice. Beyond ensuring included papers are peer reviewed and published in scholarly journals, assessing the quality of individual papers before including them in the study is not part of the remit of a scoping paper (although a scoping paper might comment on the overall quality of the body of research) (Colquhoun et al., 2014[3]). However, in this case, a small number of papers identified for screening were excluded because their poor English grammar and syntax made them difficult to comprehend. Other reasons for exclusion during the screening process included papers not addressing effectiveness or skills outcomes, papers focussed on domains outside of higher education (e.g., non-formal or work-based learning), papers that could not be retrieved for screening, or papers that contained only cursory mention of either higher-order thinking skills or online learning.

This scoping review focusses on fully online learning with some attention given to blended and flipped learning. An in-depth discussion of hybrid learning is beyond the scope of the current paper (hybrid learning is used here to mean that some students attend physically in-person, and some students join the same session online. See Table 1 for clarification of how terms are used in this paper). The specific practices required in hybrid learning to include students participating online as well as in-person, as well as practical and technical considerations about placement of screens, cameras, and microphones make it a special case of online learning that requires more detailed attention than can be provided here. Finally, the paper does not discuss Massive Open Online Courses (MOOCs), focussing instead on online learning as part of formal institutional programmes within higher education.

1.2.3. Number of papers included

769 papers were identified and screened by applying the above inclusion and exclusion criteria, which led to a final body of 94 reviewed papers. Figure 1.1 provides a PRISMA flow chart showing the details of the number of screened documents.

Figure 1.1. PRISMA flow chart of screening process



Source: Author's elaboration, based on (Page et al., 2021[7]).

1.2.4. Charting included papers

The data was systematically extracted into a form, which captured the main information on study aims, country, course, discipline, study duration, skill focus, methods and evidence used, student level, online type and main findings. Although it is customary that more than one researcher take part in the screening of papers and charting of data for scoping reviews (for both practical reasons and as a safeguard against bias), in this case only one researcher was responsible for the whole study selection, extraction, analysis, and writing process.

2. Defining terms: Higher-order thinking skills

The term higher-order thinking skills is often related to Bloom's learning taxonomy, later revised by Anderson and colleagues, which aimed to classify learning outcomes (Anderson et al., 2000[8]). The revised taxonomy featured six categories of cognitive process: 1) remember, 2) understand, 3) apply, 4) analyse, 5) evaluate and 6) create. These processes move progressively from requiring simple and concrete thinking at the lower levels to more complex and abstract thinking at the higher levels. The taxonomy offered sub-categories under each of the six processes (critiquing, for example, falls under evaluate) and suggested they could be applied to four different types of knowledge (factual, conceptual, procedural and metacognitive) (Krathwohl, 2002[9]). Higher-order thinking skills involve students moving beyond simply memorisation and recall towards the 'higher levels' of a thinking process, involving analysis, evaluation and creation (McLoughlin and Mynard, 2009[10]). They can be particularly important when responding to non-routine problems faced, for example, in many contemporary workplaces (Lewis and Smith, 1993[11]).

Higher-order thinking skills enable students to generate and evaluate ideas and solutions and are important to employability, well-being, civic participation, and innovation (Vincent-Lancrin et al., 2019[12]). Exactly what does and does not count as a higher-order thinking skill is still debated, however, and the area has been described as a conceptual swamp, defying attempts at clear delineation between higher-order skills on the one hand and broader terms such as reasoning or thinking in general on the other (Cuban, 1984[13]). For example, neither critical thinking nor problem-solving were included in the original or revised Bloom's taxonomy as the authors considered that, as they were popularly used at the time, these terms could fit under multiple categories (Krathwohl, 2002[9]). Despite this, critical thinking and problem-solving are commonly taken to be higher-order thinking skills, not least because they rely on analysis and evaluation. Given these debates, most authors have been content to offer operational understandings of the terms, outlying how they are used in a particular context rather than how they should be defined universally. In the present paper, higher-order thinking skills are operationalised to include critical thinking, evaluation, problem-solving, creativity and creative thinking.

2.1. The OECD fostering and assessing creativity and critical thinking project.

This paper supports a broader investigation into efforts to foster and assess creativity and critical thinking across educational systems. The OECD Centre for Educational Research and Innovation (CERI) runs a quasi-experimental research study on the development of creativity and critical thinking across primary, secondary, and tertiary education, including teacher education[1]. The project works with educational institutions, who undergo professional learning and then develop interventions to support student creativity and critical thinking within their subject teaching. The project starts from a shared vocabulary around creativity and critical thinking, set out in conceptual and assessment rubrics that were developed by teachers and can be used to discuss with students what creativity and critical thinking involves. The conceptual rubrics characterise creativity as "coming up with new ideas and solutions" and critical thinking as "questioning and evaluating ideas and solutions" and describe both skills under four sub-dimensions – inquiring, imagining, doing, and reflecting. This common language is used to inform the design of pedagogical interventions to foster and assess creativity and critical thinking alongside subject teaching. Monitoring instruments are administered to educators and students pre and post interventions, which aim to assess the perceived effects of the intervention on both staff and students (Vincent-Lancrin et al., 2019[12]).

The fieldwork for the higher education strand of the project began in January 2020 just before the start of the global COVID-19 pandemic. Early rounds of fieldwork took place during the initial period of emergency online learning. Participating faculty members experimented with explicitly integrating creativity or critical thinking into their teaching at the same time as they moved their classes online. This provided anecdotal information about the benefits and challenges of using online forms of learning to foster creativity and critical thinking. This paper contextualises this information through an examination of the extent of recent literature in the area of online learning and skills development. The focus of this paper is therefore on creativity (coming up with new ideas and solutions) and critical

[1] A quasi-experimental study, like a true experiment or a randomised control trial (RCT), uses control and treatment groups to try to understand the relation between the experiment and the outcome and to check that this relation cannot be explained by factors outside of the experiment. However, whilst in a true experiment, the subjects are randomly assigned to treatment and control groups, in a quasi-experimental research design, a non-random method may be used to assign subjects to groups (Abrami and Bernard, 2009[173]).

thinking (questioning and evaluating ideas and solutions), as they are defined by the OECD rubrics for creativity and critical thinking (Vincent-Lancrin et al., 2019[12]). Other elements of higher-order thinking, such as problem-solving or other 21st century skills, for example communication and collaboration, are addressed only intermittently.

3. Defining terms: Types of online learning

The use of online learning in higher education is not by any means new. Back in 2002, the President of Pennsylvania State University suggested that blended learning was the single greatest unrecognised trend in higher education (Graham and Allen, 2011[14]). Yet, despite more than 20 years of online teaching in higher education, there remains no universally shared related vocabulary, and terms such as blended, hybrid, and even online are used inconsistently to refer to diverse forms of teaching and learning (Smith and Hill, 2019[15]). This is not confined to the English language; multiple terms also circulate in other languages. The multiplicity of terms across languages can pose a challenge for developing and translating evidence on online learning in different contexts, as well as for discussing related policy and practice and developing institutional and inter-institutional exchange[2]. A shared taxonomy of terms related to online learning is needed within institutions, but also nationally and internationally (Dziuban et al., 2018[16]).

3.1. Terms related to online learning.

Although there are different uses of terms across policy, practice and literature contexts, some uses are becoming more prominent. Reflecting those patterns, the table below sets out how terms related to online learning are used in this paper.

[2] A recent OECD working paper on digital higher education found that quality assurance activities often need to start with creating a common understanding of digital education amongst higher education stakeholders, again highlighting the need for shared vocabulary and taxonomies (Staring et al., 2022[172]).

Table 3.1. Definitions of online learning terms

TERM	HOW THE TERM IS USED IN THIS PAPER
In-person	Students and faculty meet physically for teaching and learning activities.
Online	A form of distance or remote learning, which takes place fully online. In some systems, the final assessment (e.g., exam) may take place in-person but teaching and learning is delivered online. Can involve both synchronous and asynchronous modalities.
Synchronous	Students learn *at the same time* as other students in the class. A synchronous meeting can take place either online (using video conferencing for example) or in-person (in a lecture hall, for example) (Bernard et al., 2004[17]).
Asynchronous	Students are given learning tasks and deadlines to complete in their own time, meaning that students may be learning *at different times* (Bernard et al., 2004[17]). Students may connect to an online platform to complete asynchronous components (e.g., write on a discussion board or watch a recorded lecture), use online resources, or use offline analogue resources (e.g., work with paper and pen).
Blended	A combination of online and in-person learning within the **same course**. Some **sessions** of the course take place with all students participating online and some sessions take place with all students participating in-person (Ulla and Perales, 2022[18]).
Hybrid	A combination of online and in-person learning within the **same session**, where some **students** are present in-person and simultaneously some connect to the same session online. (Raes et al., 2020[19]). Hybrid has sometimes been used interchangeably with blended learning or referred to as bimodal but in the post-pandemic context, it has become more common to use the term hybrid to refer specifically to integrating online and in-person students in the same synchronous learning experience (Ulla and Perales, 2022[18]; Wahls, Dijkstra and Ouwehand, 2022[20]). This paper does not address hybrid learning in-depth.
Hy-flex	A form of hybrid learning, in which students choose how they attend class (i.e. for each session, students choose whether to attend in-person or online) (Malczyk, 2019[21]). Sometimes referred to as flex or polysynchronous learning. This paper does not address hy-flex learning in-depth.
Flipped classroom	Rather than receiving content in class (e.g., listening to lectures) and applying content out of class (e.g., in preparation of course work), students actively apply knowledge in class time and receive content (e.g. watch video lectures) out of class. Flipped learning can be seen as a form of blended learning as some parts of the learning experience make use of online tools and platforms whilst other elements retain their in-person element (O'Flaherty and Phillips, 2015[22]).

3.1.1. Blurred boundaries in practice

This diversity of language is no surprise given that even as defined above and used in this paper, each of these forms of online learning are umbrella terms embracing a wide range of learning approaches which can look quite different to one another in practice (Garrison and Kanuka, 2004[23]; Hrastinski, 2019[24]). For example, the "blend" or mix of blended learning can refer to various combinations of synchronous and asynchronous, online and in-person learning at the levels of individual activities, courses, programmes, or institutions (Dziuban et al., 2018[16]). It is usually the total percentage of online delivery that determines whether the course is labelled as online or blended. A course taking place 90% online may be seen as online, whereas a course taking place 60% online and 40% in-person may be regarded as blended. In most blended learning designs, one element (i.e. either online or in-person) dominates the other (Wahls, Dijkstra and Ouwehand, 2022[20]; Neumeier, 2005[25]). However, questions abound as to where the cut off lies between different forms of learning (Khalil, Meguid and Elkhider, 2018[26]).

These blurred boundaries, and the range of teaching and learning approaches they represent, bring challenges for establishing a solid body of evidence about what constitutes effective practice. This is one reason why a scoping review, including descriptive studies, can helpfully build clarity in this area. The analysis that follows attempts to better understand the breadth of evidence available, its specificity, and the extent to which it is generalisable to different forms and environments of online learning. Research suggests that models of online delivery should remain flexible to enable them to respond to their

contexts and to a wide variety of learning objectives, student levels, subjects and purposes (Moskal, Dziuban and Hartman, 2013[27]). Understanding the quality of evidence and the extent to which it can be applied to different combinations of online learning is an important part of supporting such flexibility and responsiveness.

4. What is the extent of research evidence on fostering higher-order skills online and what gaps exist?

Despite a growing literature on online learning generally, the variety in this field means that evidence on the effectiveness of specific types of online learning for the development of specific higher-order skills remains sparse. This scoping review identified 94 papers divided over a range of different types of online learning, skills, disciplines, countries and methodological approaches.

4.1. The distribution of evidence

Looking at the distribution of included studies reveals a number of trends and gaps:

Lack of research attention to creativity: Forty-seven of the included studies primarily addressed critical thinking whilst only ten were addressed primarily to creativity. The remaining 37 covered a set of skills such as 21st century skills, problem-solving skills or the four Cs (collaboration, communication, creativity and critical thinking), many of which gave only passing attention to creativity. This suggests a need for more sustained attention to whether and how creativity can be fostered in online learning environments.

The English-language literature is dominated by research from the United States, but individual studies exist from a broad range of other countries: Twenty-five of the included studies were from the United States, which was the most represented country. There were eight studies from the People's Republic of China, six from Chinese Taipei, and Indonesia, four from Canada, three from the United Kingdom. The rest were divided relatively equally between a further twenty countries and economies. The review focussed on English-language studies only and there is likely to be more evidence available in local languages.

A more established literature in education, health sciences and business but little coverage of other disciplines or of multiple disciplines: The most common discipline addressed by included papers was education, which was the focus of 28 of the 94 included studies. This dominance of education was also identified in a previous review on the development of critical thinking online (Chou, Wu and Tsai, 2019[28]). The second most common disciplinary area covered by the papers was health studies (including nursing, physiology, and veterinary sciences) with ten of the included papers. There were eight studies of business and management courses, six in English as a foreign language (EFL) courses, three in psychology and two in economics. Six of the papers did not specify a discipline whilst eight were reviews that covered a multitude of disciplines. A further six addressed an interdisciplinary course or courses in more than one discipline. The rest of the papers came from additional individual disciplines, including geography, dance, biochemistry, agriculture, engineering and information systems. More attention is needed to how to develop higher-order thinking skills online in particular disciplines and across disciplines, especially given that higher-order thinking skills may manifest differently in different disciplines (Baer, 2016[29]; Barbot, Besançon and Lubart, 2016[30]).

