Effectiveness of Blended Learning Approach in Achieving Clinical Competencies of Health Professions Students: A Systematic Review of Experimental Studies

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Abstract. Multiple challenges to clinical education have occurred during and post-COVID-19 pandemic era. Blended learning is well-known for cognitive development. However, the role of blended learning for the development of clinical competencies is not clear. This review aims to evaluate the studies focusing on blended learning approaches compared to face-to-face and online-only instructional approaches to build clinical competencies in undergraduate health professional students. Studies were searched from CINAHL, PubMed, Scopus, Cochrane Library, HEC Library, and Google Scholar dated January 2013 to January 2023. The RCTs and quasi-experimental studies were included. All studies were assessed for quality using a medical education research quality instrument. Studies were abstracted and the descriptive results were presented. An initial search yielded 331 studies and 15 met the inclusion criteria; six were RCTs, and nine were quasi-experimental studies. Most papers came from Australia ($n = 5$). The following disciplines were included 5-nursing, 5-medical, 10 out of 15, three midwifery, one dental and one physiotherapy each. All studies yielded favorable mean quality scores of 14.40 and all were retained. Students generally had a positive view of blended learning and were satisfied and confident in achieving clinical competencies. Students exposed to blended learning approaches performed better on knowledge, skills, attitude, and practice than those in the conventional and online-only groups. The performance of students in the intervention arm was statistically higher than those in control group in 14/15 studies (P-Value < 0.05). There is a need for further research on blended learning in middle- and lower-income countries.

Keywords: Blended Learning · Health Professions Students · Systematic Review

1 Introduction

The World Health Organization declared COVID-19 a public health emergency [1], a disease feared by people that is characterized as a rapidly spreading infection and associated with high fatality [2]. Therefore, universities suspended on-campus face-to-face (F2F)

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classroom and clinical activities. Clinical education is imperative for theory-practice integration and development of clinical competencies [3]. Challenges to clinical education are well documented in the pre-COVID era [4], which became more problematic during the pandemic. Blended learning was slackly used for clinical competencies before the COVID-19 pandemic. However, it was forced into the educational system during the epidemic as a safe mode of instruction by educational authorities. Blended learning refers to a combination of online and F2F instructional strategies [5], online and offline education [6], or a mix of Web-based technologies and a mix of various pedagogical approaches [7]. Due to strong societal demands the higher education commission encouraged educational institutions to use blended learning and other learning technologies to continue the educational processes [8]. Blended learning has gained popularity in higher education over the past few decades [9]. Its demand consistently increased during COVID-19 and continued across disciplines [10]. The American society for training and development identified blended learning as one of the top ten trends in the knowledge delivery industry [11]. Blended learning delimits the geographical boundaries, maximizing the use of learning technology with online face-to-face instruction and assessment when physical F2F interactions are impossible [12]. However, the literature is splintered into various terms regarding blended learning and many overlapping terms, included distributed learning, decentralized learning, hybrid learning, flexible learning and mixed learning emerged in the literature [8, 13].

Educational and social responses to the COVID-19 pandemic are seen as a necessity and a stimulus and opportunity to change educational approaches. Therefore, the various blended learning strategies became a new normal of education during and beyond COVID-19 [14, 15]. The post-pandemic era accentuates educators to rethink assumptions of education to balance technology and pedagogy [16]. It is also believed that the digital revolution has not yet been matched by mainstream transformations of education systems [17].

The educators are expected to take responsibility to provide opportunities for developing clinical competencies using creative strategies to be mixed and adjusted to the context and learner. Therefore, an effective blended learning instructional approach for developing clinical competencies may not be established. This systematic review aims to explore the effectiveness of blended learning as an instructional approach for developing the clinical competencies and/or clinical skills in undergraduate health professions students.

2 Methods

The systematic review is setup to answer, what is the effectiveness of the blended learning approach on clinical competencies of health professional learners. The systematic review is a valuable strategy for collating the results from many studies to answer the research questions that focus on effective intervention measures [18]. The PICOTS approach to tabulate review questions and evaluate the question using the FINER acronym, denotes five essential characteristics of a good research question. It should be feasible, interesting, novel, ethical and relevant [19].

