# Effectiveness of Practical Experiences in Using Digital Pedagogies in Higher Education: A Meta-Analysis

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*Higher education institutions are trying to give a greater flexibility and individualization, generally through the use of new digital pedagogies. The goal of the meta-analysis is to evaluate the efficacy of a real-world experiences using digital pedagogies in higher education. To that end, the PubMed and Medline databases have been combed for relevant research through December 2021, and the eligible papers were selected using the PRISMA-based selection approach. One compared digital pedagogies to traditional teaching approaches. Various digital pedagogy technologies, such as video tutorials/social media, mobile app/computer software, flipped classroom, and virtual reality/simulation, were applied in this research. As a consequence of the present search, twenty-three research with a total of 1450 participants adopting digital pedagogies for higher education were discovered. The findings advised that higher education stake-holders use an innovative teaching strategy based on digital pedagogies. This integration of digital tools generates an effective learning environment and encourages the self-learning, which enhances the pedagogical performance of students and teachers.*

*Keywords: digital pedagogy, higher education, video tutorials/social media, mobile app/computer software, flipped classroom, virtual reality/simulation*

## INTRODUCTION

Higher education institutions are trying to give more flexibility and individualization, which is mostly accomplished through the use of new technology in online or mixed learning environments. The integration of technology and the Internet in education and learning, which continues to increase, is one of the authoritative pedagogical techniques. In order to achieve the expectations of a digital world, educational institutions are required to give more flexibility and individualization, allowing students to modify their learning to their own requirements and life stages (Barnett, 2014). Flexible learning, a concept that is commonly used in this context, is a wide spread term with many diverse meanings (Hrastinski, 2019). Technologies have the potential to change education, not only due to the ability of asynchronous communication tools and behaviors to improve the face-to-face learning experience (Chen, 2018; Garrison & Kanuka, 2004) for the creation of chances for exploration and discovery, for the simulation or enhancement of environments, for the development of behaviors, or for the simulation or enhancement of environments. Technologies that enable online education by introducing or maximizing the possibilities of synchronous and asynchronous contributions (Hrastinski, 2008; Murray et al., 2014) may also help students learn in a face-to-face classroom: activities that can be done before, during, or after class. Blended learning, on the other hand, claims to not only enhance classroom learning but also to reinvent the learning

environment to provide learners more autonomy (Smith & Hill, 2019). Students should be able to study more independently of time and location, and they should be able to choose their own subject and learning temp. The key question is whether online features can replace some portions of classroom time while maintaining educational quality and performance (Owston & York, 2018). This is particularly critical in light of the COVID-19 epidemic. Many institutions have been exploring replacing part or all of their classroom coaching with an online learning environment, both now and in the future (Peters et al., 2022; Saichaie, 2020); Tsekhmister et al., 2021). With the development of internet tools and technologies, social media has emerged as a critical instrument for supporting practical learning activities. Tutors can use social media technology to engage students in crucial time-on-task learning (Purvis, Rodger & Beckingham, 2016) and self-regulated learning (Dabbagh & Kitsantas, 2012). In general, the benefits of social media allow users to form relationships and involve with people regardless of time or distance. Facebook, Twitter, Instagram, YouTube, and LinkedIn are all popular social networking platforms that are meant to be simple to use and available from any internet-connected device. Users of social media are active players in the culture of social media, contributing user-generated content (van Dijck, 2009) and are able to use photographs, video, and music to create multimedia artefacts that they may share on social networking networks. Many social media platforms allow the exchange of brief messages accompanied by visual attachments, memes, and animated GIFs to supplement or replace written communications, frequently to communicate mood or cultural knowledge (Miltner & Highfield, 2017).