Acceleration of interest since the COVID-19 pandemic: Fifty-six of the included studies were published between 2002 and the start of the COVID-19 pandemic in 2020, whilst

thirty-eight were published from 2020 onwards. This means around 40% of included studies were published in the last four years, compared to around 60% in the previous 17 years.

4.2. Methodological approaches

Thirty of the included studies were experimental or quasi-experimental, eight were literature reviews and the rest were non-experimental, usually mixed method case studies or cross-sectional quantitative studies focussing on particular details of online courses. A small number were descriptive or theoretical. Many of the included experimental and quasi-experimental studies compared different types of online learning with in-person learning (see section 5 for a mapping of this literature).

All included studies, whether quantitative or qualitative used one or more of the following seven kinds of evidence:

1. Student outcomes (assessment scores, either teacher-given or standardised) (used by 43 or around 46% of included papers)
2. Student course work (content analysis of student work) (25 studies or approx. 27% of included papers)
3. Student or faculty perceptions (gathered via questionnaires, surveys, focus groups or interviews) (40 papers or about 43% of included papers)
4. Reviews of the literature (8 out of 94 or about 9% of included papers)
5. Direct observation of teaching and learning (4 out of 94 or around 4% of included papers)
6. Student evaluations (3 out of 94 or around 3% of included papers)
7. Descriptive or theoretical (8 out of 94 or around 9% of included papers)

It was most common for studies to use between one and three of these types of evidence, but one study used four types (Giacumo and Savenye, 2020[31]). The range of types of evidence and methodological approaches is necessary to building up a well-rounded picture of online skills development. However, the same variety can make aggregating the collected body of evidence more difficult.

4.3. The limitations of this body of research

The research literature in this field is fast growing and varied, but also remains under-developed. This is remarked upon within the literature itself (McPherson and Bacow, 2015[32]). Coelho and Martins (2022[33]) suggest the related literature is still in its infancy and others point to the need for more robust research design in this area (De Brún et al., 2022[34]). Several experimental or quasi-experimental studies exist (as mentioned, 30 were included in this review) although these often involve small convenience samples or are limited in scope and detail. Only 19 of the 94 included studies had sample sizes over 100 and only 12 of those more than 200. The largest sample size was 2 458 (Wang et al., 2023[35]). In addition, the following factors mean that caution is required about how research findings are interpreted, and provide directions for further research in this area:

Short study durations: Almost all 94 studies looked at semester-long university courses varying in length from four to twenty weeks. One study covered two semester periods (Yang, Newby and Bill, 2005[36]) and another covered one semester but with a retention test four weeks later (Şentürk, 2021[37]). Several studies noted that this as a limitation in

that one semester may not be long enough to have a significant effect on students' higher--order thinking skills and called for more longitudinal studies of longer duration (Al-Fadhli and Khalfan, 2009[38]; Altınay, 2016[39]; Şendağ and Ferhan Odabaşi, 2009[40]; Al-Husban, 2020[41]). One study noted that short study durations of one semester implied a need to develop more sensitive scales and monitoring instruments to pick up smaller changes in the quality of student work (Ertmer et al., 2007[42]).

Lack of specificity regarding online experience and choice to study online: Evidence suggests that online learning becomes more effective when it is more familiar to students (Fructuoso, Albó and Beardsley, 2022[43]; Richardson and Ice, 2010[44]). Students in later years of their higher education journey may have more readiness for online or flipped learning (Hao, 2016[45]). Although, one study did not find any difference in skills outcomes according to the online experience of students (Alexander et al., 2010[46]), others find that online learning models and their effectiveness change over time (Alhammadi, 2021[47]). A meta-analysis on the use of blended learning in business courses found evidence of a clear learning curve, suggesting that blended learning gets better outcomes as it becomes a more prominent part of an institution's offer (Cosgrove and Olitsky, 2015[48]). It might also be expected that the characteristics and experience of faculty make a difference to how successfully they facilitate skills online and that students who choose to study online may have different perceptions and needs than those who are randomly assigned to study online (Limniou, Schermbrucker and Lyons, 2018[49]). However, few of the included studies reported how much experience the instructor, institution or students had in online teaching and learning or, in some cases, whether or not they chose to be studying or teaching online.

Missing details on pedagogy: Several studies suggest that the effectiveness of online learning for skills development depends on both context and pedagogy used (Mueller and Wulf, 2022[50]; Mandernach, Forrest and Babutzke, 2009[51]). However, papers tended to provide few details of the pedagogy used, meaning the learning conditions they study would be difficult to replicate. Nevertheless, some more detailed studies are included in the current review, which provide useful starting places for understanding the pedagogical techniques that have been associated with online skill development (See section 6 for a synthesis).

Other limitations also exist. For example, although most studies are careful to use either established measurement instruments (e.g. the California Critical Thinking Skills Test (Facione, 1990[52]) or to test the validity of instruments developed by researchers, there is still some debate about what these skills look like in practice (Brookfield, 2011[53]; Egan et al., 2017[2]). The complexity of these skills might cause some construct validity and comparability issues across the body of literature. There may also be a publication bias in that studies that find statistically insignificant or negative results are less likely to be published (Franco, Malhotra and Simonovits, 2014[54]). An additional challenge is that, as detailed below, the large-scale and rapid scale-up of online learning that took place during the pandemic reduces the relevance of studies that took place before the pandemic. Yet studies that took place during COVID-19-related social distancing restrictions were often hastily designed and reflected a very particular pandemic context, so their generalisability to post-pandemic conditions may also be limited.

4.4. Evidence from the pandemic: challenges and opportunities

Remote learning during the COVID-19 pandemic bought more wide-spread online practices and experimentation, but research suggests that the pedagogy used in pandemic online teaching, and its effectiveness, varied across institutions (Cacault et al., 2021[55]). Monitoring and evaluation frameworks were not often in place to measure the effect of moves to online learning during the pandemic and the related evidence remains limited in

scope. Despite these limitations, there is evidence of faculty experiencing stress and overwork, students experiencing mental health difficulties and screen fatigue, and a lack of strategy, integration and policy for institutional approaches to online learning during the pandemic (Junus et al., 2021[56]). There is also some evidence that the shift to online learning had a negative effect on learning outcomes in some contexts. For example, one study randomized 555 students across 12 instructors and found that final grades (teacher-given grades across all assessment activities in each course) dropped by 0.215 standard deviations and that this difference increased for lower-ability students (Kofoed et al., 2021[57]). In general, however, caution should be exercised around using evidence on the effectiveness of the emergency move to online learning to make conclusions about online learning in general. The pandemic move to online learning was imposed rather than identified as most appropriate for a particular context and planned over time. The health, political, social and economic circumstances that surrounded the pedagogy used during this period were extraordinary (Williamson, Eynon and Potter, 2020[58]).

4.5. Summary: The extent of evidence and remaining gaps

The wide range of studies illustrates the heterogeneity in this area and provides a useful emerging picture of how research on online skills development has been approached. Further thought about study design and methodological approach is needed to address the challenges of small sample sizes, short study durations, and varying population characteristics and models of online learning. More in-depth attention is needed to understand the effectiveness of different types of pedagogy for the online development of higher-order thinking skills in a changing post-pandemic context. Not enough is known about fostering creativity online or how to foster these skills in particular disciplines for students at different levels, especially given that the changing contexts in which students may need to exercise creativity in the future. Despite its limitations, however, the existing literature does offer a useful range of starting places for further understanding the effectiveness of online learning and its variation. The following sections map some of the main findings of this body of research, concentrating first on the comparative literature (section 5) and then on the more descriptive literature (section 6), and reflects further on the generalisability of findings.

5. What comparisons are made in this body of literature and what can be learnt from them?

This section looks in more detail at the literature that compares the effectiveness of different forms of in-person and online learning for the development of higher-order thinking skills. It moves through a number of types of comparisons, synthesising key findings and noting any limitations to this approach. This part of the paper starts with a short section that addresses the more established literature which makes comparisons between online and in-person learning generally, rather than specifically for skills outcomes. Although not the central focus of this review, this offers important context for the reviewed studies that do address skills outcomes directly, as well as highlighting some of the benefits and challenges of comparative evidence in this domain more generally.

5.1. Online learning compared to in-person learning.

5.1.1. Subject knowledge outcomes

There is a substantial literature that compares the effectiveness of online learning and in-person learning but focusses on subject knowledge outcomes generally rather than looking specifically at higher-order thinking skills. The key findings of this literature include:

Stronger outcomes in-person than online for most students and purposes: There is some relatively extensive experimental evidence suggesting that fully in-person learning results in better outcomes than fully online learning for most students and purposes. Pre-pandemic studies showed a positive relationship between in-person education and student satisfaction, perceived learning and performance (Alpert, Couch and Harmon, 2016[59]; Xu and Jaggars, 2013[60]; Figlio, Rush and Yin, 2015[61]). Evidence also suggests that studying fully online is associated with higher attrition rates in both the studied course and courses taken subsequently, poorer progression and worse labour market outcomes than studying in traditional in-person settings (Bettinger et al., 2017[62]; Cacault et al., 2021[55]; Deming et al., 2016[63]).

Speculation on what explains favourable results for in-person learning: Beyond the advantages of shared social context, interaction, and relationship and community building (Price Banks and Vergez, 2022[64]), studies suggest that students may need to take notes more diligently in-person (as there is usually no video record of the lecture), students may get to know the instructor better and be more willing to ask for help, struggling students may be more visible to the instructor, and attending classes in-person may be beneficial to developing a routine to support learning (Cosgrove and Olitsky, 2015[48]).

Studies do not always take into account the specificities of the online context. There is some room for caution, however. In an effort to compare like with like and ensure variables are observable, many existing experimental studies on the effectiveness of online learning compare lecture delivery in-person with lecture delivery online, with all other dimensions of the learning experience kept constant (Bernard et al., 2004[17]). For example, one study compares attending lectures in-person with attending the same lectures via live-streaming, with no video recordings available for later review and with the camera placed at the back of a large lecture theatre, at a considerable distance from the professor at the front (Cacault et al., 2021[55]). This is not unreasonable, given that this may be how online lectures are delivered in some contexts, especially for larger sized classes. The authors find negative effects of viewing live streams of lectures on the grades of lower ability students, with an average decrease over this group of approximately 2 percentage points and an increase of approximately 2.5 percentage points for students at the top of the study's ability distribution. However, research suggests that one cannot simply transfer the same pedagogical methods used in-person to online contexts, but that instead online environments have unique affordances and limitations, requiring a different organisation and design of learning or the provision of different types of learning resources and tools (Vaughan, 2014[65]; Altınay, 2016[39]). One might expect to find that in-person learning is more effective than online learning if the affordances of online learning are excluded from study. What can be concluded from many of these comparative studies, therefore, is that online delivery is less effective than in-person delivery when it attempts to replicate in-person delivery exactly, rather than that online delivery is less effective per se.

The challenge of comparing equivalent versions of in-person and online learning: There are some experimental studies that try to address this and make comparisons between more equivalent versions of in-person and online learning. For example, one study compared groups of students randomly assigned to a live section and to an online section,

which were identical in every way except for the format of lecture delivery. However, in this study, both groups had access to an online platform containing a wide range of online resources so that the implicit reference point was no longer the resources provided in a traditional in-person course. The study found modest benefits in grades for students in the live section, and, as in several other studies, found that those benefits were uneven in magnitude across different subgroups of students (Figlio, Rush and Yin, 2015[61]). It is unclear whether this would also be the case for students who choose to study online rather than being randomly assigned to study online as part of a research design. The comparative literature in this area has often lacked nuanced attention to the idea that different forms of learning and combinations thereof may be more or less effective for different kinds of objectives, contexts, and levels of study and to different groups of students at different periods of their programmes (Escueta et al., 2017[66]).

5.1.2. Higher-order thinking skills outcomes

Inconclusive evidence about the effectiveness of fully online learning for skills outcomes: Strong experimental evidence from both before and during the pandemic regarding the use of online, flipped, and blended learning for the development of higher-order cognitive skills is lacking or inconclusive (O'Flaherty and Phillips, 2015[22]). For example, a small-scale experimental study in Scotland compared online discussion to in-person discussion of a journal article and found online discussion was better at encouraging students to weigh evidence whilst in-person discussion featured more interaction. Results were inconclusive about which mode of study was preferred by students (Guiller, Durndell and Ross, 2008[67]). Another small quasi-experimental study in Kuwait, using the California Critical Thinking test, found that e-learning groups outperformed control groups in critical thinking and that this difference was more marked for male students (a mean increase of 1.8) than for female students (a mean increase of 0.5 points) – but that more than 12 weeks would have been needed to see more developed critical thinking (Al-Fadhli and Khalfan, 2009[38]). A previous review also commented on the lack of research attention comparing online and in-person learning for skills outcomes and highlighted that the majority of those studies that do exist do not generally find statistically significant differences in outcomes between online and traditional courses (McPherson and Bacow, 2015[32]).