Table 1. Framing of systematic review

Population	Undergraduate Health Professions Education Students (Nursing, Medical, Dental, Pharmacy, Physical therapy)
Intervention	Blended learning approach A mix of the online and offline, onsite and offsite instructional strategy ensuring human factor F2F or online and learning technologies.
Comparison	- F2F approaches - Online-only approach
Outcome measurements	Any change in the clinical competence and/or skills that has been identified in the preliminary literature review.
Type of question	Testing the effectiveness of an educational approach
Type of study	Systematic review of randomized trials and quasi experimental studies

2.1 Data Sources and Search Strategy

The literature was searched from PubMed, CINAHL, Scopus, HEC Digital Library, Cochrane Library and Google Scholar. English language quantitative experimental studies with and without control, systematic review and meta-analysis were searched and accepted from nursing, medical, dental, pharmacy, and physical therapy professions i.e., adult populations (Table 1).

A systematic review [20] focusing on blended learning and clinical competence was conducted in 2012. Therefore, only literature after this period (January 2013–January 2023) is included in the review. Blended learning approach, blended learning strategy, clinical competencies, clinical competence, clinical skills and clinical training were combined with Boolean operative AND to search the studies. All citations were imported into the web-based bibliographic manager Mendeley, and duplicate citations were removed manually with further duplicates removed when found later in the process.

2.2 Relevance Screening

For the first level of screening, only the title and abstract of citations was reviewed to disqualify the resources that did not meet the inclusion criteria. Second level screening was performed on full text articles having research design RCT and quasi-experimental studies. Studies must compare the blended learning approach i.e., a mix of online and offline, onsite and offsite instructional strategy ensuring human factor F2F or online and use of learning technologies.

2.3 Quality Assessment

All studies selected for full-text review were evaluated for quality based on the medical education research quality instrument (MERSQI) [21]. The instrument is specific for