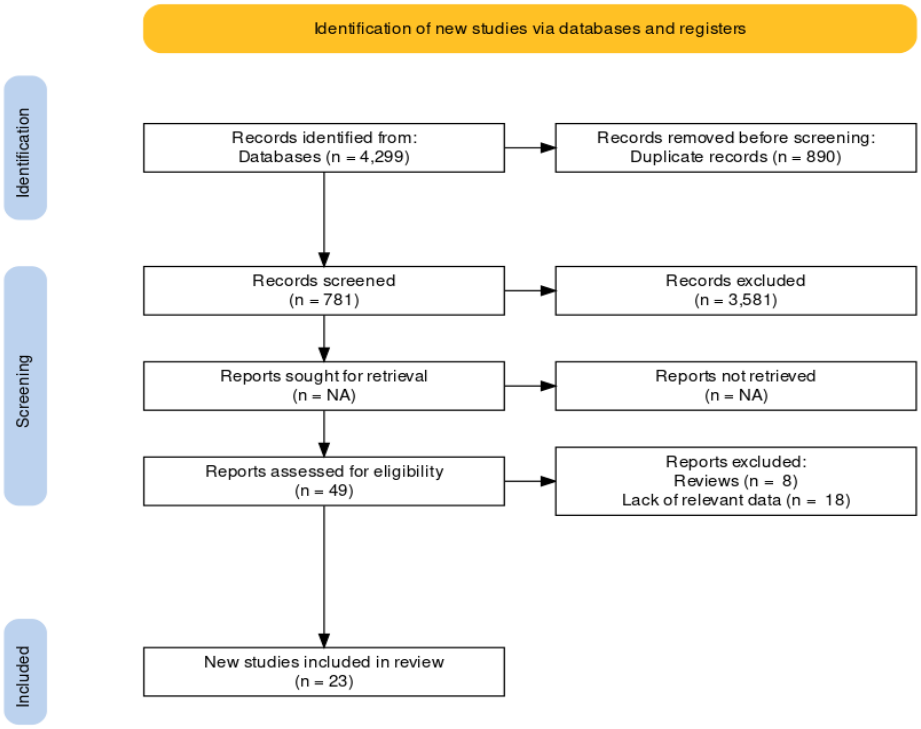
Cha et al. (2007) appeal that user-generated video material published to YouTube has changed how we watch video and television by giving engagement statistics like as views, ratings, stars, and favorites to indicate how popular content is (Manca, 2020). Users may search for specialty, topic-specific videos and create their own learning opportunities by searching for them. The implementation of social media for education is undoubtedly haphazard, unexpected, and complicated, with pockets of innovation driven by enthusiasts (Liu et al., 2020; McLoughlin & Lee, 2010; Moran et al., 2011) as opposed to being sponsored and executed across institutions in a coordinated manner. The facilitation of social learning is complicated, and it necessitates consideration of social connection formation as well as platform selection (Stürmer et al., 2018). Whether or not there is institutional backing is irrelevant. Although pedagogy has been a key component of these research, there has been no attention given to scaling up such programs and providing the necessary institutional support.

Appropriate use of technology can promote learning by allowing us to more effectively carry out our existing practices or to invent new ones. As a result, educational institutions throughout the world are increasingly under pressure to employ modern Information and Communication Technologies to teach students and help them gain the information and skills they will need in the twenty-first century. The goal of this study was to see how effective digital pedagogies are in higher education.

## MATERIAL AND METHODS

One searched PubMed and Medline databases in December 2021 for this meta-analysis, which included the most recent literature on randomized controlled trials and cohort studies for the use of digital pedagogies in higher education. The employed search criteria were digital pedagogy, higher education, randomized control trials, cohorts, and practical experiences. During the first search, one also searched through the reference tracking of bibliographies and manual searches to see if there were any relevant additional studies. Titles and abstracts were separately reviewed for inclusion by the authors. The studies were identified using the PRISMA method, and they were only considered qualified if they satisfied the inclusion criteria (Figure 1).

**FIGURE 1**
**THE PRISMA FLOW CHART OF THE LITERATURE SELECTION FOR THE META-ANALYSIS**




After removing the material that was obviously unrelated, the authors separately examined the study abstracts and full texts, deciding which publications to include based on the inclusion and exclusion criteria (Table 1). Any issues or conflicts were discussed and resolved by all writers.

