

# Instructional Design Models for Digital Learning in Higher Education — A Scoping Review

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<i>Keywords</i>	<b>Abstract</b>
instructional design model, higher education, digital learning, digital transformation	Instructional design (ID) is a systematic process that is used to develop education and training programmes in a consistent and reliable way. A key challenge faced by educators is selecting an ID model by deciding which ID model will be more suitable in order to achieve an effective digital teaching and learning process. The objective of this scoping review was to present recommendations to select ID models for digital learning in higher education. Nine databases were searched for eligible publications. The search retrieved 643 records. Forty articles were included in this review. Results show that employing a systematic process in instructional design (an ID model) has produced an effective, consistent and reliable digital teaching and learning process in higher education. Selection of an ID model depends on the requirements of the course, timeline, resources available for the design and development of the course and the expertise in the ID process.

## Introduction

The teaching and learning process in higher education is currently undergoing a rapid digital transformation. This digital transformation has to follow a reliable and consistent procedure in order to achieve an effective and high-quality digital teaching and learning process. Instructional design (ID) is a systematic process that is used to develop education and training programmes in a consistent and reliable way (Reiser & Dempsey, 2012). An ID model represents this systematic process. It includes different components in the ID process such as determining outcomes, collecting and analysing data, designing and developing teaching and learning materials, implementing, evaluating and revising the results of teaching and learning activities (Branch & Kopcha, 2014).

Digital learning differs from traditional learning in many ways. Digital learning effectively uses digital technology to enhance students' learning, while traditional learning does not use digital technology. In digital learning the student can access abundant learning resources while the students in traditional learning have access only to the materials their teachers provide. In digital learning the students self-regulate their learning while the teacher guides the learning. On the contrary, in traditional learning, the teacher regulates the students' learning. Digital learning can go beyond the classroom and can make learning accessible from anywhere, while traditional learning is bound within the walls of the classroom.

Digital learning provides many benefits for teachers as well. The teacher can provide the students with multiple and interactive learning resources in the digital environment. The teacher can easily communicate with students with the aid of digital technologies and have individual



focus on the student's learning. Moreover, digital learning can also reduce the teaching cost because of the features of digital learning, such as reusable learning materials (Lin et al, 2017).

The most widely used ID models for digital learning are reported as the ADDIE (analysis, design, development, implementation, evaluation) model, the rapid prototyping, successive approximation model, and the Dick and Carey Systems Approach (Arshavskiy, 2017). These ID models vary in relation to the process, cost and contexts that can be applied. Moreover, the uses and impact of each ID model varies considerably as well (Arshavskiy, 2017). The proper selection of instructional design models enables appropriately matching the right process with the right context (Branch & Kopcha, 2014). Therefore, a proper understanding of ID models for digital learning is crucial for educators, in selecting the ID model which best matches with the requirement of the course/module to be designed and developed. A key challenge faced by educators is selecting an ID model by deciding which ID model will be more suitable, in order to achieve an effective and high-quality digital teaching and learning process (Branch & Kopcha, 2014). This is mainly because they are unaware of the factors that can influence the selection of an ID model, the ID models that are available for digital learning and the impact of each ID model on the success of digital learning.

### **Objectives**

Therefore, the objective of this study was to undertake a scoping review on instructional design models for digital learning in higher education to investigate three critical research questions (RQs), which are worth exploring in order to achieve success in the digital teaching and learning process in higher education. These are:

- 1) What are the key factors to consider when selecting an ID model?
- 2) What are the ID models that can be used in digital learning?
- 3) What could be the impact of using each ID model?

### **Methods**

#### **Framework**

This scoping review followed the Updated Methodological Guidance for the Conduct of Scoping Reviews by Joanna Briggs Institute (JBI) (Peters et al., 2020). In contrast to systematic reviews that strive to answer a specific question, scoping reviews are designed to determine the extent and nature of the evidence available on a topic (Peters et al., 2020). The objectives of this review were developed in order to facilitate a broader scope according to the population-concept-context model (Peters et al., 2020), where the population is the students and faculty in higher education, the concept is instructional design models and the context is educational experiences where instructional design models are used and evaluated. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews checklist (Tricco et al., 2018) and the Methodological Guidance Paper: The Art and Science of Quality Systematic Reviews (Alexander, 2020) guided the reporting of this scoping review.

