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Literature Review

A Review of Post-Pandemic Online Assessment Research to Inform Practice

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Abstract

Prior to the COVID-19 pandemic, small percentages of PK-12 and post-secondary students engaged in virtual learning environments. The pandemic forced emergency remote learning, and this shift coupled with rapid advances in technology changed teacher and student practices. Prompt investments to districts' and universities' technological infrastructure immediately improved teacher and student experiences with remote learning, and data show that meaningful percentages of students initially remained enrolled in virtual learning environments. This systematic review examines post-pandemic research related to online assessment in both the PK-12 and post-secondary environments. and discusses implications for improving online assessment practices based on that research. After exclusion of theoretical, conceptual, and self-report-based studies, 10 studies grounded in higher education were examined for analyses. These studies addressed rapid changes in course and testing modality, but the majority only examined student performance on tests. The studies incorporated little additional formative or summative assessments and there was little mention of broader classroom assessment systems. Two of the studies did show evidence of utilizing a wide range of formative and/or summative assessment tools. Overall, few studies published during and immediately post-pandemic addressed robust classroom assessment practices, suggesting the need for increased assessment literacy and improved assessment practices for online educators.

Keywords: classroom assessment, online assessment, formative assessment, assessment literacy, online education, distance education, online assessment systems, higher education

1. Introduction

In recent decades, major technological advancements have resulted in the evolution of distance education from correspondence courses to fully online courses. As more students engage in online learning experiences, assessment in the online environment grows in importance and deserves greater attention. Regardless of course modality, assessment practices determine the degree to which students attain course outcomes. Online assessments demand more from teachers because they must integrate with the pedagogy of online courses. This places higher demands on educators, requiring them to understand both pedagogy and the technological tools needed to deliver and assess online learning

(Vonderwell & Boboc, 2013).

Adapting traditional formative and summative assessments presents challenges to online instructors in terms of complexities associated with technology integration (Sebastianelli & Tamimi, 2011; Vonderwell & Boboc, 2013). Additionally, sustaining high quality online summative and formative assessments is time-consuming for a teacher, posing an additional challenge (Lin & Lai, 2011). Online classroom assessment systems are not merely processes for assigning grades; in online education, assessment systems provide a means of communicating, sharing feedback, and establishing one-on-one relationships with students (Meyen et al., 2002).

With the onset of the COVID-19 pandemic, educational institutions at all levels faced unexpected challenges including forced school closures and mandated remote learning due to social distancing requirements, moving online education to the forefront. This unexpected change resulted in both challenges and opportunities for educators.

During the pandemic, educators continued to teach during lockdowns and regulated social distancing periods with the use of technology. Educators' digital literacy and access to educational technology increased, and they were forced to adjust the instruction and assessment practices they used for face-to-face teaching. In times of crisis, practices are revisited and may change. Educators have embraced technology to various degrees (Eringfeld, 2021; Ratten, 2023) but some researchers posit that moving back to pre-pandemic practices would be insufficient (Regnier et al., 2024).

The abrupt switch to online learning during the COVID-19 pandemic coupled with innovative advances in technology seemingly changed teacher and student practices. For instance, the pandemic accelerated the purchasing, adoption, and integration of educational technology tools and platforms in teaching and learning, including personal devices, video conferencing software, learning management systems (LMS), and educational apps. During the pandemic, disparities in internet connectivity and technological access led to increased funding allotments to mitigate digital equity issues, as all students needed to engage in distance education. As educators moved instruction to remote and hybrid teaching environments, districts and institutions provided professional development opportunities to support teachers' learning and increase their digital literacy. At the same time, teachers reconsidered traditional assessment methods. These rapid and forced changes have left the current status of online assessment and assessment literacy somewhat unknown.

1.1 Purpose

Thus, this paper explores post-pandemic research on online assessment. The purpose of this review is twofold: 1) to examine, summarize, and synthesize post-pandemic research related to online assessment in the PK-12 and post-secondary environments; and 2) to discuss implications from this synthesis for improving online assessment practices and assessment literacy.

1.2 History of Distance and Online Education

To explore the evolution of online classroom assessment systems, it is essential to first understand the historical context of distance education leading to the pivotal role assessment plays in education.

Distance education has long existed, with early distance learning experiences taking the form of correspondence courses, followed by courses shared over the mediums of radio and television using mainly printed learning resources (Crisp, 2018; Sumner, 2000). Over time, advances in technology consistently and continuously improved the format, quality, and access to distance education. Remote learning grew in scope in the 1990's with the development of the world wide web, which provided widespread access to shared files, facilitated the creation of multimedia content, and transformed the internet (Berners-Lee et al., 2010; Cailliau & Gillies, 2012; Campbell-Kelly & Garcia-Swartz, 2013). When the world wide web was placed in the open domain and web technologies became an open standard, the potential for distance education and many other web-based applications increased substantially (Cailliau & Gillies, 2012).