**TABLE 1**
**CRITERIA FOR THE INCLUSION AND EXCLUSION OF STUDIES IN THE META-ANALYSIS**

| Inclusion | Exclusion |
|---|---|
| Original article | Reviews |
| Randomized control trials | Meta-analysis |
| Cohort studies | Systemic reviews |
| Innervation measures | Books/documents |
| Higher education studies | School and college education studies |

**Data Analysis**

Review Manager 5.4 was used to examine the retrieved data with a 95% confidence interval. The heterogeneity among the studies was determined using the random model. Forest plots were created in order to determine the total cumulative impact. Because we predicted heterogeneity among the papers included in the meta-analysis, we used a random effects model.

## RESULTS

The PRISMA flowchart in Figure 1 demonstrates a simplified research selection procedure. Table 2 shows the findings of the current search, which reveal twenty-three research with a total of 1450 participants adopting digital pedagogies for higher education. Twenty of the studies used the randomized controlled trial (RCT) approach, while three used the cohort model. Table 2 provided an overview of the studies that were included.

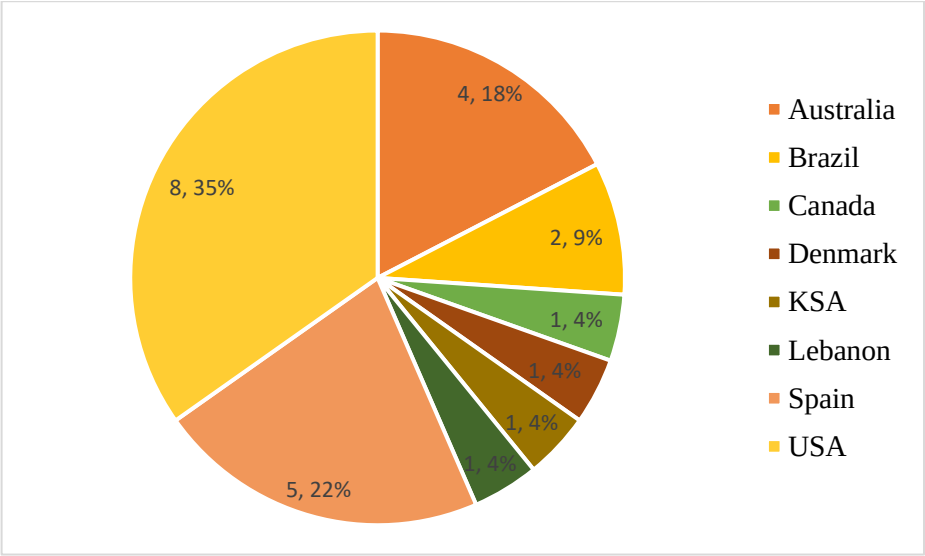
**TABLE 2**
**CHARACTERISTICS OF INCLUDED STUDIES PRESENTING STUDY DESIGN, COUNTRY AND DIGITAL PEDAGOGY FOR HIGHER EDUCATION**

| Author year | Study design | Study country | Digital pedagogy |
|---|---|---|---|
| (Ulrich et al., 2021) | Randomized controlled trail (RCT) | Denmark | 360° video used as e-learning |
| (Elzainy et al., 2020) | RCT | KSA | E-learning and online assessment |
| (Bartlett & Smith, 2020) | RCT | USA | Blended learning approach with mobile app |
| (Lozano-Lozano et al., 2020) | Double-blinded RCT | Spain | Blended learning approach with Ecofisio interactive website/app |
| (Day, 2018) | Cohort | USA | Flipped classroom |
| (Deprey, 2018) | Cohort | USA | Flipped classroom |
| (Rocha et al., 2017) | RCT | Brazil | Educational video game (quiz type) |
| (da Costa Vieira et al., 2017) | Prospective crossover | Brazil | Blended learning approach with e-learning classroom |
| (Fernández-Lao et al., 2016) | Single-blinded RCT | Spain | Blended learning approach with interactive/app (Ecofisio) |
| (Nicklen et al., 2016) | RCT | Australia | Remote-online challenge-based learning |
| (Murray et al., 2014) | Cohort | USA | Flipped classroom |
| (Sharara-Chami et al., 2014) | RCT | Lebanon | Simulation |
| (Maloney et al., 2013a) | RCT | Australia | Blended learning approach with pre-recorded video tutorials (Pilot study) |
| (Maloney et al., 2013b) | RCT | Australia | Blended learning approach with pre-recorded video tutorials (Main study) |
| (Noguera et al., 2013) | Crossover RCT | Spain | Anatomy-learning app for mobile devices |