#### **Search Strategy**

The following nine databases were searched for eligible publications; SCOPUS, EBSCOhost, Emerald, JSTOR, Taylor and Francis, PubMed (MEDLINE), ERIC, ACM and IEEE Xplore using the search string of "instructional design models" AND "higher education". The search was conducted from January, 2023 to March, 2023. Articles published from the year 2000 onwards were searched.

### **Study Selection**

The study selection was performed using the Covidence platform. The citations were imported to Covidence for screening. Quantitative, qualitative and mixed-method research conducted on instructional system design models in digital learning in higher education and which were reported in the English language were included in this review. Higher education contexts were identified according to the definition of higher education provided by UNESCO: “all types of studies, training or training for research at the post-secondary level, provided by universities or other educational establishments that are approved as institutions of higher education by the competent state authorities”(UNESCO, 1998). Digital learning was identified as, “any instructional practice that effectively uses technology to reinforce a student’s learning experience and incorporates a wide range of tools and practices” (Every Student Succeeds Act, 2015, p. 1969). An instructional design (ID) model was identified as, “a systematic process that is used to develop education and training programmes in a consistent and reliable way” (Reiser & Dempsey, 2012, p. 8).

Two independent investigators conducted the title/abstract screening and full text screening. The conflicts were resolved by consensus. Articles considered to be potentially eligible were retrieved for full text review. Full texts were assessed in detail against the inclusion criteria and full texts that did not meet the inclusion criteria were excluded and the reasons for exclusion were noted.