5.1.3. Uneven outcomes

Uneven outcomes both for subject knowledge and for the development of higher-order skills: Perhaps the most important learning from the comparative literature regarding the effectiveness of online forms of learning both pre and during pandemic is that online learning has often led to uneven learning outcomes for different groups of students - both for subject knowledge and for the development of skills. Studies find evidence that students who are high achievers in traditional in-person settings tend also to achieve well in the online context (Broadbent and Poon, 2015[68]; Cacault et al., 2021[55]). Conversely, the barriers faced by disadvantaged students in in-person education can be exacerbated online, further increasing achievement gaps (Xu and Jaggars, 2014[69]). Several studies on flipped classes and blended learning find that positive effects on learning outcomes increase with previous student achievement (Swoboda and Feiler, 2016[70]; Setren et al., 2021[71]; Hao, 2016[45]). For example, one quasi-experimental study in Thailand found blended learning could lead to positive outcomes for critical thinking when attention was provided to supporting student motivation, but there were differences according to student attitudes and levels of self-regulation (Deechai and Sovajassatakul, 2019[72]). Studies also show that online learning during the COVID-19 pandemic, bought more challenges for working students, parents, those who shared computers with family members, those with poor bandwidth, and those who spoke a first language different from the language of instruction.

Often, these factors were concentrated in students from more disadvantaged backgrounds (Ezra et al., 2021[73]).

5.2. Online learning compared to blended learning

Blended models show better results than fully online learning, for subject knowledge and for skills: Some experimental studies find that blended learning (i.e. some "contact hours" with students spent online and some spent in-person) is associated with modest benefits compared to fully online learning, related to increased student motivation, access, and student to student interaction (Nguyen, 2017[74]; McCutcheon, O'Halloran and Lohan, 2018[75]). Studies suggest that blended learning, when appropriately designed, can provide flexibility, just-in-time learning (i.e. meeting the learning need of the student in the moment it arises rather than at a pre-set time), as well as greater access to classes for students with work or family commitments or reduced mobility, with no reduction in learning or skills outcomes (Alpert, Couch and Harmon, 2016[59]; Müller and Mildenberger, 2021[76]). However, these studies also suggest that this is largely dependent on context and how much interaction is built into the design of such learning and it is therefore inappropriate to draw generalised conclusions about blended learning from most existing research (Koç, 2017[77]).

5.3. Blended learning compared to in-person learning

Blended learning has some benefits for developing higher-order thinking skills: For example, one experimental study on skills development in blended problem-based learning found that blended groups did significantly better in tests of critical thinking than groups receiving in-person learning only (Swoboda and Feiler, 2016[70]). Another pre-pandemic quasi-experimental study comparing blended learning to in-person learning for nursing education in China found that students in the blended learning condition showed significantly more improvement than those in the in-person condition in a Chinese version of the California Critical Thinking Disposition Inventory (CCTDI), measuring constructs such as open-mindedness, inquisitiveness, analyticity and curiosity (Yu et al., 2021[78]). A quasi-experimental study comparing blended learning to in-person learning found that those in the blended condition developed more 21st century skills, with a mean score of 4.66 for blended learning, versus 3.06 for the control group. The effect size was r = 0.944, but no details were given on pedagogy (Şentürk, 2021[37]). An Indonesian quasi-experimental study found that blended learning resulted in modest improvements in grades for both subject knowledge and 21st century skills compared to in-person learning for 48 teacher educators (Hadiyanto et al., 2021[79]). Several studies find that students perceive that they are better able to develop critical thinking though blended learning (Mintu-Wimsatt, Sadler and Ingram, 2007[80]; Lu, 2021[81]) In addition, some descriptive studies suggest that the increased autonomy and independence of students in blended learning can lead to more emphasis on student-constructed meaning, which in turn can support the development of higher-order thinking skills (Garrison and Kanuka, 2004[23]; Nussbaum et al., 2020[82])

5.4. Flipped learning compared to in-person learning

Flipped learning has been associated with some positive skills outcomes: Flipped learning involves students assimilating knowledge before class, often using online tools, and actively discussing and applying it during class time and thus is a form of blended learning. Some studies suggest that this way of organising teaching time also provides more opportunities for active and collaborative learning (Roach, 2014[83]; Eagleton, 2017[84]).

Four experimental or quasi-experimental studies and found better results for flipped learning than fully in-person learning:

- An experimental study of a community nursing course, found the flipped condition led to higher academic performance and increases in self-reported higher level thinking abilities but did not improve student satisfaction and course experience and that more may be needed to create student buy-in for active flipped approaches (Dong et al., 2021[85]).
- Another found that combining flipped learning with a project-based approach could effectively develop critical thinking when combined with careful professor feedback and conscious attention to keeping students motivated (do Amaral and Fregni, 2021[86]).
- A third quasi-experimental study found learning outcomes, including for skills, were an average of 10.5% higher in flipped than in traditional didactic teaching but suggested the need for further studies to ascertain if flipped learning would result in long-term retention of this knowledge and skills (O'Connor et al., 2016[87]).
- A fourth quasi-experimental study of an e-learning course in teacher education found flipped learning led to more positive results for the development of creativity than a traditional lecture format, particularly for measures of fluency, flexibility and novelty (Al-Zahrani, 2015[88]).

In addition, several of the included studies find positive student perceptions about flipped learning for skills development (Fructuoso, Albó and Beardsley, 2022[43]; Latorre-Cosculluela et al., 2021[89]; O'Flaherty and Phillips, 2015[22]; Rodríguez et al., 2019[90]).

5.5. Summary: What can be learnt from comparisons and their limitations

Studies from before and during the pandemic support the long-established view that situated social interaction and human relationships are important for learning and difficult to replicate in learning that takes place fully online, which is necessarily mediated by a screen. However, when in-person learning is supplemented with online learning, this can provide opportunities for educators to create learning experiences which encourage students to develop their subject knowledge whilst also exercising higher-order thinking skills such as creativity and critical thinking. Beyond this, there are limitations to this comparative literature, including the need for more scholarly attention to research design and methods of comparison of modes of learning that can be quite different from one another. This has also been pointed out by McPherson and Bacow (2015), who write,

> *Ultimately, there are limits to what can be learned from piling up longer lists of A to B comparisons between online and traditional versions of the same course particularly when the definitions of "online" and "traditional" vary from one example to the next. (This is not to say that we cannot learn from such comparisons, only that we have to be careful about generalizations.) What we really lack is an adequate understanding of what makes for effective instruction in particular settings, with students who have particular characteristics, with effectiveness judged by the achievement of well-defined and valued outcomes. (McPherson and Bacow, 2015, p. 146[32]).*

McPherson and Bacow's conclusion is just as relevant at the time of writing in late 2023 as it was in 2015. The literature is dominated by generic references to online or blended learning and there is a need to look more closely at individual instructional strategies that can change what online learning looks like and involves (and therefore its effectiveness)

from context to context. The next section looks at the nature and extent of existing evidence on the more contextual elements that impact the effectiveness of online learning for skills development.

6. What factors have been associated with effective online learning for higher-order thinking skills?

The comparative literature covered in the previous section tries to establish which modes of delivery lead to better outcomes for the development of higher-order thinking skills. Several studies find that the effectiveness of online and blended models can vary greatly across contexts with different characteristics (Koç, 2017[77]; Cacault et al., 2021[55]). The question naturally arises, therefore, of what makes a difference? What methods and factors can lead to the effective development of higher-order thinking skills in online forms of learning? The current section summarises how much evidence exists on the contextual variables that have been associated with the development of higher-order thinking skills online, drawing mainly on the more descriptive studies identified in this scoping review. However, this literature does not always provide generalisable and robust evidence and does not cover the whole range of possibly important variables. Therefore this section simply indicates where the research aligns on possible success factors and provides a brief summary of related findings.

6.1. Student self-regulation, motivation and persistence

Many of the included studies point to students' ability to self-regulate as a critical success factor for the development of higher-order thinking skills online ((Anwar and Muti'ah, 2022[91]; Stephen and Rockinson-Szapkiw, 2021[92]; Cortázar et al., 2022[93]; Iqbal et al., 2021[94]; Karatas, 2021[95]; Nussbaum et al., 2020[82]; Ekahitanond, 2013[96]; Fructuoso, Albó and Beardsley, 2022[43]). For example, one of these studies found that self-directed learning skills (understood as self-control, motivation, self-confidence, and self-monitoring) predicted readiness for online learning (with an effect size of 0.39) and differences in self-regulation skills may be one reason that online learning can result in uneven outcomes (Karatas, 2021[95]). Whilst one study was not able to find a strong relation between self-regulated learning and critical thinking (Anwar and Muti'ah, 2022[91]), another found that students who did significantly better in critical thinking in a standardised test, also had more positive attitudes to learning, higher motivation and more confidence about using online discussion boards (Ekahitanond, 2013[96]). Other studies note the importance of keeping students motivated online (Altınay, 2016[39]; do Amaral and Fregni, 2021[86]) and the role of student confidence levels as critical variables in how successfully online programmes can develop students' skills (O'Flaherty and Costabile, 2020[97]; Yang et al., 2013[98]; Richardson and Ice, 2010[44]). These studies build on a wider literature on the importance of persistence, motivation, self-efficacy and self-regulation both for online learning generally (Rovai, 2003[99]) and for in-person learning for creativity and critical thinking (Zielińska et al., 2021[100]).

6.2. Online pedagogy for higher-order thinking skills

The effectiveness of online learning environments for the development of creativity, critical thinking and other skills depends not just on whether learning takes place online but also on how the online environment is used. Although many of the included papers did not fully specify the pedagogy used, some did reflect on what kinds of pedagogies were associated with the development of higher-order thinking skills online.

6.2.1. Interactive and active learning

A large number of included studies cite interaction (between instructors and students and between students) and active learning (meaning students do not passively receive information but instead actively engage with the learning content through activities, discussions, collaborations, projects, reflection etc.) as critical success factors for the effectiveness of online development of skills (Alexander et al., 2010[46]; Chou, Wu and Tsai, 2019[28]; Coelho and Martins, 2022[33]; Ganeser, 2020[101]; Garrison and Kanuka, 2004[23]; Liao et al., 2020[102]; Mandernach, Forrest and Babutzke, 2009[51]; Nugraheni, Surjono and Punto, 2022[103]; Saadé, Morin and Thomas, 2012[104]; Williams and Lahman, 2011[105]). This focus on interaction and active online learning for skills development again builds on two or three decades of scholarly work on the importance of communication, collaboration, social dialogue and students being active in online learning generally (Rugube, Mthethwa-Kunene and Maphosa, 2020[106]; Beyer, Brownson and Evans, 2017[107]; Wilson and Lowry, 2000[108]). It also reflects a well-established and significant focus on active learning in the literature that addresses the development of creativity and critical thinking in in-person environments (Esquivel, 1995[109]; Henriksen et al., 2021[110])

What does interactive and active learning involve in online contexts? Traditionally, interaction in online learning has taken place mainly asynchronously and in writing, through students and academic staff posting messages on online discussion boards (there is a large literature on supporting higher-order thinking skills with discussion boards, which is summarised in section 6.2.2 below). However, in recent years as video conferencing software has advanced, discussion and interactivity also commonly take place synchronously, both in plenary and in smaller break-out groups as well as using a variety of asynchronous tools (e.g., video discussion boards) (Kofoed et al., 2021[57]; Li, Zhou and Lam, 2022[111]). In addition, opportunities can be provided for students to actively engage in planning, curating, collaborating, communicating, analysing and generating products with online tools, such as video and audio editing software, collaborative documents, online simulations, social media, video games, websites, and modelling tools (Dailey-Hebert, 2018[112]). In fact, it has been suggested that a focus on active learning is more important than the mode of delivery for the development of skills.

> *Results indicate that the mode of instructional delivery (face-to-face or online) is not as influential as the instructor's level of interactivity in promoting active engagement with course material. Findings suggest that the asynchronous component of online learning does not inherently prompt students toward enhanced critical thinking but may serve as a vehicle for online instructors to encourage increased engagement and critical thinking. (Mandernach, Forrest and Babutzke, 2009, p. 49[51]).*

Some studies do note, as in the quotation above, however, that active online learning does not automatically develop skills. Active learning needs to be planned carefully so as not to become one-dimensional "busy" work and to ensure that it generates learning and skills development rather than leading to simplification and superficiality (Kacetl and Semradova, 2020[113]).

Studies highlight that students sometimes resist both interaction and active learning online with evidence from the pandemic showing that some students preferred not to speak up during synchronous learning, or to keep their cameras switched off so their face could not be seen by others in the session (Yarmand et al., 2021[114]). Active learning, combined with video conferencing, have been associated with increased online learning fatigue in medical

students (de Oliveira Kubrusly Sobral et al., 2022[115]) and can be less effective if students are "left to their own devices" with little direction, support, or input from the instructor (Reese, 2014[116]). Active online learning pedagogies also require active facilitation and preparation from faculty, and measures to demonstrate the instructor's "teaching presence" in both synchronous and asynchronous learning (Costley and Lange, 2016[117]) (see box 6.1). A quasi-experimental study finds positive effects of participating in an online simulation for developing critical thinking skills but notes that this requires faculty to spend time carefully designing such simulations (O'Flaherty and Costabile, 2020[97]). In summary, this literature suggests that interactive and active learning approaches are necessary but not sufficient for the development of higher-order thinking skills online and require careful planning and targeted pedagogical support.