| | | | |
|---|---|---|---|
| (Blackstock et al., 2013) | RCT | Australia | Blended learning approach with simulated learning environment videos |
| (Arroyo-Morales et al., 2012) | RCT | Spain | Blended learning approach with ecofisio interactive website/app |
| (Allen Moore & Russell Smith, 2012) | RCT | USA | Blended learning approach with Video podcasting (videoclips) |
| (Cantarero-Villanueva et al., 2012) | RCT | Spain | Blended learning approach with interactive website/app (Ecofisio) |
| (Thomas et al., 2010) | RCT | USA | High-fidelity simulators |
| (Campbell et al., 2009) | RCT | Canada | High-fidelity simulation |
| (Donoghue et al., 2009) | RCT | USA | High-fidelity simulation |
| (Solomon et al., 2004) | RCT | USA | Digital and live lecture formats |

The highest percentage of selected studies has been conducted in USA (n=8; 35%) followed by Spain (n=5; 22%). While, 18% (n=4) and 9% (n=2) of studies were from Australia and Brazil respectively as presented in Figure 2.

**FIGURE 2**
**COUNTRY WISE DISTRIBUTION OF SELECTED STUDIES PRESENTING VARIOUS DIGITAL PEDAGOGIES FOR HIGHER EDUCATION**

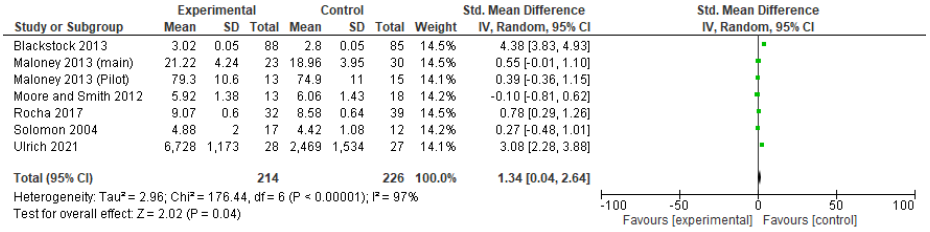



Digital pedagogies were compared to traditional teaching approaches in all of the considered research. Various digital pedagogy technologies, such as video tutorials/social media, mobile app/computer software, flipped classroom, and virtual reality/simulation, were applied in selected research. When compared to conventional learning, we aggregated seven research with a total of 440 individuals who used video tutorials/social media in their learning. The meta-analysis using random effects models showed significant

difference in video tutorials/social media and traditional learning [MD and its 95% CI were 1.34 (0.04, 2.64)] as showed in Figure 3.

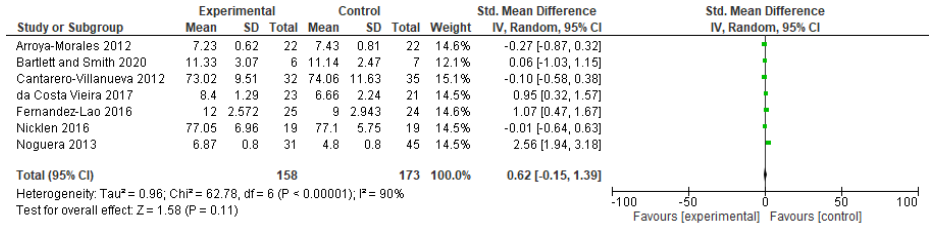
This result showed statistically significant (P=0.04) difference between digital pedagogical learning (video tutorials/social media) and traditional teaching in higher education. Further, for studies using mobile app/computer software (n=7) a total of 331 participants were included.