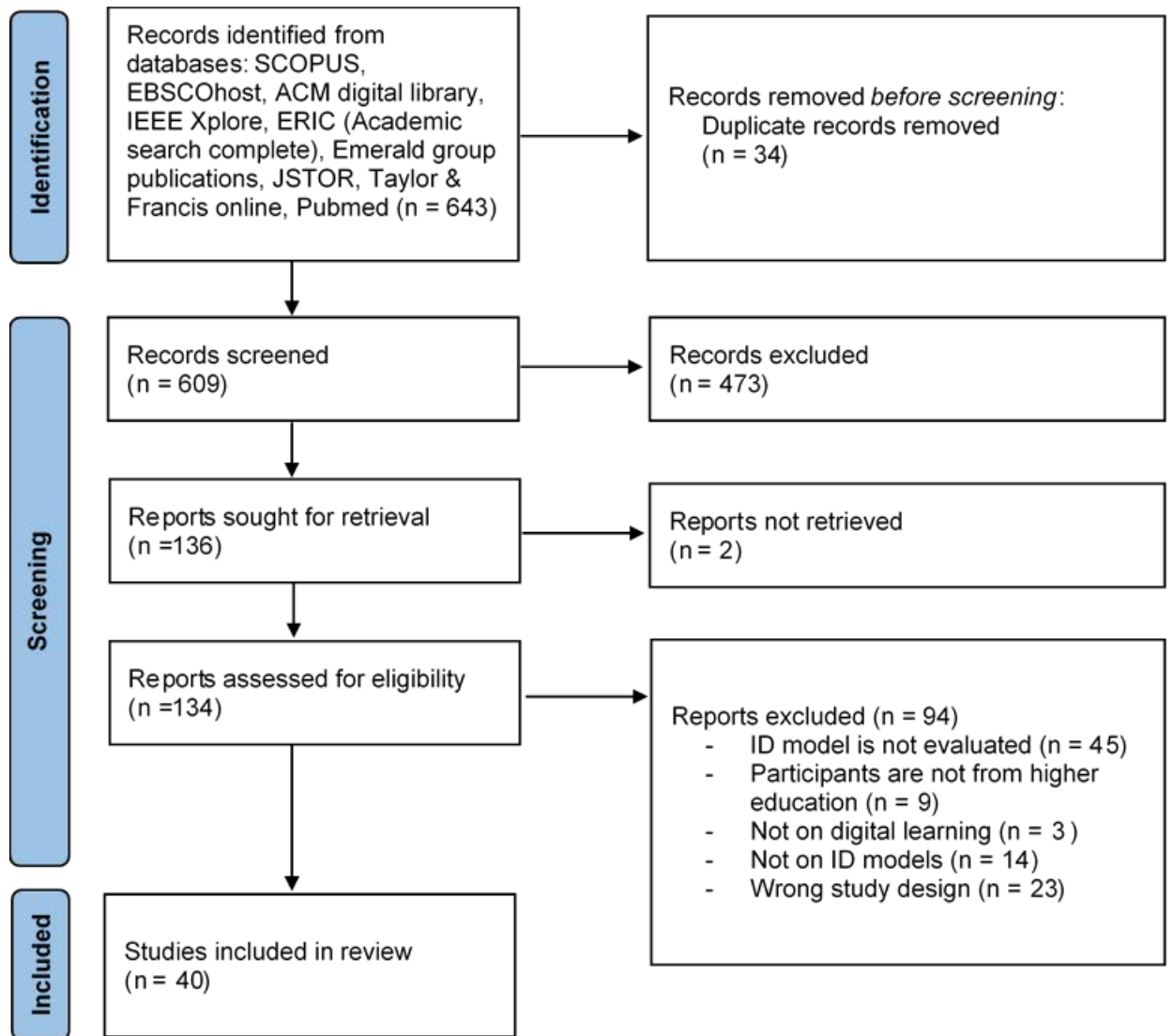
### **Data Extraction and Synthesis**

Two investigators independently extracted the data using customised tables in Covidence. After the extraction was finished the discrepancies were resolved via consensus. Author(s), year of publication, title, country, aim, study design, population, inclusion/exclusion criteria, method of recruitment of participants, population characteristics, field of study, course name, mode and sample size together with the data items related to the three research questions that were extracted. Accordingly, data items such as: 1. The key factors the authors of each study considered in selecting an ID model, 2. The ID model which has been used in each study and 3. the impact of each ID model that was extracted. In order to investigate the impact of each ID model, outcomes of the course designed using each ID model were assessed. Quantitative outcomes (e.g., academic performance of students in the designed course) and qualitative outcomes (e.g., satisfaction of students, perception of teachers) were extracted to assess the impact of each ID model.

## **Results**

### **Overview**

The search retrieved 643 records and among those 34 were duplicates. Out of the remaining 609 articles, 134 articles were selected for full-text review after title/abstract screening, based on the selection process described above. At the end of the full-text review, 40 articles were included in this review. The flow of the studies through the search and selection process is presented in Figure 1.



**Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews Flowchart for the Article Search**

### Study Characteristics

The 40 included studies were published from 2001 to 2022 (i.e., number of articles in each year: 2001-1, 2004-1, 2006-1, 2009-1, 2010-1, 2011-3, 2013-3, 2014-1, 2015-3, 2016-1, 2017-2, 2018-4, 2019-5, 2020-3, 2021-7 and 2022-3). This research originated from 23 countries including, Australia (n = 1), Austria (n=1), Belgium (n = 1), Brazil (n = 1), Canada (n = 1), Chile (n = 1), Germany (n = 1), Indonesia (n = 2), Jordan (n = 1), Malaysia (n = 2), Mexico (n = 1), Morocco (n=1), Netherlands (n = 2), New Zealand (n = 1), Norway (n = 1), Portugal (n = 1), Singapore (n = 1), Saudi Arabia (n = 1), South Africa (n = 2), South Korea (n = 1), Taiwan (n = 1), United Kingdom (n = 2) and the United States of America (n = 13). Selected research has been conducted in 15 fields of study including education (n = 13), engineering (n = 5), language learning (n = 4), computer science (n = 3), multidisciplinary (including participants from more than one field of study) (n = 3), information technology (n = 2), information literacy (n = 2), chemistry (n = 1), cross-cultural understanding (n=1), entrepreneurship (n = 1), geography (n =

1), management of information systems (n = 1), mathematics (n = 1), physics (n = 1) and tourism (n = 1). The ID models used to design and develop courses were as follows: with theory components (n = 4), skills components (n = 6) and courses with both theory and skills components (n = 30). The developed courses were delivered via online mode (n = 27), blended learning mode (n = 9), face-to-face mode (n = 3) and by using all three modes (n = 1). The outcomes of the courses were assessed quantitatively (n = 3), qualitatively (n = 33) and by using a mixed-method approach (n = 4). To evaluate the outcomes of the courses, 33 of the studies used qualitative approaches, three used quantitative approaches and four studies used a mixed method approach.