Box 6.1: Distance and presence in online learning

Effective online education usually means taking steps to lessen the effects of physical distance between students and between students and educators, for both subject knowledge outcomes and for developing student skills. One of the oldest and most well-known theories of distance learning is **Moore's theory of transactional distance**, suggesting that physical distance leads to a communication gap between lecturers and students. Moore argues that the distance becomes not just physical but also psychological, eventually becoming a pedagogical phenomenon (Moore and Diehl, 2019[118]). The theory suggests that three types of interaction are key to meaningful online learning: learner-learner, learner-teacher and learner-content interaction.

Garrison, Anderson and Archer developed this into the **Community of Inquiry (CoI) model**, suggesting that online interaction requires **cognitive presence** (the extent to which participants are able to construct meaning from their interactions together), **social presence** (the extent to which participants are able to identify with the community and communicate with trust) and **teaching presence** (the extent to which participants have a clear sense that the teacher is actively guiding the process and providing feedback). They looked for evidence of social, cognitive, and teaching presence in discussion posts of a computer-based teaching programme (Garrison, Anderson and Archer, 1999[119]). They suggested that cognitive presence involves four phases, (1) a trigger involving the identification of a problem for (2) further exploration, reflection and discussion, followed by a phase of (3) integration, which requires increased teacher presence to help students move to a deeper level of understanding, and finally (4) resolution in which students apply their new knowledge to a domain or workplace setting (Arbaugh, 2007[120]). In a later paper, they suggested that cognitive presence, a community of inquiry, along with skilled facilitation, are essential for the development of higher-order skills such as critical thinking online (Garrison, Anderson and Archer, 2001[121]).

Critiques of the community of inquiry model include claims that cognitive presence and course outcomes do not necessarily interact with social presence (Annand, 2011[122]). Nonetheless a major concern of the literature on online learning has been on the importance of online educators establishing, modelling, and measuring different kinds of "presence" even when they are not physically present with students (Akcaoglu and Lee, 2016[123]; Richardson et al., 2017[124]). During asynchronous learning, studies suggests that teaching presence can be supported by the instructor asking well-timed personalised questions and regularly offering alternative perspectives or elaborations (Apps et al., 2019[125]; Stone and Springer, 2019[126]; Rapanta et al., 2020[127]). The detailed mechanisms of establishing different types of "presence" in various forms of online learning are less clear, however, leading to some claims the construct needs to be better defined to support educators to operationalise it (Tu, 2002[128]). Despite this, a number of studies included in this scoping review find a positive relation between teaching, social, and cognitive presence and the development of higher-order skills online (Garrison and Kanuka, 2004[23]; Hosler and Arend, 2012[129]; Shwartz-Asher, Raviv and Herscu-Kluska, 2022[130]; Lee, 2014[131]; Hosler and Arend, 2012[129]).

6.2.2. Effective use of discussion boards for higher-order thinking

A good proportion of the included studies address the most effective way to use discussion boards to nurture higher-order thinking, with the majority of these studies focussing on

critical thinking (Yang, Newby and Bill, 2005[36]; Meyer, 2003[132]; Alexander et al., 2010[46]; Yang and Chou, 2007[133]). A discussion board is an online forum on which students can post messages, usually in writing, although video discussion boards also exist. Other students can reply or comment and therefore engage in discussion with each other without being in the same place at the same time. Each initial post is kept in a thread of discussion, providing a record of all posts in order. One qualitative study on nine different courses found that discussion boards can be conducive to critical thinking because they allow students time to reflect and to experiment informally with emphasising different elements of discussion. It also found that this was best supported by relatively infrequent instructor postings to give students time to develop their position and take ownership of the conversation (Arend, 2009[134]).

Another study found that separating online classes into small (<10) and medium (<20) sized discussion groups was more conducive to critical thinking. It found that students in larger groups find it more difficult to engage critically due to the high degree of cognitive load posed by the volume of posts (i.e. more working memory is needed to follow threads of discussion when there are large numbers of posts to keep track of) (Afify, 2019[135]). Two studies mention the promise of combining discussion boards with the use of case studies to encourage higher-order thinking in online learning (Saadé, Morin and Thomas, 2012[104]; Szabo and Schwartz, 2011[136]) Others emphasise the importance of reflective writing on discussion boards to support students' engagement and analysis. (Szabo and Schwartz, 2011[136]).

A 2014 review summarises a set of empirically supported pedagogical techniques for developing critical thinking on discussion boards, including structured discussion prompts, providing models of initial and follow-up posts that feature critical thinking, debate-based approaches, and student facilitation of the discussion board (Schindler and Burkholder, 2014[137]). A later review confirmed support for these techniques, along with additional approaches such as providing scripts or guidelines for how to construct posts that demonstrate critical thinking and including peer feedback and assessment of posts. The authors remarked, however, that although some empirical evidence exists for these techniques, the evidence is not extensive (Foo and Quek, 2019[138]).

Some studies also suggest that although higher-order thinking skills can be fostered at a basic or general level on discussion boards, that it is more challenging to foster more developed skill levels, especially over the relatively short time period of one semester (Al-Husban, 2020[41]; Meyer, 2003[132]). For example, a study on perspective-taking on discussion boards found that guided discussions (in which the instructor posts an initial question rather than allowing students to organise their own topics of discussion) could encourage some perspective taking in students. Yet, more in-depth levels of perspective taking whereby students demonstrate a nuanced understanding of multiple perspectives were not always evidenced and took longer to develop. (Chadwick and Ralston, 2010[139]). A further two studies found discussion boards could be used successfully to develop dimensions of critical thinking such as analysis and interpretation but that it was unusual to see more developed and nuanced 'critical' elements of critical thinking on discussion boards such as interrogating assumptions (Maurino, 2007[140]; McLoughlin and Mynard, 2009[10]).

> *The synthesis revealed that current literature touts the potential for development of deep learning and critical thinking skills through online threaded discussions. For the most part, however, research does not show this happening at a high level or to any great extent. Confounding the issue is the fact that current research is predominated by examination of education and graduate level online classes and*

is mainly focused on student perceptions and outcomes. (Maurino, 2007, p. 241[140]).

Again this quotation reminds us of the limited scope of this body of literature, as well as the challenges of reaching deeper expressions of critical thinking on online discussion boards.

There are some studies which address specifically how the instructor can support more developed aspects of critical thinking on discussion boards. One study described deepening critical thinking by asking students to tag different dimensions of critical thinking in their own and other student posts, in this case using a version of de Bono's 6 thinking hats (in which each colour hat represents a different part of a thinking process) (De Bono, 1990[141]). The authors suggested that this allowed the online discussion board to become both a visualisation and a reflection on what it means to think critically (Schellens et al., 2009[142]).

Another quasi-experimental study found that instructors can use Socratic questioning on discussion boards (i.e., posting a series of carefully constructed open-ended questions to stimulate rational thinking) to encourage students to engage in a deeper level of critical thinking and learning. In particular, they suggest using 6 categories of questions on discussion boards to move students beyond simply justifying a position and towards considering assumptions, alternative perspectives and uncertainty. This method showed particularly good results for students who had demonstrated lower levels of critical thinking when tested at the beginning of the course (Yang and Chou, 2007[133]). In the study, Socratic questioning involved a disciplined questioning process, using the following six categories:

1. questions of clarification,
2. questions that probe assumptions,
3. questions that probe reason and evidence,
4. questions about viewpoints or perspectives,
5. questions that probe implications and consequences,
6. questions about the question.

Although these studies are somewhat dated, discussion boards continue to be used in many online courses and so the methods they describe remain relevant.

Finally, a study using content analysis of student posts found that an experimental group who had experienced coaching around higher-order thinking demonstrated complex higher-order thinking more frequently than a control group who had not experienced such coaching (e.g. their posts more often not just demonstrated adequate justification for their position but also considered other possible positions, their assumptions and any remaining uncertainty) (Stein et al., 2013[143]). Coaching involved suggesting particular behaviours rather than prompting or modelling posts. However, beyond this the study was light on details or the differences between simply facilitating a discussion board and such coaching.

6.2.3. Online project-based learning for higher-order thinking

Several studies focus on well-structured project-based learning (in which students work on projects over an extended period, often centred around real-world problems) as a possible way to develop higher-order cognitive skills online (Cortázar et al., 2021[144]; do Amaral and Fregni, 2021[86]; Haniah and Setyaningsih, 2021[145]; Cortázar et al., 2021[144]; Peng et al., 2023[146]). For example, a quasi-experimental study comparing two teacher education cohorts undergoing blended learning, one using a problem-based approach and the other

using a "conventional" approach (with no further details given of what this involved) found better results for critical thinking in problem-based blended learning (Hursen, 2021[147]). Another small quasi-experimental study found a combination of project-based and flipped learning led to significantly improved higher-order skills as compared to conventional project-based learning (Listiqowati and Nyoman, 2022[148]) whilst a third found that project-based learning led to increased higher-order skills but had no significant effect on content knowledge learning outcomes (Şendağ and Ferhan Odabaşi, 2009[40]). There is little research coverage, however, of the details of facilitating project-based learning online for the development of higher-order thinking skills or on the sort of professional learning that academic staff may need to develop their approach to facilitating project-based learning.

6.2.4. Using a range of different pedagogical techniques.

Some studies suggest that using a range and combination of instructional techniques and learning activities is most effective for developing higher-order thinking skills online (Morin, Thomas and Sádee, 2015[149]; Fox, 2003[150]; Richardson and Ice, 2010[44]). One of these compares different pedagogical techniques, including learning journals, peer tutoring, online debate, and final reflections and finds that a combination of active methods is necessary to develop different dimensions of these skills. The study finds that some of these techniques do not make excessive demands on tutors' time, despite frequent reports that running online classes can take more time and planning than in-person courses (Fox, 2003[150]). Another quasi-experimental study finds it is important to use a range of instructional techniques, including brainstorming, role-playing, and Socratic questioning, claiming that regular change prevents students from getting so used to a particular approach that it becomes routine and keeps performance improving (Kalelioğlu and Gülbahar, 2014[151]). The experience of "flow" (the feeling of being entirely engaged in an activity) was identified in one study as a mediating factor on the positive effects of flexibility and interactivity in supporting skill and content knowledge outcomes in blended learning. The study also found that the experience of flow varies according to different online learning designs with different structures (Mueller and Wulf, 2022[50]).

6.2.5. Scaffolding

A number of included studies cite the importance of scaffolding (Haniah and Setyaningsih, 2021[145]; Jin et al., 2022[152]; Schellens et al., 2009[142]; Eagleton, 2017[84]; Yeh, 2012[153]; Giacumo and Savenye, 2020[31]; Cortázar et al., 2022[93]) and using small 'chunks' of learning content (Saadé, Morin and Thomas, 2012[104]) for the development of skills online. Scaffolding involves providing support to students with tasks they find challenging (this support could involve, for example, guides, prompts, careful questioning to guide student thinking, scripts, modelling etc.) and then gradually reducing that support over time so that students are able to accomplish more and more of the task independently (Acquaro, 2020[154]). For example, one paper studied an intentional learning design in which groups of students moved, with the prompting of the professor, progressively through four stages of collaborative critique, finding that this form of scaffolding was useful for developing critical thinking (Campbell, 2015[155]).

Another study looked at four different kinds of scaffolding or "ladders for learning" – procedural (supporting student understanding of process e.g. step by step guides), metacognitive (supporting student understanding of their own learning process e.g. prompts to self-monitor or reflect), conceptual (supporting student understanding of concepts e.g. offering different perspectives at key moments in the learning process), and strategic (supporting student understanding of potential problem-framing and problem-solving strategies e.g. providing gradually more complex learning materials) scaffolds. The

study found these methods contributed to better problem-solving learning outcomes, more satisfaction and greater management of cognitive load (Janson, Söllner and Leimeister, 2020[156]). An additional study found that providing a visual guide to the stages of project-based learning helped to narrow the achievement gap between high and low-achieving students (Peng et al., 2023[146]). Several studies mention that a scaffolded process of supporting student's metacognition is an important step in moving from learning in general to learning that fosters higher-order thinking skills (Karatas, 2021[95]; Maryani et al., 2022[157]), and can be further supported by the instructor providing explicit descriptions of what critical thinking involves (Swart, 2018[158]).