**FIGURE 3**
**FOREST PLOT PRESENTING EFFECT OF VIDEO TUTORIALS/SOCIAL MEDIA (DIGITAL PEDAGOGY) WHEN COMPARED TO TRADITIONAL METHODS IN HIGHER EDUCATION**



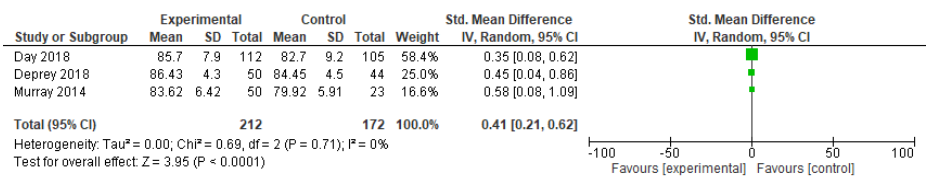

The meta-analysis using random effects models showed non-significant difference in mobile app/computer software and traditional learning [MD and its 95% CI were 0.62 (-0.15, 1.39)] as showed in Figure 4.

**FIGURE 4**
**FOREST PLOT PRESENTING EFFECT OF MOBILE APP/COMPUTER SOFTWARE (DIGITAL PEDAGOGY) WHEN COMPARED TO TRADITIONAL METHODS IN HIGHER EDUCATION**




These results showed no statistically significant (P=0.11) difference between digital pedagogical learning (mobile app/computer software) and traditional teaching in higher education. Similarly, we also united three studies including a total of 384 participants that used flipped classroom method in their learning when compared to tradition-al learning. The meta-analysis using random effects models showed significant difference in flipped classroom and traditional learning [MD and its 95% CI were 0.41 (0.21, 0.60)] as showed in Figure 5.

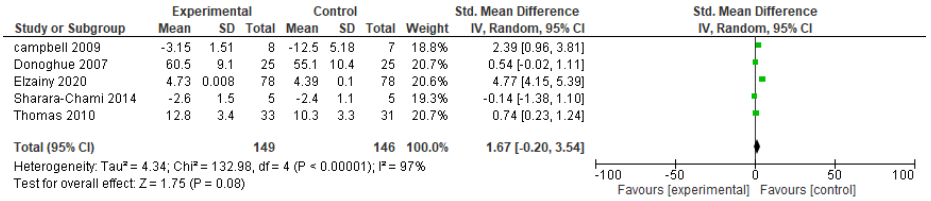
**FIGURE 5**
**FOREST PLOT PRESENTING EFFECT OF FLIPPED CLASSROOM (DIGITAL PEDAGOGY) WHEN COMPARED TO TRADITIONAL METHODS IN HIGHER EDUCATION**



This result showed statistically significant (P<0.0001) difference between digital pedagogical learning (flipped class-room method) and traditional teaching in higher education.