### **Key Factors to Consider When Selecting an ID Model**

Seventeen studies considered the requirements of the course to be designed and developed as the main factor when selecting an ID model. Requirements mentioned were: to deliver the designed course in three modes (online, blended, face-to-face) (Barefah et al., 2018), to integrate information literacy in the course (Mullins, 2016), to facilitate adult learning (Knowlton & Simms, 2010; May et al., 2015), to stimulate deep learning (Larmuseau et al., 2018), to use multimedia and technology to augment the learning experience (Smith et al., 2022), to facilitate work-based learning (Mardini, 2013; Wolz et al., 2020), to develop a model that was contextualised for the local circumstances of the students (Chetty & van der Westhuizen, 2015; Tadesse & Davidsen, 2020), to improve ill-structured problem solving abilities (Choi & Lee, 2009), to combine the cognitive, affective, and social aspects of learning (Gunawardena et al., 2004); (Moallem, 2001) and to effectively deliver blended learning courses (Jones & Sharma, 2018; Lee et al., 2017; Suartama et al., 2019).

Three studies (Desrosier, 2011; Mei et al., 2021; Warren & Wakefield, 2011) considered timeline (available time duration to design and develop the course) as a key factor to be considered when selecting an ID model. Three studies considered available resources when selecting the ID model, such as funding (Desrosier, 2011; Warren & Wakefield, 2011) and multiple stakeholders in the ID process (Mei et al., 2021). Moreover, two studies (Dennen & Hao, 2014; Mei et al., 2021) considered the expertise in the ID process when selecting an ID model.

### **ID Models for Digital Learning in Higher Education**

According to the analysis, 30 studies used the ID models in current practice (i.e., number of articles which used each ID model: ADDIE - 20, Rapid prototyping - 3, 4C/ID model - 2, Morrison, Ross and Kemp (2004) – 2, IDEA – 1, ASSURE – 1 and Six-step blended learning conversion model – 1). The other 10 studies used newly developed ID models according to the requirements of the courses to be designed and developed. The summary of the ID models in current practice and their impact is given in the Table 1.

**Table 1: ID Models for Digital Learning in Higher Education**

ID model, Developed by (Author, Year)	Features of the ID model	Points to consider when using the ID model
ADDIE, (Branson et al., 1975)	Is a generic instructional model that provides a road map for ID process with five phases; analysis, design, development, implementation and evaluation.	<ul style="list-style-type: none"> <li>• Can be used to design and develop digital learning courses in face-to-face, blended and online modes.</li> <li>• Can be used by academics and instructional designers who are new to ID process.</li> <li>• Is time-consuming.</li> </ul>
Rapid prototyping, (Tripp & Bichelmeyer, 1990)	Has overlapping phases in the ID process and involves quickly developing a prototype product in the very early stages of ID process and then going through a series of rapid testing and revision cycles till a satisfactory version of the product is produced	<ul style="list-style-type: none"> <li>• Is suitable for designing courses delivered using online mode.</li> <li>• Can be used when limited time and resources are available for ID process</li> <li>• It allows formative evaluation of the prototypes during the process.</li> <li>• It facilitates collaboration with multiple stakeholders (i.e., subject matter experts, instructional designers) in the ID process.</li> <li>• High level of expertise in ID process is required.</li> </ul>
4C/ID model, (Van Merriënboer et al., 1992)	It describes educational programmes/course as being built from four components: (1) learning tasks, (2) supportive information, (3) procedural information, and (4) part-task practice	<ul style="list-style-type: none"> <li>• Is specially designed for developing educational programmes/courses for teaching complex skills or professional competencies.</li> <li>• It stimulates self-directed and deep learning by providing the four components of learning at the student's disposal</li> </ul>
Morrison, Ross and Kemp (2004) model, (Morrison et al., 2004)	It is a curvilinear ID model which conveys flexibility in the ID process. It makes instructional elements and decisions regarding design very explicit.	<ul style="list-style-type: none"> <li>• It provides an explicit ID process by providing many design elements.</li> <li>• It is well-suited to meet the learning needs of adult students.</li> </ul>
IDEA, (Mullins, 2014)	It has four steps; interview, design, embed and assess, in order to facilitate integration of information literacy in academic courses.	<ul style="list-style-type: none"> <li>• Can be used to integrate information literacy in academic courses.</li> </ul>
ASSURE, (Heinich et al., 1999)	It consists of six distinctive steps in the ID process. It draws on multimedia and technology to augment the learning experience	<ul style="list-style-type: none"> <li>• It draws on multimedia and technology to augment the learning experience and best suits for design and development of online courses.</li> </ul>