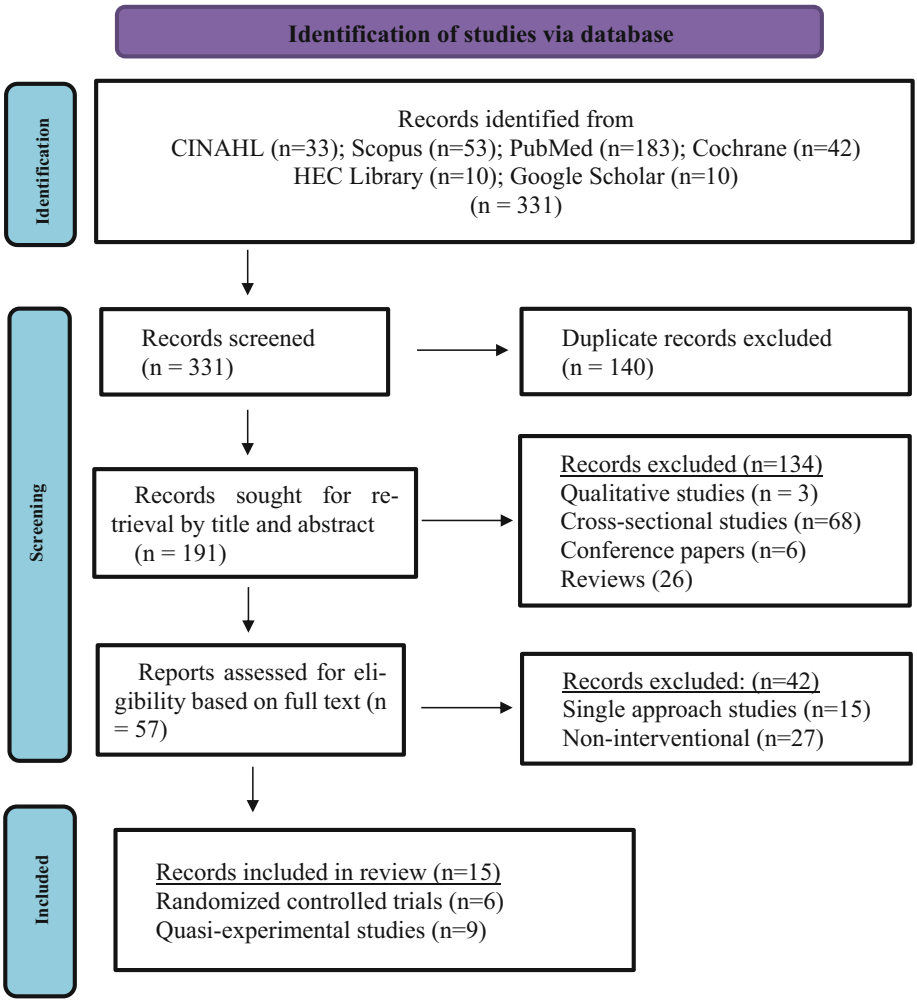

Fig. 1. PRISMA Flow Diagram

educational studies and the evaluation is based on study design, sampling, types of data, the validity of evaluating instrument, data analysis, and outcomes each having a score of three and 18 cumulative. Studies having a score <10 are considered of low quality (Fig. 1).

3 Results

The initial search yielded 331 articles from the databases and grey literature. After removal of duplicate titles and abstracts, 191 articles were screened, and 134 were excluded at first and 42 at second level screening. The final 15 studies consisted of 6 RCTs and 9 Quasi-experimental studies.

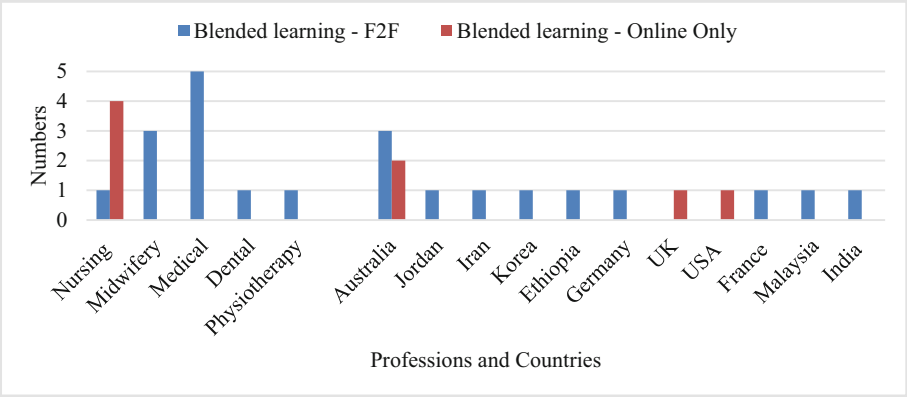

Fig. 2. Profession and countries distribution by blended learning-F2F and online only n = 15

Most papers in the review were came from nursing; one compared blended learning with F2F while four online-only instructional approaches. Five medical studies, three midwifery, one dental and physiotherapy each. All of them compared blended learning with F2F approaches for developing clinical competencies. Blended learning approaches were highly researched in Australia with three focusing on blended learning against F2F and two evaluated online-only approaches. While, Jordan, Iran, Korea, Ethiopia, Germany, the United Kingdom, the United States of America, France, Malaysia, and India provided one publication each in the systematic review (Fig. 2).

Quality assessment of studies using medical education research quality instruments (MERSQI) determined quality scores for RCTs [22–25] at 15.3 and quasi-experimental [5, 6, 26–29]. The quality scores were higher among the studies that used objective measurements such as performance checklists. All studies collected data from one respective institute and the response rate was ≥75%. The outcomes of only one study was behavior and the rest reported knowledge and/or skills. A range of 18–885, and a total of 3,487 health professions students participated in studies in the present review. Out of these 1,661 were exposed to a blended learning intervention. Except for the physiotherapy postgraduate students [26], all were undergraduate students, including [6], [30–33] nursing [6, 30–33], midwifery [27, 28, 34], medical [22–25, 29] and dental [5].