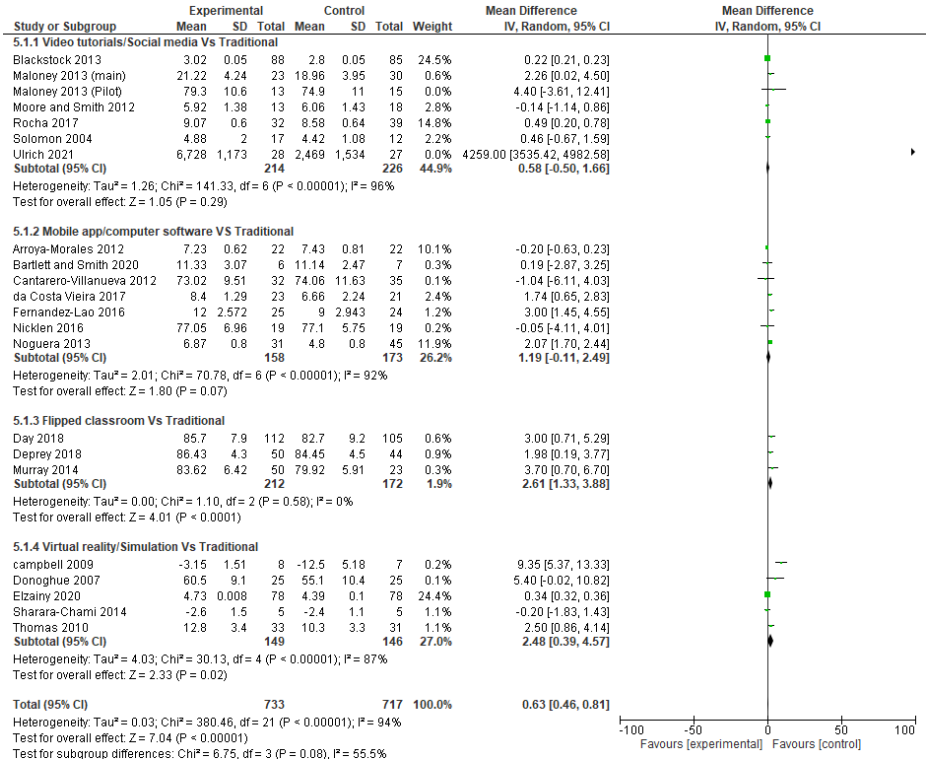
On the other hand, one also united five studies including a total of 295 participants that used virtual reality/simulation method in their learning when compared to traditional learning. The meta-analysis using random effects models showed non-significant difference in virtual reality/simulation and traditional learning [MD and its 95% CI were 1.67 (-0.20, 3.54)] as showed in Figure 6.

**FIGURE 6**
**FOREST PLOT PRESENTING EFFECT OF VIRTUAL REALITY/SIMULATION (DIGITAL PEDAGOGY) COM-PARED TO TRADITIONAL METHODS IN HIGHER EDUCATION**




This result showed statistically significant (P=0.08) difference between digital pedagogical learning (virtual reality/simulation) and traditional teaching in higher education. The overall effect of digital pedagogies for selected studies (n=23) in higher education was also determined. The meta-analysis using random effects models showed significant difference among all digital pedagogies and traditional learning [MD and its 95% CI were 0.63 (0.46, 0.81)] as showed in Figure 7.

**FIGURE 7**
**FOREST PLOT PRESENTING OVERALL EFFECT OF DIGITAL PEDAGOGY WHEN COMPARED TO TRADITION-AL METHODS IN HIGHER EDUCATION**



This result showed statistically significant (P<0.00001) difference between all digital pedagogical learning methods and traditional teaching in higher education.

## DISCUSSION

Higher education institutions are attempting to give more flexibility and individualization, which is mostly accomplished through the use of new technologies in online or mixed learning environments. The integration of technologies and the Internet in education and learning, which continues to increase, is one of the prevailing pedagogical techniques. Several studies have looked into the efficacy of digital pedagogies/technologies for lifelong e-learning and professional development (Cook et al., 2008). Digital learning offers various benefits, including enabling students to engage in self-directed learning (Huynh, 2017) and keeping curriculum up to date (Ruiz et al., 2006). The goal of this study was to see how successful digital pedagogies are in higher education. Video tutorials/social media, mobile app/computer software, flipped classroom, and virtual reality/simulation were among the digital pedagogy technologies deployed. The primary findings are that twenty research used the RCT technique, whereas three studies used the cohort approach. When compared to conventional learning, we aggregated seven research with a total of 440 individuals who used video tutorials/social media in their learning. Using random effects models, a meta-analysis revealed a substantial difference between video tutorials/social media and conventional learning. [MD and its 95% CI were 1.34 (0.04, 2.64)]. In one meta-analysis, self-produced films outperformed traditional classroom education on a practical skill in a cervical spine scenario by a statistically significant margin (Maloney et al., 2013; Gyamfi, 2021; Damşa et al., 2015; Maloney et al., 2013b). This conclusion needs to be validated in a bigger meta-analysis due to the small number of participants. When compared to practical classroom instruction alone, combining practical classroom teaching with students' self-produced videos working practical skills may encourage greater skill development. The capacity to relate transferred information to practical consequences and student achievement is one reason for this impact. This corresponds to mobile learning, which focuses on students' newly acquired information and abilities (Merrill, 2002). Using self-produced films as a complement to practical classroom instruction also allows teachers, tutors, and supervisors to provide feedback on students' clinical performance. Furthermore, self-produced films allow for peer-to-peer learning by sharing and discussing the outcomes of the videos, as well as the opportunity for self-reflection as part of the process of building professional clinical abilities.