As computers became more affordable, available, and integrated into society throughout the 1990s, both hybrid and totally online modalities emerged as forms of distance learning. Distance learning encompasses several formats including correspondence, hybrid, and online courses. Technological advances such as computer conferencing that provided two-way interaction continued to evolve and improve pedagogical quality and access to all forms of distance education courses (Sumner, 2000). Companies were formed to provide platforms for online course delivery, and instructional strategies and resources expanded to include videos, podcasts, slide shows, recordings of on-campus lectures, discussion boards, and live conferencing.

Transitions to computer-mediated online learning opportunities were not without problems, however, as force-fitting technology posed compatibility, licensing, and other issues (Duncan, 2005). The U.S. Army's journey with distance education reflected other organizations' transitions, having varied support levels under different leaders; facing costs associated with hardware, software, development, and re-development; dealing with debates over proper ratios of face-to-face versus remote course hours; and perhaps the greatest challenge navigating uncertainties about the quality of online learning (Duncan, 2005). This historical context is important given recent experiences with forced remote learning. Figure 1 provides a schematic of the stages of distance education.

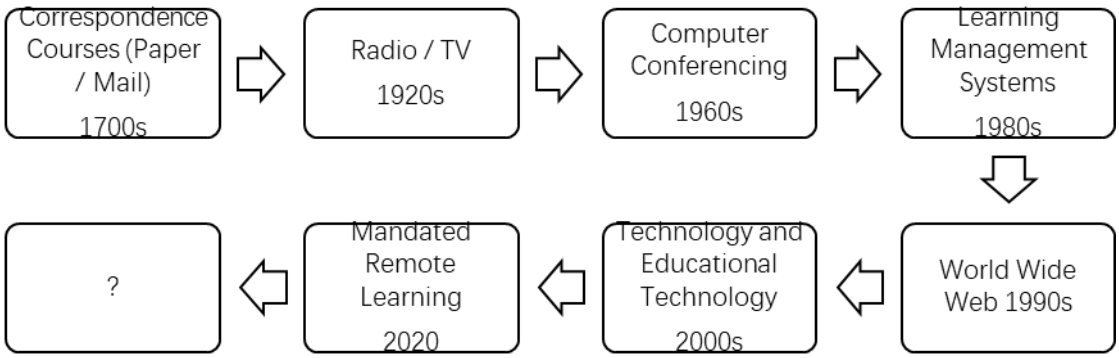

Figure 1. History of Distance Education

1.3 Enrollment in Distance and Online Undergraduate Courses

While concerns over the quality of distance education persisted, continuous technological advances in mobile technology, computing power, and software development supported growth of remote learning starting in the 1990s and leading into the 2020s. With respect to higher education in the United States, in 1997-98, approximately 1.36 million students enrolled in distance courses for online credit, and approximately 29% of education institutions offered undergraduate distance education courses (Lewis et al., 1997). In the fall of 2002, over 1.6 million students took online courses, and close to 600,000 took all of their course online (Allen & Seaman, 2003). By the mid-2000s, online learning grew to reach millions with the availability of massive open online courses (MOOCs). During the fall 2007 semester, 3.9 million students (over 20%) were taking at least one online course (Allen & Seaman, 2008).

Enrollment continued to increase, and in the fall of 2014, 5.8 million students in higher education enrolled in distance education courses, with 4.8 million students taking undergraduate courses, and 2 million enrolling exclusively in distance education courses (Allen & Seaman, 2016). Just prior to the onset of the COVID-19 pandemic in the fall of 2019, 2.4 million students were pursuing their undergraduate education exclusively online and 3.6 million were enrolled in some distance education courses (Hill, 2021). Approximately 36% of undergraduates were enrolled in at least one online course (National Center for Education Statistics (NCES), 2023). These statistics show the rapid growth of undergraduate enrollment in online education in the United States from the 1990s through 2020.