3.1 Clinical Competencies

Studies included in the review showed that clinical competencies can be developed through blended learning approaches (Table 2). Numerous clinical competencies were reported including dental clinical skills [5], physiotherapy competence and clinical practice [26], midwifery competence including antenatal, intra-natal, and post-natal care, newborn care, family planning, physical examination, medication administration, manual and vacuum removal of placenta, assisted vaginal delivery and neonatal resuscitation [27, 28, 34], clinical reasoning [29, 34], decision making [24], newborn assessment [25], asynchronous clinical supervision [6], and supervisee skills [30]. Blended learning approaches also demonstrated that they could impart emergency lifesaving competencies

i.e., airway management [22] and pediatric basic life support [24]. Electrocardiography as a basic diagnostic tool in routine and acute cardiac care was also evaluated through a blended learning approach [23]. Placement of intravenous catheter as a basic clinical competence was investigated in online-only and blended learning environment [33]. Lastly, medication administration competence using infusion pump is common. Intravenous pump emulator (IVPE) skills development and performance was studied in two studies [31, 32].

3.2 Educational Interventions and Their Effects

Blended learning to develop clinical competencies among health professions students was a central concept in the current review. Specifically, blended learning incorporating human factor to facilitate learning and developing competence was attended. Most recent studies incorporated flipped classroom [5] and stream-based clinical courses [26]. Flipped classroom which incorporated pre-class activities usually with online methods

Table 2. Characteristics of studies (n = 15)

Author, Year Country	**Discipline**	**Blended learning/ F2F & Online-only**	**Clinical Competencies**	**Assessment Tools**	**Findings and *evaluation***	**MERSQI Quality Score**
Blended Learning – Face to Face Instruction						
Qutieshat et al., 2020 Jordan*	Dental	Flipped classroom (e-lecture 31–79 min, online discussion forum, hands on training, case of the month) and mobile app. Conventional F2F	Dental Clinical skills	Case report Online exam Clinical performance checklist	- Study group students showed significantly higher performance on all assessment with the overall grade difference 7.25 higher than the control group. - Students were also more satisfied from the blended learning approach. - *Students' performance was high with blended learning approach (P-Value < 0.05).*	14.5
Bastick et al., 2020 Australia*	Physiotherapy	Stream-based clinical course, feedback Conventional	Self-efficacy Confidence	Self-efficacy questionnaire	- Post intervention scores were significantly higher for stream-based course. Junior physiotherapist showed higher efficacy with minimal supervision but confidence was how for independent practice. - *Blended learning is effective to improve knowledge but practice require additional support (P-Value < 0.05).*	12.5

(*continued*)

Table 2. (*continued*)

Author, Year Country	**Discipline**	**Blended learning/ F2F & Online-only**	**Clinical Competencies**	**Assessment Tools**	**Findings and *evaluation***	**MERSQI Quality Score**
Parandavar et al., 2019 Iran*	Midwifery	Film screening, a group discussion of real scenarios, simple simulation and four clinical decision-making question Traditional teaching	Clinical practice Clinical reasoning	OSCE	- Clinical practice scores increased from 16.6 to 35.7 and clinical reasoning scores increased from 6.8 to 11.6. - Score were higher with blended approach but no statistical difference was found. *- Blended learning improved clinical practice and clinical reasoning of the students (P-Value < 0.05).*	14.5
Noh & Kim, 2019 Korea*	Nursing	Online + off line activities, feedback, reflection and case study discussion F2F/campus	Asynchronous coaching	SDL Competency Questionnaire, Clinical Competency Questionnaire	- Experimental group mean score was high for self-directedness 162.09 ± 17.77 than 161.14 ± 14.99 in control group and likewise for 162.70 ± 23.98 than 156.43 ± 17.72 for clinical competence. - Clinical practice, self-reflection, facilitating and learning content was significantly higher P-Value < 0.05 in the blended learning group. Also, students were more satisfied. *- Blended of online and offline activities was an effective approach for developing coaching skills.*	12.5

(*continued*)

Table 2. (*continued*)