ID model, Developed by (Author, Year)	Features of the ID model	• Points to consider when using the ID model
Six-step blended learning conversion model, (Jones, 2012)	It consists of six steps which provide the ID process for design and developing blended learning courses.	<ul style="list-style-type: none"> <li>• It can be used as an ID model to design and develop blended learning courses.</li> </ul>

### Impact of ID Models for Digital Learning in Higher Education

The courses developed using ADDIE fulfilled the learning objectives of students and resulted in improved academic performance of students (Awajan, 2022; Barefah et al., 2018; Charbonneau-Gowdy et al., 2021; Dennen & Hao, 2014; Ngui et al., 2020) and high student satisfaction (Behney, 2019; Braun et al., 2021; El Kharki et al., 2021; Hamid et al., 2021; Huang et al., 2006; Jamridafrizal et al., 2019; Medina et al., 2013; Miner-Romanoff et al., 2019; Mohammed et al., 2021; Neto et al., 2021). The Rapid prototyping ID model has been effective in developing online courses in the case of a limited time frame and limited resources (Desrosier, 2011; Mei et al., 2021; Warren & Wakefield, 2011). The 4C/ID model has been effective in fulfilling learning objectives resulting in satisfaction of students, with all students passing the summative assessment task (Wopereis et al., 2015). Moreover, it allowed students to self-direct their learning (Larmuseau et al., 2018). The Morrison, Ross and Kemp (2004) ID model was effective in designing courses which successfully addressed the preferences of adult learners (Knowlton & Simms, 2010). The IDEA model resulted in an efficient and effective pedagogical approach to curriculum design with integration of information literacy in an academic course (Mullins, 2016). The ASSURE model was effective in the creation of effective digital learning material (Smith et al., 2022). The learners showed satisfaction about the course developed using the six-step blended learning conversion model (Jones & Sharma, 2018).

## Discussion

### Key Factors to Consider When Selecting an ID Model

The reported studies considered four factors when selecting an ID model to design and develop courses. Those factors were: requirements of the course, timeline, resources available and expertise in ID process. Instructional design models are valuable sources for appropriately matching the right creative process to the right design situation (Branch & Kopcha, 2014). Therefore, the ID model can be selected according to the requirements of the course to be designed and developed. Timeline is a crucial factor to be considered during ID in higher education (Arshavskiy, 2017). The included studies reported rapid prototyping can be used when a limited time is available for the ID process. This is because Rapid prototyping model has overlapping phases in the ID process and involves quickly developing a prototype product in the very early stages of the ID process and then going through a series of rapid testing and revisions (Tripp & Bichelmeyer, 1990). As the ADDIE model needs considerable time for the analysis phase at the beginning and also for each phase to be completed before moving to the next, the ID process using ADDIE model is very time consuming (Arshavskiy, 2017). Resources available for the ID process can influence the selection of an ID model. The rapid, overlapping phases of the rapid prototyping model has enabled it to be used when limited funding is available for the ID process (Desrosier, 2011; Warren & Wakefield, 2011). The expertise in the ID process can

influence the selection of an ID model (Arshavskiy, 2017). To carry out a rapid, overlapping ID process by using rapid prototyping model requires a high level of expertise in using the model. On the other hand, the generic, step-by-step process of the ADDIE model has made it easier for use by academics and instructional designers who are new to the ID process (Arshavskiy, 2017).