1.4 Increased Enrollment in Distance and Remote Undergraduate Courses

Similar to undergraduate education, online education in PK-12 settings in the United States also experienced significant growth since the development of the world wide web in the mid-1990s. In 2000, between 40,000 and 50,000 students were enrolled in PK-12 online education (International Association for K-12 Online Learning & International Association for PK-12 Online Learning, (iNACOL), 2009). In 2002-03, 36% of school districts corresponding to 8,200 public schools (76% of which were high schools) collectively had approximately 328,000 students enrolled in a distance education course (Setzer & Lewis, 2005). Approximately half of the total distance education course enrollments of 328,000 were Internet-based or online. In 2007, 700,000 PK-12 students were enrolled in at least one online or blended course, and almost three-fourths of districts with students enrolled in distance learning at that time planned to increase their online offerings (Picciano & Seaman, 2007; Picciano et al., 2012). In 2009, the estimated enrollment in distance courses grew to 1,030,000 students (Picciano & Seaman, 2009; Picciano et al., 2012).

As online course offerings increased, the availability of totally online education at the PK-12 levels in the United States also increased. In 2010-11, reports show that full-time online education was offered to at least some students in 30 states plus Washington, D.C. (Watson et al., 2011). In the fall of 2012, 43 percent of district administrators were offering online courses, and 48 states provided funding specific to PK-12 online education (Stedrak & Rose, 2015). In 2017-18, at least one online course was offered

by 21% of public schools; yet, only 6% offered a majority of classes online (USAFacts, 2023). De Brey et al., (2021) reported there were 56.4 million students aged 5-17 in the United States in 2017 and 3% (~1.7 million) of them took online courses. Prior to the COVID-19 pandemic, online learning was gaining traction and popularity, but overall, relatively small percentages of PK-12 students engaged in virtual learning environments.

1.5 COVID-19 and Online Learning

The onset of the COVID-19 pandemic forced emergency remote learning, altering the landscape of education. At the start of the pandemic in spring 2020, 84% of undergraduate students in the United States reported having some or all classes moved to online-only instruction (Cameron et al., 2021). For comparison, just prior to the pandemic in the fall of 2019, 36% of undergraduates were enrolled in at least one distance education class (Hussar et al., 2020). Post-pandemic, some data are available and suggest enrollment in online courses will remain high. In the fall of 2021, 11.2 million college students were enrolled in at least one distance education class, including 61% of undergraduate students. In 2022, the corresponding data were 10.1 million college students representing 54% of undergrads; and in the fall of 2023, 53.2% of college students enrolled in distance education courses in postsecondary institutions (BestColleges, 2024; NCES, 2024a).

At the PK-12 level, data show there were 52 million families with school aged children enrolled in school during the pandemic. In April 2020, 72% of families reported their children's classes moved to a distance learning format using online resources. This percent was slightly less at 67% in September 2020. Data also show that 59% of parents reported their children's schools provided computers (NCES, 2022b). In May 2021, 68% of children received online instruction; and close to 80% of fourth and eighth graders had remote learning available as an optional modality (NCES, 2022a; Zota & Granovskiy, 2021).

While the long-term plans of undergraduate students and PK-12 school districts and families to engage in virtual learning environments remain unknown, prompt investments to universities' and districts' technological infrastructure supported teacher and student experiences with remote learning, and data suggest that meaningful percentages of students remain enrolled in virtual learning environments. In some fields like management, changes brought about by the COVID-19 pandemic resulted in key alterations in instruction and assessment practices, changing the field to use new digital technologies that offer interactive teaching and learning experiences (Ratten, 2023).

Given possible changes that have occurred across disciplines as a result of pandemic, a comprehensive exploration of the current state of online education, specifically through the lens of online assessment, has the potential to significantly advance the quality of online education. To that end, the state of online classroom assessment is explored in the current study through examination of research published during and immediately after the pandemic. First, background literature highlighting key features related to online assessment are summarized to provide greater context.

1.6 Assessment in the Online Environment

Assessment lies at the heart of the learning process, regardless of the modality of instruction. Sound classroom assessment systems incorporate a variety of formative and summative assessments aligned to course objectives that are used to monitor teacher instruction and student achievement. Course level assessments utilize a variety of formal, informal, direct, indirect, summative, and formative assessments (Brookhart, 2004; Sebastianelli & Tamimi, 2011; Tilghman, 2011). Sound assessment systems are viewed as fair and thorough with justifiable evidence of reliability and validity. Students' perception of fairness is based on the integration of instruction, assessment and their learning (Baniasadi et al., 2023). Integrated instruction and effective teaching strategies coupled with comprehensive assessment methods lead to favorable student outcomes.