Author, Year Country	Discipline	Blended learning/ F2F & Online-only	Clinical Competencies	Assessment Tools	Findings and *evaluation*	MERSQI Quality Score
Yigzaw et al., 2019 Ethiopia*	Midwifery	Onsite and offsite training, SMS and phone calls Conventional	Newborn care Medication administration, Manual and vacuum removal of placenta, assisted vaginal delivery & neonatal resuscitation	OSCE (knowledge and skills)	- Assessment of knowledge showed no significance difference among blended and conventional groups (58.5% vs 61.5%, p-Value > 0.05). - Mean score for skills was significantly higher among the conventional group compared to what?? 85.8% vs 75.3%, p-Value < 0.05). - Cost per trainee was considerably lower in blended learning course 1032$ than 1648$ in the conventional course. - *Blended learning is cost effective and appropriate to gain knowledge.*	14.5
Kho et al., 2018 Malaysia^	Medical	Video based lectures, skills manual self-study, hands on practice F2F lectures and hands on practice	Airway management	Checklist	- Students improved scores in the both arms of intervention for theory and practice. - There was no statistical difference as well. - Perception was more positive for blended learning approach. - *Video lectures are equally effective and useful alternative for F2F lectures (P-Value > 0.05).*	15.5

(*continued*)

Table 2. (*continued*)

Author, Year Country	**Discipline**	**Blended learning/ F2F & Online-only**	**Clinical Competencies**	**Assessment Tools**	**Findings and *evaluation***	**MERSQI Quality Score**
Balasubramani et al., 2018 India*	Midwifery	Online interactive presentation + live demonstrations, discussion, case-based take home assignments. 72 h F2F/campus training	Midwifery skills Antenatal intra-natal & post-natal care, newborn care, family planning, physical examination.	OSCE Passing score ≥ 75%	- Post intervention scores were significantly higher on all midwifery skills p-Value < 0.001 with overall mean difference of 32.57 favoring blended learning approach. - Moreover, 55% passed the OSCE exam in post-test as compared to none in pretest. *- Students exposed to blended learning performed better in gaining midwifery skills than conventional method.*	14.5
Montassier et al., 2016 France^	Medical	E-lecture on Moodle, feedback and discussion forum Conventional lecture-based method	Electrocardiography	Quiz, Feedback	- Students in the e-course improved their scores significantly p-Value < 0.0001 in the posttest though there was no statistical difference in pretest and posttest with regard to approaches. - Students rated the e-course significantly higher for ease of access and use, educational value and satisfaction p-Value < 0.05. *- E-course using blended learning approach was effective to achieve ECG competence.*	15.5

(*continued*)

Table 2. (*continued*)

Author, Year Country	Discipline	Blended learning/ F2F & Online-only	Clinical Competencies	Assessment Tools	Findings and *evaluation*	MERSQI Quality Score
Ilic & Diug, 2016 Australia*	Medical	Mobile learning, interactive lecture, bedside teaching Didactic lecture	Clinical reasoning	Berlin Questionnaire	- Undergraduate students performed better with the didactic lectures. - Graduate students performed better with blended learning approach. - *Blended learning approach is equally effective and favor graduate students with more experience (P-Value < 0.05).*	12.5
Lehmann et al., 2015 Germany^	Medical	Simulation, Web-based virtual patients, video clips Simulation based PBLS	Pediatric Basic Life Support (PBLS) Decision making	Key feature test, performance checklist	- Intervention group performed significantly higher for procedural quality, temporal demands and algorithms p-value < 0.05. - Knowledge and performance score consistently increased from t0, t1 and t2. Clinical decision making was better among the blended learning group. - *Blended learning approach is superior for practical skills acquisition.*	15.5
Stewart et al., 2013 Australia^	Medical	Standard teaching + PENSKE baby check module and interaction via email. Standard teaching method (weekly lecture, bedside tutorial, demonstration)	Newborn assessment	Performance Checklist	- Blended learning group performed significantly better 30.0 ± 4.9 as compared to control group 27 ± 4.7, p-value 0.02. - Student satisfaction was also high with PENSKE baby check module. - *Blended learning approach resulted in higher performance for newborn assessment and satisfaction from teaching approach.*	15.5