## **ID Models for Digital Learning in Higher Education**

### ***Existing ID Models***

In 30 studies (75%), ID models in current practice were used to design and develop the courses. Twenty (50%) of the reported studies used the ADDIE model. The main reason for selecting ADDIE was that being a generic instructional model it provided an organised process for developing instructional materials which could be used in all three modes (face-to-face, blended and online). Three studies used rapid prototyping because it facilitates design and developing a new course within a limited timeframe and with limited resources. Two studies used the 4C/ID model, which was specially designed for developing educational programmes/courses for teaching complex skills or professional competencies (Van Merriënboer et al., 1992). Two studies used the Morrison, Ross and Kemp model (2004) to meet the learning needs of adult students (Knowlton & Simms, 2010). One study used the IDEA model to integrate information literacy in academic courses (Mullins, 2016). The ASSURE model was used in one study to draw on multimedia and technology to augment the learning experience in online learning environment (Smith et al., 2022) and the six-step blended learning conversion model was used by one study as an approach to develop blended learning courses (Jones & Sharma, 2018).

### ***New ID Models***

In 10 studies (25%) of new ID models were developed based on one or more existing ID models such as ADDIE, rapid prototyping, the Dick and Carey model, etc. The reasons for developing new ID model were; to develop work-based ID model (Mardini, 2013; Wolz et al., 2020), to develop a model that was contextualised for the local circumstances of the students (Chetty & van der Westhuizen, 2015; Tadesse & Davidsen, 2020), to address a specific learning outcome such as improving ill-structured problem solving abilities (Choi & Lee, 2009), to develop new ID model that focused on combining the cognitive, affective, and social aspects of learning (Gunawardena et al., 2004); (Moallem, 2001) and to develop an ID model for blended learning (Lee et al., 2017; Suartama et al., 2019). All these 10 models have proved to be effective for achieving the desired outcomes of each model. However, these new ID models cannot be generalised and to use of these models in future, the aims, learning needs, and contexts should be similar to those in which the models were originally used.

## **Impact of ID Models for Digital Learning in Higher Education**

The structural integrity, flexibility, and simplicity of ADDIE has made it one of the most popular of all ID models (Spatioti et al., 2022). Findings on the ADDIE model indicate that the five phases of the ADDIE (analysis, design, development, implementation and evaluation) have provided a holistic ID process and a roadmap for the entire instructional design process. It was observed that in the design phase the studies used a design framework, which fulfills specific requirements of that particular course. Courses which are designed and developed with ADDIE have fulfilled the learning objectives of students and resulted in high student satisfaction, irrespective of the delivery mode and the subject of the course, indicating the effectiveness of the ADDIE model.



Rapid prototyping is popular for providing a way to generate quality instructional material under time and resource constraints (Daugherty et al., 2007) and for effective collaborative course development involving multiple stakeholders (Mei et al., 2021). Rapid prototyping requires a high level of expertise in the ID process and, therefore, in two studies in which rapid prototyping was used professional instructional designers were involved in the ID process in addition to university teachers (Desrosier, 2011); (Mei et al., 2021). Findings of this review suggest that rapid prototyping has been effective in developing online courses in the case of a limited time frame.

4C/ID model (Van Merriënboer et al., 1992) has provided self-directed and deep learning by providing holistic and different components of learning at the student's disposal (Larmuseau et al., 2018; Wopereis et al., 2015). The Morrison, Ross and Kemp (2004) model has been effective in meeting the learning needs of adult students (Knowlton & Simms, 2010). The IDEA model has been effective for integrating information literacy in academic courses (Mullins, 2016). The ASSURE model has been effective in the accomplishment of learning objectives achieved through independent and shared activities (Smith et al., 2022). The Six-step blended learning conversion model has provided a suitable approach to develop blended learning courses (Jones & Sharma, 2018).

### Limitations and Future Directions

In an era of digital transformation of higher education, this study provides recommendations for educators in higher education to select the best-matching ID model for digital learning. This study provides information on: 1. the key factors to consider when selecting an ID model for digital learning, 2. the ID models available for digital learning and 3. the impact of each ID model. The teachers, administrators and policy makers in higher education can use this information in planning and executing an effective digital transformation of higher education.

This review was limited to English-language publications. Therefore, there may be other studies regarding ID models for digital learning in higher education, which were published in languages other than in English. The majority of the included studies are qualitative in nature. Therefore, future studies should aim to conduct interventional studies that provide quantitative findings to gain a better understanding of the effects of ID models.

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