6.3. Assessment and feedback for higher-order thinking skills

Many included studies suggest that the effective development of higher-order thinking skills online is related to authentic or anchored assessment practices in which the focus is on how students can use and apply their learning in relation to real-life problems, scenarios or settings (Clemons SA, 2005[159]; Eagleton, 2017[84]; Nussbaum et al., 2020[82]; Mclachlan and Tippett, 2023[160]). Research also focusses on online peer assessment (Ekahitanond, 2013[96]) and careful regular feedback that aligns with the desired learning outcomes and content of the course (Cortázar et al., 2021[144]; Hosler and Arend, 2012[129]; Yeh, Huang and Yeh, 2011[161]; Eagleton, 2017[84]; Clemons SA, 2005[159]; Shively, Stith and Rubenstein, 2018[162]; Li et al., 2022[163]). However, studies suggest that if alternative assessment methods such as peer assessment are used, this needs to be paired with explicitly building student understanding of these methods. For example, one study looked at student perceptions of peer assessment in Ireland, finding that it caused apprehension in the first instance but with instruction and explanation students perceived it contributed to improvements in their critical thinking (De Brún et al., 2022[34]). Another found that although students often valued instructor feedback the most, they did ascribe some value to both giving and receiving peer feedback (Ertmer et al., 2007[42]). Other studies stress the importance of supplementing instructor and peer assessment with opportunities for students to engage in self-reflection (Stephen and Rockinson-Szapkiw, 2021[92]; Wang et al., 2023[35]). A final study found positive effects of online learning for developing creativity online but emphasised that feedback is crucial to supporting psychological safety (students feeling they can safely speak up, challenge, and make mistakes) (Robbins and Kegley, 2010[164]). However, again, the detailed mechanisms of what makes for effective online feedback for the development of higher-order skills online is missing from most studies.

6.4. Summary: What supports the development of higher-order thinking skills online?

Much like in-person teaching, the effectiveness of online learning for skills development depends on how the online teaching and learning takes place and is supported. Although studies do not always provide enough detail, there is evidence that interactive and active learning, project-based learning and careful scaffolding of the learning process are important to online skills development. The research also emphasises feedback and alternative methods of assessment including peer and self-assessment, as well as students engaging in reflective activities and their ability to self-regulate and maintain motivation. Empirical evidence exists for a range of techniques that can support higher-order thinking skills on discussion boards, including Socratic questioning, the use of case studies, student facilitation of the discussion board, and tagging student posts with skills markers. Much of this literature can provide only indications of the factors that might contribute to the effective development of higher-order thinking skills in certain contexts; it does not make causal claims and findings may have limited transferability. Yet, knowledge of the range

of evidence and findings can be useful to practitioners as they develop approaches to support higher-order thinking skills online.

7. Conclusion and policy implications

Debates about the promise of online forms of learnings have long existed, with some scholars championing the benefits of online learning (e.g. Waller, Lemoine and Richardson (2020[165])) and others lamenting its lack of interactivity (e.g. Kozakowski (2019[166])). The two sides can be equally intractable about the use of online learning for specific teaching and learning objectives, such as the development of creativity, critical thinking, and other skills. Arriving at a sufficiently robust and nuanced picture therefore requires both careful critical interrogation of existing research and the development of further evidence.

This scoping review has mapped out the variety of English-language evidence that exists on this topic, discussing two groups of studies. Comparative studies try to ascertain whether different modes of delivery can effectively develop students' higher-order thinking skills and which modes are most effective. A second group of studies examines the specific factors and pedagogical methods that have been associated with developing higher-order thinking skills online. This review offers an outline of the scope, findings and limitations of this wide-ranging literature – something which did not previously exist on this scale. Its synthesis of research on online pedagogy for higher-order thinking skills in particular provides a basis for the development of practice, policy and further research in this area.

There is evidence that in-person learning often leads to equivalent or better skills outcomes than online learning. Blended and flipped learning, on the other hand, may offer additional opportunities for the development of skills that move beyond what is possible with solely in--person delivery, particularly for high achieving students with experience of studying online. However, online, blended and flipped learning have generally resulted in uneven outcomes for both technical content and skills, which can concentrate and exacerbate disadvantage for some students.

Pedagogical approaches for the development of skills online include an emphasis on interactive and active learning, well-structured project-based learning, intentional facilitation of discussion boards, including student facilitation, tagging of student posts with skills markers, and Socratic questioning (i.e. using a series of focussed and open-ended questions to support discovery and reflection on a topic). Many studies focus on assessment, including peer and self-assessment, regular feedback, and promoting psychological safety in the learning environment (i.e., supporting students to feel they can safely make mistakes and disagree constructively). Although these approaches come from the literature on online learning, they have similarities with research on how higher-order thinking can be supported offline (Vincent-Lancrin et al., 2019[12]).

More research attention is needed to the detailed mechanisms through which these pedagogical techniques function online in specific disciplines, as well as to how to support students to develop more in-depth approaches to higher-order thinking skills online (e.g. to generate more unusual meaningful ideas or to consider what assumptions different perspectives are based on) and to demonstrate them more consistently. There is a lack of research specifically on how to support creativity online, but a significant amount of research on developing critical thinking online. Detailed evidence is also lacking regarding promising practices for embedding equity for skills outcomes across forms of online learning and disciplines. This is particularly pressing given evidence that online learning can result in uneven outcomes.

Developments in technologies such as generative artificial intelligence and virtual reality could also change the landscape of online skills development and the practices it involves. Not only do such developments need specific research attention, but they could also alter the way that skills are used and developed and therefore the questions and methodologies needed for related research. The limitations of this body of literature and the fast-moving technological landscape signify a need for caution about over-interpreting or generalising the results to make claims about what is effective across the board. In spite of a growing breadth of coverage, there is a need for greater depth in understanding what supports higher-order thinking skills in a variety of contexts, disciplines and modes of delivery.

The findings of this scoping paper do, however, have several implications for policy. There are a number of policy levers used by OECD countries to influence digital provision in higher education, as indicated in the OECD Higher Education Policy Survey (HEPS) (Broberg and Golden, 2023[167]). The HEPS found that creating innovation funds to support experimentation around digital tools and pedagogy is one way to support development in this area. Such innovation funds could be targeted to the exploration of online pedagogy for the effective and equitable development of higher-order thinking skills. It may also be helpful to provide guidance materials and facilitate national and international networks of institutions and educators to exchange on developing skills equitably online. This could be supported by integrating more attention to these skills, and to online pedagogy that can support them, in teaching qualifications (where they exist) and professional learning for academic staff (OECD, 2023[168]). This aligns with the ongoing need to support and reward better teaching generally in higher education, which is often characterised by greater attention to research quality than to teaching quality (Basilotta-Gómez-Pablos et al., 2022[169]; Van Damme and Zahner, 2022[170]).

The HEPS found that data is collected about the experiences of students and academic staff with digital modes of delivery at the jurisdiction level in very few systems (Broberg and Golden, 2023[167]). Given the relative scarcity of evidence found in the present scoping paper, this is a missed opportunity. Related research could be co-ordinated at the system level, with attention to how to mobilise the resulting evidence in the higher education system in question (OECD, 2023[171]). In view of the roles of creativity and critical thinking in innovation, employability and well-being, the importance of supporting these skills should be considered in discussions about the future of online delivery in higher education institutions and systems.

This paper contributes a thorough review of the extent of existing evidence and confirms the promise of blended and flipped learning for fostering higher-order thinking skills such as creativity and critical thinking. Ultimately, the findings of this scoping review suggest that the most interesting question is not whether online learning is effective for the development of higher-order thinking skills in higher education per se. Instead, it is important to understand how particular forms of online learning can be designed and delivered to be most effective and equitable for the development of specific higher-order thinking skills given the needs of particular students and faculty in a variety of disciplines and contexts. The research literature has only begun to provide this more fine-grained analysis.

References

Abrami, P. and R. Bernard (2009), "Research on Distance Education: In defense of field experiments", *Distance Education*, Vol. 27/1, pp. 5-26, https://doi.org/10.1080/01587910600653116. [173]

Acquaro, P. (2020), "Structuring and Scaffolding the Online Course", *International Journal of Online Graduate Education*, Vol. 3/1, https://doi.org/10.5281/ZENODO.3686090. [154]

Afify, M. (2019), "The influence of group size in the asynchronous online discussions on the development of critical thinking skills, and on improving students' performance in", *International Journal of Emerging Technologies in Learning*, Vol. 14/5, https://www.academia.edu/download/80263898/5522.pdf (accessed on 11 May 2023). [135]

Akcaoglu, M. and E. Lee (2016), "Increasing social presence in online learning through small group discussions", *International Review of Research in Open and Distance Learning*, Vol. 17/3, pp. 1-17, https://doi.org/10.19173/IRRODL.V17I3.2293. [123]

Alexander, M. et al. (2010), "Using the Four-Questions Technique to Enhance Critical Thinking in Online Discussions", *MERLOT Journal of Online Learning and Teaching*, Vol. 6/2. [46]

Al-Fadhli, S. and A. Khalfan (2009), "Developing critical thinking in e-learning environment: Kuwait University as a case study", *Assessment & Evaluation in Higher Education*, Vol. 34/5, pp. 529-536, https://doi.org/10.1080/02602930802117032. [38]

Alhammadi, S. (2021), "The effect of the COVID-19 pandemic on learning quality and practices in higher education—using deep and surface approaches", *Education Sciences*, Vol. 11/9, https://doi.org/10.3390/educsci11090462. [47]

Al-Husban, N. (2020), "Critical thinking skills in asynchronous discussion forums: A case study.", *International Journal of Technology in Education*, Vol. 3/2, pp. 82-91, https://eric.ed.gov/?id=EJ1264025 (accessed on 11 May 2023). [41]

Alpert, W., K. Couch and O. Harmon (2016), "A Randomized Assessment of Online Learning", *American Economic Review*, Vol. 106/5, pp. 378-82, https://doi.org/10.1257/AER.P20161057. [59]

Altınay, Z. (2016), "Evaluating peer learning and assessment in online collaborative learning environments", *Behaviour & Information Technology*, Vol. 36/3, pp. 312-320, https://doi.org/10.1080/0144929X.2016.1232752. [39]

Al-Zahrani, A. (2015), "From passive to active: The impact of the flipped classroom through social learning platforms on higher education students' creative thinking", *British Journal of Educational Technology*, Vol. 46/6, pp. 1133-1148, https://doi.org/10.1111/BJET.12353. [88]

Anderson, L. et al. (2000), *A Taxonomy for Learning, Teaching and Assessing: A revision of Bloom's Taxonomy of Educational Objectives*, Longman. [8]

Annand, D. (2011), "Social presence within the community of inquiry framework", *The International Review of Research in Open and Distributed Learning*, Vol. 12/5, pp. 40-56, https://doi.org/10.19173/IRRODL.V12I5.924. [122]

Anwar, Y. and M. Muti'ah (2022), "Exploration of critical thinking and self-regulated learning in online learning during the COVID-19 pandemic", *Biochemistry and molecular biology education : a bimonthly publication of the International Union of Biochemistry and Molecular Biology*, Vol. 50/5, pp. 502-509, https://doi.org/10.1002/BMB.21655. [91]

Apps, T. et al. (2019), "The role of social cues in supporting students to overcome challenges in online multi-stage assignments", *The Internet and Higher Education*, Vol. 42, pp. 25-33, https://doi.org/10.1016/J.IHEDUC.2019.03.004. [125]

Arbaugh, J. (2007), "An empirical verification of the community of inquiry framework", *Journal of Asynchronous Learning Networks*, Vol. 11/1, pp. 73-78. [120]

Arend, B. (2009), "Encouraging Critical Thinking in Online Threaded Discussions.", *Journal of Educators Online*, Vol. 6/1. [134]

Arksey, H. and L. O'Malley (2005), "Scoping studies: towards a methodological framework", *International Journal of Social Research Methodology*, Vol. 8/1, pp. 19-32, https://doi.org/10.1080/1364557032000119616. [4]

Baer, J. (2016), "Creativity Doesn't Develop in a Vacuum", *New Directions for Child and Adolescent Development*, Vol. 2016/151, pp. 9-20, https://doi.org/10.1002/CAD.20151. [29]

Barbot, B., M. Besançon and T. Lubart (2016), "The generality-specificity of creativity: Exploring the structure of creative potential with EPoC", *Learning and Individual Differences*, Vol. 52, pp. 178-187, https://doi.org/10.1016/J.LINDIF.2016.06.005. [30]

Basilotta-Gómez-Pablos, V. et al. (2022), "Teachers' digital competencies in higher education: a systematic literature review", *International Journal of Educational Technology in Higher Education*, Vol. 19/1, pp. 1-16, https://doi.org/10.1186/S41239-021-00312-8/FIGURES/6. [169]

Bernard, R. et al. (2004), "A methodological morass? How we can improve quantitative research in distance education", *Distance Education*, Vol. 25/2, pp. 175-198. [17]

Bettinger, E. et al. (2017), "Virtual Classrooms: How Online College Courses Affect Student Success", *American Economic Review*, Vol. 107/9, pp. 2855-75, https://doi.org/10.1257/AER.20151193. [62]

Beyer, C., S. Brownson and S. Evans (2017), "Enhancing interactivity in online classes: A framework for enhancing instructor-student, student-student, and student-content engagement", *International Journal of Learning*, Vol. 16/5, pp. 53-71, http://www.ijlter.net/index.php/ijlter/article/download/818/823 (accessed on 15 June 2022). [107]