(*continued*)

Table 2. (*continued*)

Author, Year Country	Discipline	Blended learning/ F2F & Online-only	Clinical Competencies	Assessment Tools	Findings and *evaluation*	MERSQI Quality Score
Blended Learning - online-only						
McCutcheon et al., 2018 United Kingdom^	Nursing	Clinical supervision app + F2F tutorials (4 + 3 weeks) Clinical supervision app + Online discussion (4 + 3 weeks)	Clinical supervision	Manchester clinical supervision scale	- Blended learning group obtained significant higher score 85.5 than 79.5, 4.2 than 3.5 and satisfaction 30.89 than 26.49 online group p-value < 0.05. - *Blended learning is effective and valuable approach to impart clinical supervisee skills.*	14
Terry et al., 2018 Australia*	Nursing	Online + Campus Campus only Online only	Intravenous pump emulator (IVPE)	Revised activity assessment tool	- Mean score of online and campus was high 70.0 as compared to campus only 65.5 and Online only 68.7. - Also, online and campus group completed activity earlier in 454.0 s as compared to campus only and online only groups 627.2 and 568.9 s. Blended learning group completed significantly faster P-Value < 0.0001. *Students performed better with blended learning approach.*	14.5

(*continued*)

Table 2. (*continued*)

Author, Year Country	Discipline	Blended learning/ F2F & Online-only	Clinical Competencies	Assessment Tools	Findings and *evaluation*	MERSQI Quality Score
Terry et al., 2016 Australia*	Nursing	Online + Campus Campus only Online only	Intravenous pump emulator (IVPE)	Activity assessment tool	- Mean score of online and campus was higher 68.7 as compared to campus only 62.0 and Online only 65.5. - Also, online and campus group completed activity faster or sooner in 486.1 s as compared to campus only and online only groups 711.6 and 619.6 s. Blended learning group performed better p-value < 0.01. Also completed activity faster. - *Blend of online and campus activities is effective to learn IVPE.*	14.5
Keleekai et al., 2016 United States of America^	Nursing	Simulation based course, workshops, case discussion Simulation based course and virtual simulator	Peripheral intravenous catheters (PIVC) insertion	Performance Checklist Self-report tool for confidence	- Students in the blended learning cohort scored higher for knowledge, skills and confidence p-value < 0.05. Than wait-list group. - Also, most were signed off in their first attempt and time for skills completion was also less. - *Simulation based blended learning course is statistical significant more effective to build PIVC insertion competence than virtual simulator.*	15.5

^RCT, *Quasi experimental, medical education research quality instruments (MERSQI)

and class activities using F2F mixed instructional approaches with e-lectures, online discussion forum, hands-on training and case of the month. Some studies also used mobile application to interact with the students [5]. The E-lectures were also used for airway management and midwifery skills as well [23, 28]. Stream-based courses incorporated video lectures, student interaction, and feedback to facilitate physiotherapy competencies and practice. Stream referred to number of activities for a clinical specialty, including musculoskeletal, neuro-medicine, cardiorespiratory, pediatrics, critical care, and women's health [26]. Video lectures were also used for midwifery skills [27], airway management [22], and pediatric basic life support [24]. The essence of a human factor i.e., live facilitation and interaction in real-time with students was ensured by a

number of studies to blend online approaches with feedback [6, 23, 25, 27–29]. Mobile learning was incorporated in various blended learning instructions for dental clinical competencies [5], clinical reasoning and decision-making [29], and clinical supervision [30]. Online discussion forums were also used to blend the learning experience for dental and midwifery students, clinical reasoning, and electrocardiography competencies of medical students [5, 23, 27, 28]. The discussion forums generally focused the case discussion using real and simulated cases. Reflection for asynchronous clinical supervision [6], simulation for midwifery skills [27], self-study as self-directed learning [22], and take-home messages [28], were also used among the intervention group to enhance the clinical learning experience. Clinical practice was sharing with blended and conventional instruction methods.