Generally, the framework for assessment plans for face-to-face and online courses are similar. Many principles from face-to-face classroom assessment systems apply (Correia, 2020; Ferretti et al., 2021; Hickey & Harris, 2021). Additionally, additional considerations exist when implementing effective online assessment systems. Online assessment systems must incorporate motivation theory, course management, and online pedagogies (Hansen & Zeanchock, 2021). They require adjustments from traditional face-to-face settings, arguably with a more systematic approach (Bauer, 2002; Gaytan, 2005; Hemby et al., 2006). Online assessment systems must balance technology, delivery, learning styles, and learning outcomes, while at the same time addressing engagement, academic integrity, development time, and scoring time (Gaytan, 2005; Hansen & Zeanchock, 2021). The shift of instruction and assessment to online settings impacts instructional design, classroom management, classroom dynamics, communication, and assessment methods (Liang & Creasey, 2004; Robles & Braathen, 2002). Thus, assessment factors heavily into determining the quality of the instructional design and instructional effectiveness of online courses (Roy et al., 2022).

As with face-to-face classes, a variety of assessments must be integrated into online courses to accurately assess student interactions, activities, and outcomes (Hemby et al., 2006; Tilghman, 2011). The use of a comprehensive range of assessment strategies remains an integral part of the assessment planning process (Vonderwell & Boboc, 2013). Assessment plans for online courses help instructors map effective online pedagogies to assessment, focus on student engagement and interactivity, and arguably require a more continuous and systematic approach than face-to-face assessment systems (Gaytan, 2005; Robles & Braathan, 2002; Vonderwell & Boboc, 2013). Therefore, knowledge of assessment principles is prerequisite for educators responsible for assessing students in online courses.

Formative assessment also plays a key role in online education, as it can increase student efficacy, self-regulation, and participation (Van gog et al., 2010; Vonderwell & Boboc, 2013). The primary role of formative assessment in online classes remains to provide feedback to students during a learning phase rather than to evaluate them for course grades (Lin & Lai, 2011; Sadler, 1989; Sadler, 1998). Embedding formative assessments into the instructional design process such that students understand expectations and what quality work looks like, can empower students to actively engage and monitor

their own progress (Sadler, 1989; Sadler, 1998). Personal connections are important in online learning (Sun & Chen, 2016), and these connections can be established and strengthened through formative assessments. Formative assessments can also be developed to align with summative assessments, such that feedback will impact future performance (van Gog et al., 2008). While teachers and college instructors may understand that formative assessment is useful, many do not have a clear understanding of how to systematically implement a realistic, attainable, and effective formative assessment system in their individual online courses (König et al., 2020; See et al., 2021).

Historically, the quality of online assessment was questioned (Northcote, 2002). Concerns over the quality of online education relate to many facets, including academic outcomes, assessment quality, academic integrity, students' sense of belonging and engagement, student motivation to learn, technological and internet access, data privacy and security, cost, and digital literacy of faculty and students. Because the development and incorporation of new technologies for instructing and assessing online require digital literacy from both educators and students, instructors need broad skill sets to assess online. Instructors must develop new technologic skill sets of their own while at the same time establishing digital competencies in their students (Guri-Rosenblit, 2018). Many faculty are reluctant to adopt online teaching and lack digital literacy themselves, posing potential challenges for quality online education. Historically, educators remained skeptical about the use of online assessment to evaluate student performance (Sebastianelli & Tamimi, 2011).

Brookhart (2023) posited likely changes in assessment in the near future, including additional incorporation of formative assessment, individual-level feedback, and an increased role of assessment information in instruction, all of which underlie online classroom assessment systems. Development of assessment plans in online settings further require an understanding of technologies available to implement the assessment activities successfully in the online environment, suggesting a necessary digital literacy component (Vonderwell & Boboc, 2013).

1.7 Assessment Literacy

All educators need proficient knowledge of assessment concepts, such as understanding the purposes and uses of a variety of assessments; analyzing assessment items; constructing scoring schemes for classroom decision-making; interpreting assessment results; and providing effective, useful feedback (Brookhart. 2011; DeLuca et al., 2016a; 2016b). These ideas relate to assessment literacy. Assessment literacy is a broad construct encompassing instructors' knowledge and skills related to assessments developed and used to measure and support student learning (Brookhart, 2011). "One becomes assessment literate by mastering basic principles of sound assessment practice, coming to believe strongly in their consistent, high-quality application in order to meet the diverse needs of all students, and acting assertively based on those values" (NWEA, 2016).

When teachers moved to online learning, literacy in classroom assessment was important because teachers had to adapt to employ effective assessment approaches; weakness in their classroom assessment approaches mark areas of concern (Asamoah et al., 2023). Teachers with different levels of

assessment literacy implement different actions, which could also result in an area of concern for online assessment (DeLuca et al., 2019). The onset of COVID-19 forced new, digital assessments into all classrooms, but the soundness of these online assessments systems is unknown. With increased enrollment in online classes, a growing number of educators teaching online classes, and continuous advances in educational technology providing new opportunities for instruction and assessment, examining the current state of online assessment practices is paramount.