Broadbent, J. and W. Poon (2015), "Self-regulated learning strategies & academic achievement in online higher education learning environments: A systematic review", *The Internet and Higher Education*, Vol. 27, pp. 1-13, https://doi.org/10.1016/j.iheduc.2015.04.007. [68]

Broberg, N. and G. Golden (2023), "How are OECD governments navigating the digital higher education landscape? Evidence from a comparative policy survey", Vol. OECD Education Working Papers. [167]

Brookfield, S. (2011), *Teaching for critical thinking: Tools and techniques to help students question their assumptions*, John Wiley & Sons, https://books.google.com/books?hl=en&lr=&id=r7DG2e41pZMC&oi=fnd&pg=PP1&dq=Teaching+for+Critical+Thinking:+Tools+and+Techniques+to+Help+Students+...&ots=UXTrhf81lM&sig=4kuYh7b_S71OD0ZNunNzKTwgGJE (accessed on 29 May 2023). [53]

Cacault, M. et al. (2021), "Distance Learning in Higher Education: Evidence from a Randomized Experiment", *Journal of the European Economic Association*, Vol. 19/4, pp. 2322-2372, https://doi.org/10.1093/JEEA/JVAA060. [55]

Campbell, M. (2015), "Collaborating on critical thinking: The team critique.", *Journal of Curriculum and Teaching*, Vol. 4/2, pp. 86-95, https://doi.org/10.5430/jct.v4n2p86. [155]

Chadwick, S. and E. Ralston (2010), "Perspective-Taking in Structured and Unstructured Online Discussions.", *Internaional Journal of Teaching and Learning*, Vol. 22/1, pp. 1-11, https://eric.ed.gov/?id=EJ913524 (accessed on 21 May 2023). [139]

Chou, T., J. Wu and C. Tsai (2019), "Research Trends and Features of Critical Thinking Studies in E-Learning Environments: A Review", *Journal of Educational Computing Research*, Vol. 57/4, pp. 1038-1077, https://doi.org/10.1177/0735633118774350. [28]

Clemons SA (2005), "Encouraging creativity in online courses", *International Jounral of Instructional Technology and Distance Learning*, Vol. 2/1, pp. 49-57, http://www.itdl.org/Journal/Jan_05/article05.htm (accessed on 13 May 2023). [159]

Coelho, M. and H. Martins (2022), "The future of soft skills development: a systematic review of the literature of the digital training practices for soft skills", *Journal of e-Learning and Knowledge Society*, Vol. 18/2, pp. 78-85, https://doi.org/10.20368/1971-8829/1135576. [33]

Colquhoun, H. et al. (2014), "Scoping reviews: time for clarity in definition, methods, and reporting", *Journal of Clinical Epidemiology*, Vol. 67/12, pp. 1291-1294, https://doi.org/10.1016/J.JCLINEPI.2014.03.013. [3]

Cortázar, C. et al. (2022), "The impacts of scaffolding socially shared regulation on teamwork in an online project-based course", *The Internet and Higher Education*, Vol. 55, p. 100877, https://doi.org/10.1016/j.iheduc.2022.100877. [93]

Cortázar, C. et al. (2021), "Promoting critical thinking in an online, project-based course", *Computers in Human Behavior*, Vol. 119, p. 106705, https://doi.org/10.1016/J.CHB.2021.106705. [144]

Cosgrove, S. and N. Olitsky (2015), "Knowledge Retention, Student Learning, and Blended Course Work: Evidence from Principles of Economics Courses", *Southern Economic Journal*, Vol. 82/2, pp. 556-579. [48]

Costley, J. and C. Lange (2016), "The relationship between social presence and critical thinking: Results from learner discourse in an asynchronous learning environment", *Journal of Information Technology Education: Research*, Cited By :6 Export Date: 23 March 2023, pp. 89-108, https://doi.org/10.28945/3418. [117]

Cuban, L. (1984), "Policy and Research Dilemmas in the Teaching of Reasoning: Unplanned Designs", *Review of Educational Research*, Vol. 54/4, pp. 655-681. [13]

Dailey-Hebert, A. (2018), "Maximizing Interactivity in Online Learning: Moving beyond Discussion Boards", *Journal of Educators Online*, Vol. 15/3, https://eric.ed.gov/?id=EJ1199230 (accessed on 31 May 2022). [112]

Daudt, H., C. Van Mossel and S. Scott (2013), "Enhancing the scoping study methodology: A large, inter-professional team's experience with Arksey and O'Malley's framework", *BMC Medical Research Methodology*, Vol. 13/1, pp. 1-9, https://doi.org/10.1186/1471-2288-13-48/PEER-REVIEW. [6]

De Bono, E. (1990), *Lateral thinking : a textbook of creativity*, Penguin Books, https://books.google.com/books/about/Lateral_Thinking.html?hl=fr&id=OYZQcUPBbqcC (accessed on 22 August 2023). [141]

De Brún, A. et al. (2022), "Evaluation of a formative peer assessment in research methods teaching using an online platform: A mixed methods pre-post study", *Nurse Education Today*, Vol. 108, p. 105166, https://doi.org/10.1016/J.NEDT.2021.105166. [34]

de Oliveira Kubrusly Sobral, J. et al. (2022), "Active methodologies association with online learning fatigue among medical students", *BMC Medical Education*, Vol. 22/1, pp. 1-7, https://doi.org/10.1186/S12909-022-03143-X/TABLES/3. [115]

Deechai, W. and T. Sovajassatakul (2019), "Efficiency and effectiveness of blended learning for critical thinking development in thai vocational students", *Revista Espacios*, Vol. 40/19, https://www.revistaespacios.com/a19v40n19/19401912.html (accessed on 13 May 2023). [72]

Deming, D. et al. (2016), "The value of postsecondary credentials in the labor market: An experimental study", *American Economic Review*, Vol. 106/3, pp. 778-806, https://doi.org/10.1257/AER.20141757. [63]

do Amaral, J. and F. Fregni (2021), "Maximizing learning in online courses using critical thinking, project-based learning, and flipped classroom approaches", *Principles and Practice of Clinical Research*, Vol. 7/2, pp. 25-36, https://doi.org/10.21801/ppcrj.2021.72.3. [86]

Dong, Y. et al. (2021), "The effects of flipped classroom characterized by situational and collaborative learning in a community nursing course: A quasi-experimental design", *Nurse Education Today*, Vol. 105, p. 105037, https://doi.org/10.1016/J.NEDT.2021.105037. [85]

Dziuban, C. et al. (2018), "Blended learning: the new normal and emerging technologies", *International Journal of Educational Technology in Higher Education*, Vol. 15/1, pp. 1-16, https://doi.org/10.1186/S41239-017-0087-5/TABLES/6. [16]

Eagleton, S. (2017), "Designing blended learning interventions for the 21st century student", *Advances in physiology education*, Vol. 41/2, pp. 203-211, https://doi.org/10.1152/ADVAN.00149.2016. [84]

Egan, A. et al. (2017), "Developing creativity in higher education for 21st century learners: A protocol for a scoping review", *International Journal of Educational Research*, Vol. 82, pp. 21-27, https://doi.org/10.1016/J.IJER.2016.12.004. [2]

Ekahitanond, V. (2013), "Promoting university students' critical thinking skills through peer feedback activity in an online discussion forum", *Alberta Journal of Educational Research*, Vol. 59/2, pp. 247-265, http://cjc-rcc.ucalgary.ca/index.php/ajer/article/view/55617 (accessed on 6 June 2023). [96]

Ertmer, P. et al. (2007), "Using Peer Feedback to Enhance the Quality of Student Online Postings: An Exploratory Study", *Journal of Computer-Mediated Communication*, Vol. 12/2, pp. 412-433, https://doi.org/10.1111/J.1083-6101.2007.00331.X. [42]

Escueta, M. et al. (2017), "Education Technology: An Evidence-Based Review", National Bureau of Economic Research, http://www.nber.org/papers/w23744 (accessed on 21 January 2022). [66]

Esquivel, G. (1995), "Teacher behaviors that foster creativity", *Educational Psychology Review*, Vol. 7/2, pp. 185-202, https://doi.org/10.1007/BF02212493/METRICS. [109]

Ezra, O. et al. (2021), "Equity factors during the COVID-19 pandemic: Difficulties in emergency remote teaching (ert) through online learning", *Education and Information Technologies*, Vol. 26/6, pp. 7657-7681, https://doi.org/10.1007/S10639-021-10632-X/FIGURES/5. [73]

Facione, P. (1990), *The California Critical Thinking Skills Test--College Level. Technical Report #1. Experimental Validation and Content Validity.*, California Academic Press. [52]

Figlio, D., M. Rush and L. Yin (2015), "Is It Live or Is It Internet? Experimental Estimates of the Effects of Online Instruction on Student Learning", *Journal of Labor Economics*, Vol. 31/4, pp. 763-784, https://doi.org/10.1086/669930. [61]

Foo, S. and L. Quek (2019), "Developing Students' Critical Thinking through Asynchronous Online Discussions: A Literature Review", *Malaysian Online Journal of Educational Technology*, Vol. 7/2, https://doi.org/10.17220/mojet.2019.02.003. [138]

Fox, S. (2003), "Can elearning promote higher-order learning without tutor overload?", *The Journal of Open, Distance and e-Learning*, Vol. 18/2, pp. 121-134, https://doi.org/10.1080/02680510307410. [150]

Franco, A., N. Malhotra and G. Simonovits (2014), "Publication bias in the social sciences: Unlocking the file drawer", *Science*, Vol. 345/6203, pp. 1502-1505, https://doi.org/10.1126/SCIENCE.1255484/SUPPL_FILE/FRANCO.SM.PDF. [54]

Fructuoso, I., L. Albó and M. Beardsley (2022), "University students' preference for flexible teaching models that foster constructivist learning practices", *Australasian Journal of Educational Technology*, Vol. 38/4, pp. 22-39, https://ajet.org.au/index.php/AJET/article/view/7968 (accessed on 8 May 2023). [43]

Ganeser, A. (2020), "A study on student's perception towards online classes and effectiveness in enhancing active participation and communication skills", *Universal Journal of Educational Research*, Vol. 8/11, https://www.researchgate.net/profile/Asha-Nair-11/publication/351990933_A_Study_on_Students'_Perception_of_Online_Classes_and_Effectiveness_in_Enhancing_Active_Participation_and_Communication_Skills/links/60b458a5299bf1f6d5881000/A-Study-on-Students-Perception-of-Online-Classes-and-Effectiveness-in-Enhancing-Active-Participation-and-Communication-Skills.pdf (accessed on 13 May 2023). [101]

Garrison, D., T. Anderson and W. Archer (2001), "Critical thinking, cognitive presence, and computer conferencing in distance education", *American Journal of Distance Education*, Vol. 15/1, pp. 7-23, https://doi.org/10.1080/08923640109527071. [121]

Garrison, D., T. Anderson and W. Archer (1999), "Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education", *The Internet and Higher Education*, Vol. 2/2-3, pp. 87-105, https://doi.org/10.1016/S1096-7516(00)00016-6. [119]

Garrison, D. and H. Kanuka (2004), "Blended learning: Uncovering its transformative potential in higher education", *The Internet and Higher Education*, Vol. 7/2, pp. 95-105, https://doi.org/10.1016/J.IHEDUC.2004.02.001. [23]

Giacumo, L. and W. Savenye (2020), "Asynchronous discussion forum design to support cognition: effects of rubrics and instructor prompts on learner's critical thinking, achievement, and satisfaction", *Educational Technology Research and Development*, Vol. 68/1, pp. 37-66, https://doi.org/10.1007/S11423-019-09664-5/TABLES/8. [31]

Graham, C. and S. Allen (2011), "Designing Blended Learning Environments", *Encyclopedia of Distance Learning, Second Edition*, pp. 562-570, https://doi.org/10.4018/978-1-60566-198-8.CH082. [14]

Guiller, J., A. Durndell and A. Ross (2008), "Peer interaction and critical thinking: Face-to-face or online discussion?", *Learning and Instruction*, Vol. 18/2, pp. 187-200, https://doi.org/10.1016/J.LEARNINSTRUC.2007.03.001. [67]

Hadiyanto, H. et al. (2021), "Students' Practices of 21st Century Skills between Conventional learning and Blended Learning | Enhanced Reader", *Journal of University Teaching & Learning Practice*, Vol. 18/3. [79]

Haniah, A. and E. Setyaningsih (2021), "Students' Perception on the Implementation of Online Project-Based Learning in Teaching 4Cs.", *Indonesian Journal of English Language Teaching and Applied Linguistics*, Vol. 6/1, pp. 123-140, https://eric.ed.gov/?id=EJ1320475 (accessed on 13 May 2023). [145]

Hao, Y. (2016), "Exploring undergraduates' perspectives and flipped learning readiness in their flipped classrooms", *Computers in Human Behavior*, Vol. 59, pp. 82-92, https://www.sciencedirect.com/science/article/pii/S0747563216300401 (accessed on 13 May 2023). [45]

Henriksen, D. et al. (2021), "Creativity and technology in teaching and learning: a literature review of the uneasy space of implementation", *Educational Technology Research and Development*, Vol. 69/4, pp. 2091-2108, https://doi.org/10.1007/S11423-020-09912-Z/FIGURES/1. [110]