Blended learning approaches incorporating a human factor generally and these approached had favorable outcomes as compared to the conventional approaches [5, 6, 22, 24–26, 28–30, 32, 33] except for a set of midwifery skills in Ethiopian study [34]. Whereas an Indian study [28] showed a significant effect from a blended learning approach for the same set of midwifery competencies. There was a mean difference of 7.25 of grades among the students in the intervention arm for achieving dental competencies [5]. A study on physiotherapist improved the knowledge on the post-test and no difference was found for skills and clinical performance [26]. Clinical scores of midwifery students increased for clinical practice, and clinical reasoning favoring blended learning. A blended learning strategy that used online asynchronous clinical supervision, and reflection for clinical practice was rated significantly higher than those in the conventional group [6].

Midwifery students in the blended learning intervention arm outperformed the conventional by having a greater mean difference of 32.57 with a high success rate on their first exam attempt [28]. Electrocardiography performance was significantly higher $p = 0.0001$ in the post-test, and the students highly appreciated the blended learning approach for ease of access and educational value [23]. Postgraduate students performed better than graduate students; as graduates performed better in the control group for developing clinical reasoning [29]. The mean score for PBLS progressively increases with a blended learning approach in a time-serious interventional study [24]. The blended learning group performed significantly better, 30.0 ± 4.9 compared to the control group, 27 ± 4.7, $p = 0.02$ in the PENSKE baby check blended learning module [25]. The blended learning group obtained a significant (p-value < 0.05) higher score of 85.5 than 79.5, 4.2 than 3.5, and satisfaction of 30.89 than 26.49 students in an online-only group [30]. Two Australian studies [31, 32] showed that learning performance was higher for IVPE and they also completed the activity faster than their online-only counterparts. Mean knowledge, skills, and confidence scores were significantly higher, p-value < 0.05 in the intervention group to learn placement of PIVC and also completed the activity faster [33]. In addition to learning outcomes, an Ethiopian study found the cost of training was much lower in the blended learning group 1,032$ than 1,648$ with the conventional training [34].

3.3 Evaluation Tools

Two types of measurement tools were used to evaluate the clinical competencies of health professions students in the present systematic review. Several studies used the performance checklist as an objective measurement tool for clinical competencies [5, 22, 24, 25, 31–33] to measure the PBLS, IVPE, PIVC, newborn assessment, midwifery skills, airway management and dental clinical skills. While midwifery educators predominantly used the OSCE [27, 28, 34] to evaluate clinical competencies. Online exam and case reports were used to assess dental clinical competence [5], key feature test for clinical decision-making in the PBLS course [24], quiz, and feedback for ECG competence [23]. Researchers also used self-report questionnaires to evaluate the clinical competencies in the blended learning environment. Berlin questionnaire was used for clinical reasoning and decision making [29], Manchester clinical supervision scale [30] for clinical supervision, self-efficacy questionnaire [26] among physiotherapist, Self-Directed Learning Competency Questionnaire, Clinical Competency Questionnaire [6] for asynchronous coaching of the students.

4 Discussion

This systematic review revealed that blended learning was used to develop clinical competencies in health profession disciplines, including nursing-focused asynchronous coaching [6], clinical supervision[30], IVPE [31, 32] and PIVC [33], medical-focused airway management [22], electrocardiography [23], clinical reasoning [29], PBLS [24], and newborn assessment [25], midwifery focused clinical practice and clinical reasoning [27], range of antennal, intra-natal and post-natal care [28, 34], dental focused clinical performance and knowledge testing [5] and range of physiotherapy competencies for musculoskeletal, neuro-medicine, cardiorespiratory, pediatrics, critical care and women's health specialties [26]. This opened the window of opportunity for educators to adopt blended learning suited to their context. They may also attempt of applying to competencies not mentioned in this review. This is only possible with educators' competence to design and use blended learning approaches effectively.

A range of 18–885, and a total of 3,487 health professions students participated in studies included in the present review. The majority of students were undergraduate from nursing, medical, and midwifery professions. Therefore, blended learning approaches can be employed for developing clinical competencies in undergraduate health professions education. Also, these professions share the common clinical practice workplace. Hence, they can collaborate, share experience and possibles to develop interprofessional approaches and competencies.