In terms of efficacy, the meta-analysis found a statistically significant improvement in learning outcomes for both flipped classroom and traditional learning formats [MD and its 95% CI were 0.41 (0.21, 0.60)]. These findings are consistent with a comprehensive evaluation of 12 research that found considerable increase in nursing students' self-directed learning skills (Liu et al., 2018). A study of 24 research in health professions education, on the other hand, found no convincing evidence that the flipped classroom improved academic outcomes (Evans et al., 2019). The flipped classroom model's pedagogical options have the ability to encourage and engage students in pre-class learning activities, develop self-regulatory abilities, and increase the flexibility and transparency of the learning process (Låg & Sæle, 2019).

In addition, in-class activities need engaged students and provide a greater chance for students to integrate new subject to past knowledge in order to solve issues, which can lead to higher-order thinking. Another option is to get immediate feedback from peers and professors (Merrill, 2002). As a result of these pedagogical options, we may infer that the flipped classroom approach has the potential to improve students' learning results (Låg & Sæle, 2019; Merayo et al., 2018).

Further, a total of 331 individuals were included in the current study for trials employing mobile app/computer software (n=7). In a meta-analysis employing random effects models, there was no significant difference between conventional learning and using a mobile app/computer program [MD and its 95% CI were 0.62 (-0.15, 1.39)]. In higher education, there was no statistically significant difference (P=0.11) between digital pedagogical learning (mobile app/computer software) and traditional teaching. The impact of utilizing a mobile app/computer program on practical abilities was shown to be statistically insignificant

(Fernández-Lao et al., 2016; Arroyo-Morales et al., 2012; Cantarero-Villanueva et al., 2012). These findings are contradicted by a comprehensive evaluation of 29 research that found mobile learning to be as successful as, if not more effective than, conventional learning (Dunleavy et al., 2019).

Liu & Yan (2021) reported the use of an intelligent online English learning system based on mobile internet technology. However, students may see how to do practical skills and learn theoretical information through interactive websites/apps since they are adaptable, accessible, and transparent. In general, studies demonstrate that incorporating mobile learning technologies into higher edu-cation courses improves student engagement, attentiveness, and learning (Merayo et al., 2018; Gyamfi, 2021). Some risk-biased research might be to blame for the discrepancy in our findings. Similarly, the current meta-analysis, which used random effects models, found no statistically significant difference between virtual reality/simulation and traditional learning [MD and its 95% CI were 1.67 (-0.20, 3.54)].

However, utilizing random effects models, this meta-analysis study found a substantial difference between all digital pedagogies and conventional learning [MD and its 95% CI were 0.63 (0.46, 0.81)]. The difference between all digital pedagogical learning approaches and traditional teaching in higher education was statistically significant (P<0.00001). The digital pedagogy learning designs were most likely planned didactic learning designs with digital learning technologies and a constructive alignment strategy. Other studies have found greater student involvement, engagement, communication, critical conversations, and student–teacher relationship as a result of these findings (Damşa et al., 2015; Mącznik et al., 2015).

It might be advised that higher education stakeholders embrace a new teaching technique based on digital pedagogies. This integration of digital tools generates an effective learning environment and encourages self-learning, which improves the pedagogical performance of students and teachers.

## CONCLUSION

In terms of knowledge and practical skills development, the findings showed that digital pedagogies are either equally or more effective than traditional classroom teaching in higher education. The video tutorials/social media and flipped classroom treatments had substantial effects on student learning, according to the meta-analyses. However, larger controlled experiments are needed to validate these findings.

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