Hosler, K. and B. Arend (2012), "The importance of course design, feedback, and facilitation: Student perceptions of the relationship between teaching presence and cognitive presence", *Educational Media International*, Vol. 49/3, pp. 217-229, https://doi.org/10.1080/09523987.2012.738014. [129]

Hrastinski, S. (2019), "What Do We Mean by Blended Learning?", *TechTrends 2019 63:5*, Vol. 63/5, pp. 564-569, https://doi.org/10.1007/S11528-019-00375-5. [24]

Hursen, C. (2021), "The Effect of Problem-Based Learning Method Supported by Web 2.0 Tools on Academic Achievement and Critical Thinking Skills in Teacher Education", *Technology, Knowledge and Learning*, Vol. 26/3, pp. 515-533, https://doi.org/10.1007/S10758-020-09458-2/TABLES/7. [147]

Iqbal, J. et al. (2021), "How Emotional Intelligence Influences Cognitive Outcomes Among University Students: The Mediating Role of Relational Engagement During the Covid-19 Pandemic", *Frontiers in Psychology*, Vol. 12, https://doi.org/10.3389/FPSYG.2021.711439/FULL. [94]

Janson, A., M. Söllner and J. Leimeister (2020), "Ladders for learning: Is scaffolding the key to teaching problem-solving in technology-mediated learning contexts?", *Academy of Management Learning and Education*, Vol. 19/4, pp. 439-468, https://doi.org/10.5465/AMLE.2018.0078. [156]

Jin, X. et al. (2022), "Using the Online Self-Directed Learning Environment to Promote Creativity Performance for University Students", *Educational Technology & Society*, Vol. 25/2, pp. 130-147, https://www.jstor.org/stable/48660129 (accessed on 13 May 2023). [152]

Junus, K. et al. (2021), "Lecturer Readiness for Online Classes during the Pandemic: A Survey Research", *Education Sciences 2021, Vol. 11, Page 139*, Vol. 11/3, p. 139, https://doi.org/10.3390/EDUCSCI11030139. [56]

Kacetl, J. and I. Semradova (2020), "Reflection on blended learning and e-learning – case study", *Procedia Computer Science*, Vol. 176, pp. 1322-1327, https://doi.org/10.1016/J.PROCS.2020.09.141. [113]

Kalelioğlu, F. and Y. Gülbahar (2014), "The effect of instructional techniques on critical thinking and critical thinking dispositions in online discussion", *Journal of Educational Technology & society*, Vol. 17/1, pp. 248-258, https://www.jstor.org/stable/pdf/jeductechsoci.17.1.248.pdf (accessed on 13 May 2023). [151]

Karatas, K. (2021), "The role of self-directed learning, metacognition, and 21st century skills predicting the readiness for online learning.", *Contemporary Educational Technology*, Vol. 13/3, https://doi.org/10.30935/cedtech/10786. [95]

Khalil, M., E. Meguid and I. Elkhider (2018), "Teaching of anatomical sciences: A blended learning approach", *Clinical Anatomy*, Vol. 31/3, pp. 323-329, https://doi.org/10.1002/CA.23052. [26]

Koç, M. (2017), "Learning Analytics of Student Participation and Achievement in Online Distance Education: A Structural Equation Modeling", *Educational Sciences: Theory & Practice*, Vol. 17/6, pp. 1893-1910, https://doi.org/10.12738/ESTP.2017.6.0059. [77]

Kofoed, M. et al. (2021), *Zooming to Class?: Experimental Evidence on College Students' Online Learning during COVID-19*, IZA Institute of Labor Economics, http://www.iza.org (accessed on 18 October 2021). [57]

Kozakowski, W. (2019), "Moving the classroom to the computer lab: Can online learning with in-person support improve outcomes in community colleges?", *Economics of Education Review*, Vol. 70, pp. 159-172, https://doi.org/10.1016/J.ECONEDUREV.2019.03.004. [166]

Krathwohl, D. (2002), "A Revision of Bloom's Taxonomy: An Overview", *Theory Into Practice*, Vol. 41/4, pp. 212-218, https://doi.org/10.1207/s15430421tip4104_2. [9]

Latorre-Cosculluela, C. et al. (2021), "Flipped Classroom model before and during COVID-19: using technology to develop 21st century skills", *Interactive Technology and Smart Education*, Vol. 18/2, pp. 189-204, https://doi.org/10.1108/ITSE-08-2020-0137/FULL/HTML. [89]

Lee, S. (2014), "The relationships between higher order thinking skills, cognitive density, and social presence in online learning", *The Internet and Higher Education*, Vol. 21, pp. 41-52, https://doi.org/10.1016/J.IHEDUC.2013.12.002. [131]

Levac, D., H. Colquhoun and K. O'brien (2010), "Scoping studies: advancing the methodology", *Implementation Science*, Vol. 5, pp. 1-9, https://doi.org/10.1186/1748-5908-5-69. [5]

Lewis, A. and D. Smith (1993), "Teaching for Higher Order Thinking", *Theory into Practice*, Vol. 32/3, pp. 131-137. [11]

Liao, Y. et al. (2020), "Impact of a Case-based–Team-based learning model on critical thinking and self-efficacy of nursing Undergraduates in China", *Indian Journal of Continuing Nursing Education*, p. 159, https://www.ijcne.org/article.asp?issn=2230-7354;year=2020;volume=21;issue=2;spage=159;epage=165;aulast=Liao (accessed on 14 May 2023). [102]

Limniou, M., I. Schermbrucker and M. Lyons (2018), "Traditional and flipped classroom approaches delivered by two different teachers: the student perspective", *Education and Information Technologies*, Vol. 23/2, pp. 797-817, https://doi.org/10.1007/S10639-017-9636-8. [49]

Listiqowati, I. and I. Nyoman (2022), "The Impact of Project-Based Flipped Classroom (PjBFC) on Critical Thinking Skills.", *International Journal of Instruction*, Vol. 15/3, pp. 853-868, https://doi.org/10.29333/iji.2022.15346a. [148]

Li, Z. et al. (2022), "Assessment of scientific thinking and creativity in an electronic educational environment", *International Journal of Science Education*, Vol. 44/3, pp. 463-486, https://doi.org/10.1080/09500693.2022.2032863. [163]

Li, Z., M. Zhou and K. Lam (2022), "Dance in Zoom: Using video conferencing tools to develop students' 4C skills and self-efficacy during COVID-19", *Thinking Skills and Creativity*, Vol. 46, https://www.sciencedirect.com/science/article/pii/S1871187122001055 (accessed on 14 May 2023). [111]

Lu, D. (2021), "Students' Perceptions of a Blended Learning Environment to Promote Critical Thinking", *Frontiers in Psychology*, Cited By :4 Export Date: 23 March 2023, https://doi.org/10.3389/fpsyg.2021.696845. [81]

Malczyk, B. (2019), "Introducing Social Work to HyFlex Blended Learning: A Student-centered Approach", *Journal of Teaching in Social Work*, Vol. 39, pp. 414-428, https://doi.org/10.1080/08841233.2019.1652226. [21]

Mandernach, B., K. Forrest and J. Babutzke (2009), "The role of instructor interactivity in promoting critical thinking in online and face-to-face classrooms", *Journal of Online Learning and Teaching*, Vol. 5/1, pp. 49-62, https://www.researchgate.net/profile/Krista-Forrest/publication/228626405_The_role_of_instructor_interactivity_in_promoting_critical_thinking_in_online_and_face-to-face_classrooms/links/0fcfd51126d73b0c52000000/The-role-of-instructor-interactivity-in-promoting-critical-thinking-in-online-and-face-to-face-classrooms.pdf (accessed on 5 May 2023). [51]

Maryani, I. et al. (2022), "Promoting higher-order thinking skills during online learning: The integration of metacognition in science for higher education", *International Journal of Evaluation and Research in Education*, Vol. 11/4, pp. 1980-1988, https://doi.org/10.11591/IJERE.V11I4.23129. [157]

Maurino, P. (2007), "Looking for Critical Thinking in Online Threaded Discussions", *Journal of Educational Technology Systems*, Vol. 35/3, pp. 241-260, https://doi.org/10.2190/P4W3-8117-K32G-R34M. [140]

McCutcheon, K., P. O'Halloran and M. Lohan (2018), "Online learning versus blended learning of clinical supervisee skills with pre-registration nursing students: A randomised controlled trial", *International Journal of Nursing Studies*, Vol. 82, pp. 30-39, https://doi.org/10.1016/j.ijnurstu.2018.02.005. [75]

Mclachlan, K. and N. Tippett (2023), "Kickstarting creative collaboration: placing authentic feedback at the heart of online digital media education", *Assessment and Evaluation in Higher Education*, https://doi.org/10.1080/02602938.2023.2209295. [160]

McLoughlin, D. and J. Mynard (2009), "An analysis of higher order thinking in online discussions", *Innovations in Education and Teaching International*, Vol. 46/2, pp. 147-160, https://doi.org/10.1080/14703290902843778. [10]

McPherson, M. and L. Bacow (2015), "Online higher education: Beyond the hype cycle", *Journal of Economic Perspectives*, Vol. 29/4, pp. 135-154, https://doi.org/10.1257/jep.29.4.135. [32]

Meyer, K. (2003), "Face-to-face versus threaded discussions: The role of time and higher-order thinking", *Journal of Asynchronous Learning*, Vol. 7/3, http://itecideas.pbworks.com/f/v7n3_meyer.pdf (accessed on 20 March 2023). [132]

Mintu-Wimsatt, A., T. Sadler and K. Ingram (2007), "Creativity in online courses: Perceptions of MBA students", *Journal of Online Learning and Teaching*, Vol. 3/4, http://jolt.merlot.org/documents/mintu-wimsatt.pdf (accessed on 14 May 2023). [80]

Moore, M. and W. Diehl (eds.) (2019), *Handbook of distance education*, Routledge. [118]

Morin, D., J. Thomas and R. Sádee (2015), "Fostering problem-solving in a virtual environment", *Journal of Information Technology Education: Research*, Vol. 14, pp. 339-362, http://www.jite.org/documents/Vol14/JITEv14ResearchP339-362Morin2031.pdf (accessed on 14 May 2023). [149]

Moskal, P., C. Dziuban and J. Hartman (2013), "Blended learning: A dangerous idea?", *The Internet and Higher Education*, Vol. 18, pp. 15-23, https://doi.org/10.1016/J.IHEDUC.2012.12.001. [27]

Mueller, F. and T. Wulf (2022), "Blended learning environments and learning outcomes: The mediating role of flow experience", *The International Journal of Management Education*, Vol. 20/3, https://www.sciencedirect.com/science/article/pii/S1472811722000969 (accessed on 14 May 2023). [50]

Müller, C. and T. Mildenberger (2021), "Facilitating flexible learning by replacing classroom time with an online learning environment: A systematic review of blended learning in higher education", *Educational Research Review*, Vol. 34, p. 100394, https://doi.org/10.1016/J.EDUREV.2021.100394. [76]

Neumeier, P. (2005), "A closer look at blended learning — parameters for designing a blended learning environment for language teaching and learning", *ReCALL*, Vol. 17/2, pp. 163-178, https://doi.org/10.1017/S0958344005000224. [25]

Nguyen, V. (2017), "The Impact of Online Learning Activities on Student Learning Outcome in Blended Learning Course", *Journal of Information & Knowledge Management*, Vol. 16/04, p. 1750040, https://doi.org/10.1142/s021964921750040x. [74]

Nugraheni, B., H. Surjono and A. Punto (2022), "How can flipped classroom develop critical thinking skills? A literature review", *International Journal of Information and Education Technology*, Vol. 12/1, pp. 82-90, https://www.academia.edu/download/77645487/1590-IJIET-3015.pdf (accessed on 14 May 2023). [103]

Nussbaum, M. et al. (2020), "Taking critical thinking, creativity and grit online", *Educational Technology Research and Development 2020 69:1*, Vol. 69/1, pp. 201-206, https://doi.org/10.1007/S11423-020-09867-1. [82]

O'Connor, E. et al. (2016), "Flipping Radiology Education Right Side Up", *Academic Radiology*, Vol. 23/7, pp. 810-822, https://doi.org/10.1016/j.acra.2016.02.011. [87]

OECD (2023), *Ensuring Quality Digital Higher Education in Hungary*, Higher Education, OECD Publishing, Paris, https://doi.org/10.1787/5f44fd6f-en. [168]

OECD (2023), *Who Really Cares about Using Education Research in Policy and Practice?: Developing a Culture of Research Engagement*, Educational Research and Innovation, OECD Publishing, Paris, https://doi.org/10.1787/bc641427-en. [171]

OECD (2021), *The State of Higher Education: One Year into the COVID-19 Pandemic*, OECD Publishing, Paris, https://doi.org/10.1787/83c41957-en. [1]

O'Flaherty, J. and M. Costabile (2020), "Using a science simulation-based learning tool to develop students' active learning, self-confidence and critical thinking in academic writing", *Nurse Education in Practice*, Vol. 47, p. 102839, https://doi.org/10.1016/j.nepr.2020.102839. [97]