Various mix of blended learning approaches were used in studies included in this review. Approaches used a wide range of learning technologies mobile app [5, 29, 30, 34], Moodle [23], discussion forum [5, 28], PENSKE online module [25], virtual patients [24], interactive video lectures [22, 24, 26, 27] and the rest mostly used e-lectures and online activities. Health professional educators used these learning technologies in different ways to improve the learning and experience of students to attain clinical competencies. Learning technologies may have contextual implications. For instance,

phone text messages can be used to interact with the students and send them questions to stimulate and enhance their learning [34].

Many studies used the blend of in-person with online approaches to develop clinical competencies in their respective contexts. The physical F2F or live online F2F approaches were pertinent to assess clinical competence. Feedback was commonly provided online [6, 23, 25, 27–29]. The performance checklists [5, 22, 24, 25, 31–33] were predominantly used in physical F2F assessment for PBLS, IVPE, PIVC, newborn assessment, midwifery skills, airway management and dental clinical skills. Midwifery educators used performance checklists in the context of OSCE [27, 28, 34]. Online exams and case reports were used to assess dental clinical competence [5], key feature test for clinical decision-making in the PBLS course [24], quiz and feedback for ECG competence [23]. These findings represent the objective measurement of clinical competence. Therefore, change in clinical competence due to exposure to blended learning may be true and generalizable among health profession learners. A few studies also used the self-report questionnaire, self-efficacy questionnaire [26], self-directed learning and clinical competence [6], Berlin questionnaire [29], and Manchester clinical supervision scale [30] to measure the clinical competence i.e., clinical reasoning and decision-making. Mainly educators used in-person assessment methods for technical skills and online methods for cognitive skills. These findings suggest that blended learning is a flexible approach to facilitate learning and measurement of clinical context in a wide variety of settings.

This systematic review has also shown the implications of blended learning among health professions, including nursing, midwifery, medicine, dentistry and physiotherapy. These disciplines share the context of clinical practice for patient care. Therefore, these may collaborate and learn from each other practices. The advent of interprofessional education may also be considered.

Studies included in the systematic review were screened for quality [21] using the medical education research quality instruments to inform the strength of evidence and inference for clinical competencies. All studies including RCT's [22–25] achieved average of 15.3 and quasi-experimental designs [5, 6, 26–29] average score of 13.8 good quality scores. The performance of the students in the interventional arm was statistically significantly higher than those in the control group in most RCTs [23–25, 30, 33], quasi-experimental [5, 6, 26–29, 31, 32, 34], except the one RCT [22] for airway management among undergraduate medical students. Furthermore, students in blended learning completed skills faster, they were more satisfied and confident. Therefore, blended learning approaches have the potential to contribute for the development of clinical competencies effectively.

The geographical distribution of the studies shows that most blended learning research was conducted in the high income than middle- and low-income countries. Being resourceful can be a general consideration. For instance, Digcomedu European educational framework encourages educators to used creative and mixed teaching methods to navigate contemporary future education shaped by technology [17]. However, the Ethiopian study illuminates an important facet of blended learning being a cost-effective instructional approach. The cost of training per students with blended learning was $616

less than training with the conventional in-person method [34]. This finding calls for the implication of blended learning and more research evidence from developing countries.

4.1 Limitations and Strengths

The main limitation of this review is the high degree of heterogeneity due to the variability of blended learning approaches, competencies, measurement and evaluation methods. Since only one study included graduate students, this review is limited to undergraduate students in nursing, midwifery, medical and dental professions. Moreover, non-English studies were excluded. This review was conducted on much needed area of education, namely the development of clinical competencies. Studies from authentic databases were included from health professions disciplines. All the studies were experimental and screened for quality assessment.

5 Conclusion

Blended learning approaches were effective to develop clinical competencies. A blend of face-to-face and a variety of online instructional methods can be used to design a specific blended learning approach that suits the context and the students. Educators preferred in-person methods for assessment using performance checklist and OSCEs. This review also indicates the need for research in the field of blended learning approaches for instruction and assessment.

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