O'Flaherty, J. and C. Phillips (2015), "The use of flipped classrooms in higher education: A scoping review", *The Internet and Higher Education*, Vol. 25, pp. 85-95, https://doi.org/10.1016/J.IHEDUC.2015.02.002. [22]

Page, M. et al. (2021), "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews", *BMJ*, Vol. 372, https://doi.org/10.1136/BMJ.N71. [7]

Peng, J. et al. (2023), "Visible thinking to support online project-based learning: Narrowing the achievement gap between high- and low-achieving students", *Education and Information Technologies*, pp. 1-35, https://doi.org/10.1007/S10639-023-11896-1/TABLES/11. [146]

Price Banks, D. and S. Vergez (2022), "Online and In-Person Learning Preferences during the COVID-19 Pandemic among Students Attending the City University of New York", *Journal of Microbiology & Biology Education*, Vol. 23/1, https://doi.org/10.1128/JMBE.00012-22/SUPPL_FILE/JMBE.00012-22-S0001.PDF. [64]

Raes, A. et al. (2020), "A systematic literature review on synchronous hybrid learning: gaps identified", *Learning Environments Research*, Vol. 23/3, pp. 269-290, https://doi.org/10.1007/S10984-019-09303-Z/TABLES/1. [19]

Rapanta, C. et al. (2020), "Online University Teaching During and After the Covid-19 Crisis: Refocusing Teacher Presence and Learning Activity", *Postdigital Science and Education*, Vol. 2/3, pp. 923-945, https://doi.org/10.1007/S42438-020-00155-Y/FIGURES/1. [127]

Reese, S. (2014), "Online learning environments in higher education: Connectivism vs. dissociation", *Education and Information Technologies*, Vol. 20/3, pp. 579-588, https://doi.org/10.1007/S10639-013-9303-7. [116]

Richardson, J. and P. Ice (2010), "Investigating students' level of critical thinking across instructional strategies in online discussions", *The Internet and Higher Education*, Vol. 13/1, pp. 52-59, https://doi.org/10.1016/j.iheduc.2009.10.009. [44]

Richardson, J. et al. (2017), "Social presence in relation to students' satisfaction and learning in the online environment: A meta-analysis", *Computers in Human Behavior*, Vol. 71, pp. 402-417, https://doi.org/10.1016/J.CHB.2017.02.001. [124]

Roach, T. (2014), "Student perceptions toward flipped learning: New methods to increase interaction and active learning in economics", *International Review of Economics Education*, Vol. 17, pp. 74-84, https://doi.org/10.1016/J.IREE.2014.08.003. [83]

Robbins, T. and K. Kegley (2010), "Playing with Thinkertoys to build creative abilities through online instruction", *Thinking Skills and Creativity*, Vol. 5/1, pp. 40-48, https://doi.org/10.1016/J.TSC.2009.07.001. [164]

Rodríguez, G. et al. (2019), "Flipped classroom: Fostering creative skills in undergraduate students of health sciences", *Thinking Skills and Creativity*, Vol. 33, p. 100575, https://doi.org/10.1016/J.TSC.2019.100575. [90]

Rovai, A. (2003), "In search of higher persistence rates in distance education online programs", *The Internet and Higher Education*, Vol. 6/1, pp. 1-16, https://doi.org/10.1016/S1096-7516(02)00158-6. [99]

Rugube, T., K. Mthethwa-Kunene and C. Maphosa (2020), "Promoting interactivity in online learning - Towards the achievement of high-quality online learning outcomes", *European Journal of Open Education and E-learning Studies*, Vol. 5/2, https://doi.org/10.46827/EJOE.V5I2.3381. [106]

Saadé, R., D. Morin and J. Thomas (2012), "Critical thinking in E-learning environments", *Computers in Human Behavior*, Vol. 28/5, pp. 1608-1617, https://doi.org/10.1016/j.chb.2012.03.025. [104]

Schellens, T. et al. (2009), "Tagging thinking types in asynchronous discussion groups: Effects on critical thinking", *Interactive Learning Environments*, Vol. 17/1, pp. 77-94, https://doi.org/10.1080/10494820701651757. [142]

Schindler, L. and G. Burkholder (2014), "Instructional Design and Facilitation Approaches that Promote Critical Thinking in Asynchronous Online Discussions: A Review of the Literature", *Higher Learning Research Communications*, Vol. 4/4, pp. 11-29, https://doi.org/10.18870/hlrc.v4i4.222. [137]

Şendağ, S. and H. Ferhan Odabaşi (2009), "Effects of an online problem based learning course on content knowledge acquisition and critical thinking skills", *Computers & Education*, Vol. 53/1, pp. 132-141, https://doi.org/10.1016/J.COMPEDU.2009.01.008. [40]

Şentürk, C. (2021), "Effects of the blended learning model on preservice teachers' academic achievements and twenty-first century skills", *Education and Information Technologies*, Vol. 26/1, pp. 35-48, https://doi.org/10.1007/S10639-020-10340-Y. [37]

Setren, E. et al. (2021), "Effects of Flipped Classroom Instruction: Evidence from a Randomized Trial", *Education Finance and Policy*, Vol. 16/3, pp. 363-387, https://doi.org/10.1162/EDFP_A_00314. [71]

Shively, K., K. Stith and L. Rubenstein (2018), "Measuring What Matters: Assessing Creativity, Critical Thinking, and the Design Process", *Gifted Child Today*, Vol. 41/3, pp. 149-158, https://doi.org/10.1177/1076217518768361. [162]

Shwartz-Asher, D., A. Raviv and R. Herscu-Kluska (2022), "Teaching and assessing active learning in online academic courses", *Social Sciences & Humanities Open*, Vol. 6/1, p. 100341, https://doi.org/10.1016/J.SSAHO.2022.100341. [130]

Smith, K. and J. Hill (2019), "Defining the nature of blended learning through its depiction in current research", *Higher Education Research and Development*, Vol. 38/2, pp. 383-397, https://doi.org/10.1080/07294360.2018.1517732. [15]

Staring, F. et al. (2022), "Digital higher education: Emerging quality standards, practices and supports", *OECD Education Working Papers*, No. 281, OECD Publishing, Paris, https://doi.org/10.1787/f622f257-en. [172]

Stein, D. et al. (2013), "From 'hello' to higher-order thinking: The effect of coaching and feedback on online chats", *The Internet and Higher Education*, Vol. 16/1, pp. 78-84, https://doi.org/10.1016/J.IHEDUC.2012.03.001. [143]

Stephen, J. and A. Rockinson-Szapkiw (2021), "A high-impact practice for online students: the use of a first-semester seminar course to promote self-regulation, self-direction, online learning self-efficacy", *Smart Learning Environments*, Vol. 8/1, https://doi.org/10.1186/S40561-021-00151-0. [92]

Stone, C. and M. Springer (2019), "Interactivity, connectedness and 'teacher-presence' : Engaging and retaining students online.", *Australian Journal of Adult Learning*, Vol. 59/2, pp. 146-169, https://search.informit.org/doi/abs/10.3316/aeipt.224048 (accessed on 28 June 2022). [126]

Swart, R. (2018), "Critical thinking instruction and technology enhanced learning from the student perspective: A mixed methods research study", *Nurse Education in Practice*, Vol. 23, pp. 30-39, https://www.sciencedirect.com/science/article/pii/S1471595317300781 (accessed on 16 May 2023). [158]

Swoboda, A. and L. Feiler (2016), "Measuring the Effect of Blended Learning: Evidence from a Selective Liberal Arts College †", *American Economic Review: Papers & Proceedings*, Vol. 106/5, pp. 368-372, https://doi.org/10.1257/aer.p20161055. [70]

Szabo, Z. and J. Schwartz (2011), "Learning methods for teacher education: the use of online discussions to improve critical thinking", *Technology, Pedagogy and Education*, Vol. 20/1, pp. 79-94, https://doi.org/10.1080/1475939X.2010.534866. [136]

Tu, C. (2002), "The Measurement of Social Presence in an Online Learning Environment", *International Journal on E-Learning*, Vol. 1/2, pp. 34-45. [128]

Ulla, M. and W. Perales (2022), "Hybrid Teaching: Conceptualization Through Practice for the Post COVID19 Pandemic Education", *Frontiers in Education*, Vol. 7, p. 924594, https://doi.org/10.3389/FEDUC.2022.924594/BIBTEX. [18]

Van Damme, D. and D. Zahner (eds.) (2022), *Does Higher Education Teach Students to Think Critically?*, OECD Publishing, Paris, https://doi.org/10.1787/cc9fa6aa-en. [170]

Vaughan, N. (2014), "Student engagement and blended learning: Making the assessment connection", *Education Sciences*, Vol. 4/4, pp. 247-264, https://doi.org/10.3390/educsci4040247. [65]

Vincent-Lancrin, S. et al. (2019), *Fostering Students' Creativity and Critical Thinking: What it Means in School*, Educational Research and Innovation, OECD Publishing, Paris, https://doi.org/10.1787/62212c37-en. [12]

Wahls, N., W. Dijkstra and M. Ouwehand (2022), *Blending Your Education: Lessons Learned During COVID*, DigTel Pro, TU Delft, https://embed.eadtu.eu/results. (accessed on 18 September 2023). [20]

Waller, R., P. Lemoine and M. Richardson (2020), "Exploring the relationships between technology and learning in global higher education", *International Journal of Education Humanities and Social Science*, Vol. 3/01, http://ijehss.com/ (accessed on 9 May 2022). [165]

Wang, S. et al. (2023), "The impact of online learning engagement on college students' academic performance: The serial mediating effect of inquiry learning and reflective learning", *Innovations in Education and Teaching International*, https://doi.org/10.1080/14703297.2023.2236085. [35]

Williams, L. and M. Lahman (2011), "Online discussion, student engagement, and critical thinking", *Journal of Political Science Education*, Vol. 7/2, pp. 143-162, https://doi.org/10.1080/15512169.2011.564919. [105]

Williamson, B., R. Eynon and J. Potter (2020), "Pandemic politics, pedagogies and practices: digital technologies and distance education during the coronavirus emergency", *Learning, Media and Technology*, Vol. 45/2, pp. 107-114, https://doi.org/10.1080/17439884.2020.1761641. [58]

Wilson, B. and M. Lowry (2000), "Constructivist Learning on the Web", *New Directions for Adult and Continuing Education*, Vol. 2000/88, pp. 79-88, https://doi.org/10.1002/ACE.8808. [108]

Xu, D. and S. Jaggars (2014), "Performance Gaps Between Online and Face-to-Face Courses: Differences Across Types of Students and Academic Subject Areas", *The Journal of Higher Education*, Vol. 85/5, pp. 633-659, https://doi.org/10.1353/jhe.2014.0028. [69]

Xu, D. and S. Jaggars (2013), "The impact of online learning on students' course outcomes: Evidence from a large community and technical college system", *Economics of Education Review*, Vol. 37, pp. 46-57, https://doi.org/10.1016/j.econedurev.2013.08.001. [60]

Yang, Y. and H. Chou (2007), "Beyond critical thinking skills: Investigating the relationship between critical thinking skills and dispositions through different online instructional strategies", *British Journal of Educational Technology*, Vol. 39/4, pp. 666-684, https://doi.org/10.1111/j.1467-8535.2007.00767.x. [133]

Yang, Y. et al. (2013), "A blended learning environment for individualized English listening and speaking integrating critical thinking", *Computers & Education*, Vol. 63, pp. 285-305, https://doi.org/10.1016/j.compedu.2012.12.012. [98]

Yang, Y., T. Newby and R. Bill (2005), "Using Socratic questioning to promote critical thinking skills through asynchronous discussion forums in distance learning environments", *The American Journal of Distance Education*, Vol. 19/3, pp. 163-181, https://doi.org/10.1207/s15389286ajde1903_4. [36]

Yarmand, M. et al. (2021), "It feels like i am talking into a void: Understanding interaction gaps in synchronous online classrooms", *Conference on Human Factors in Computing Systems - Proceedings*, https://doi.org/10.1145/3411764.3445240. [114]

Yeh, Y. (2012), "A co-creation blended KM model for cultivating critical-thinking skills", *Computers & Education*, Vol. 59/4, pp. 1317-1327, https://doi.org/10.1016/j.compedu.2012.05.017. [153]

Yeh, Y., L. Huang and Y. Yeh (2011), "Knowledge management in blended learning: Effects on professional development in creativity instruction", *Computers & Education*, Vol. 56/1, pp. 146-156, https://doi.org/10.1016/J.COMPEDU.2010.08.011. [161]

Yu, Z. et al. (2021), "Effects of blended versus offline case-centred learning on the academic performance and critical thinking ability of undergraduate nursing students: A cluster randomised controlled trial", *Nurse education in practice*, Vol. 53, https://doi.org/10.1016/J.NEPR.2021.103080. [78]

Zielińska, A. et al. (2021), "Self-Regulation in Creative Learning: Agentic Perspective", *Creativity*, Vol. 8/1, pp. 52-71, https://doi.org/10.2478/CTRA-2021-0005. [100]