2. Method

The educational context just described highlights the need to learn more about the current state of online assessment in both PK-12 and undergraduate education. The aim of this systematic review was to explore, summarize and synthesize the academic literature around online classroom assessment that has been utilized in PK-12 and undergraduate online education since the COVID-19 pandemic.

To that end, the study gathered the research aims, methodological approaches, references related to assessment literacy, and evidence that identifies factors that contribute to and detract from quality online assessment. This paper conceptually analyzes online classroom assessment research, summarizing the characteristics, strengths, and weakness of classroom-based online assessment from an assessment-literacy perspective. The research questions examined were:

1) How is online assessment being utilized in PK-12 and post-secondary settings?
2) What factors contribute to and detract from quality online classroom assessment systems and practices?

2.1 Design

This study implemented a systematic review. Systematic reviews are challenging, as retrieving relevant literature is central to their success. While there is no standard definition of a systematic review, following a protocol is considered to be best-practice; the protocol should describe the rationale, hypothesis, and planned methods of the review (Moher et al., 2015). The current study will incorporate the steps outlined by Khan et al. (2003).

1) Framing questions for a review
2) Identifying relevant work
3) Assessing the quality of studies
4) Summarizing the evidence
5) Interpreting the findings

Additionally, the PRISMA model was used to report on the system review process, as it is applicable across a wide variety of disciplines (Siddaway et al., 2019).

In the current study, the researcher hypothesized that published research would summarize current (post-COVID-19) online assessment practices at both the PK-12 and undergraduate levels, with more research existing at the secondary than primary and middle-school levels. The researcher posited that formative assessments would be prevalent in the literature given the prevalence of LMS access and features; and PK-12 classroom level research would show more comprehensive assessment systems

than college classrooms, partly due to the pedagogical training PK-12 educators receive through their teacher certification programs.

2.2 Related Systematic Reviews

During the literature search, published systematic reviews tangentially related to the current study arose. These systematic reviews included during- or post-pandemic literature related to online instruction and/or assessment. In a systematic review aimed to identify the trends of online assessment strategies, challenges, effectiveness, and implications in teaching and learning using a narrative, content analysis method, Namdeo (2023) found a "paradigm shift in the teaching learning process" with technology playing a pivotal role and being used effectively (p. 62). Namdeo found online assessment platforms varied, students engaged with assignments set up with basic LMS features, educators need to be adaptable, and findings showed mixed levels of effectiveness in online assessment. Most of the studies summarized by Namdeo were based on survey data or other self-report measures, that were not of interest in the current examination. Overall, the author concluded that additional research is needed related to online assessment.

In a systematic review of the instructional strategies used during the shift to online modality during the pandemic, Koh and Daniel (2022) used the Systematic and Tripartite Approach, and found instructors used a variety of instructional strategies, and students had mixed experiences related to instruction of hands-on skills and academic integrity in assessments. Online access and deficiency in self-directed learning skills were challenges. These authors also recommended future research in this area, due to the dynamic and diverse nature associated with online instruction and assessment. Again, many of the studies included in the review were based on self-report qualitative interview or questionnaire data.

Third, Khamees et al. (2022) conducted a systematic review to examine developments in online learning for post-graduate students in medical education. The authors examined literature summarizing activities that replaced those conducted in face-to-face settings prior to the COVID-19 pandemic. The authors produced a narrative description, and found partnerships, use of synchronous online activities, and varied degrees of student engagement with technology. Among the limitations they highlighted due to the shift to online learning were lack of hands-on experiences, challenges with using technology, and limited transferability. Positively, the authors found that educators embraced online learning beyond their expectations.

Topuz et al. (2022) examined technological aspects of online assessment systems rather than the assessments themselves, examining the platforms, security features, and common features of the underlying technology. They found that some LMS do not have compatibility with mobile technology, LMS are differentially compatible with various web browsers, test security features were in place, and the LMS systems supported multiple item types and camera use during test taking. Their study focused on assessment via tests, which is again not the focus of the current systematic review.

2.3 Search Methods

To obtain studies for the current review, several steps were conducted. To identify research that

examined online classroom assessment systems during and immediately post-pandemic, a search strategy moving from broad to more specific keywords was implemented. The platform used for searching was available through the author's university. The Ex Libris Central Discovery Index (CDI) is a central, unified index, for scholarly and academic material worldwide. It contains over 5 billion records and many different resource types from thousands of publishers, aggregators, and repositories. The Summon discovery system aided in the search. The Summon discovery search includes ProQuest, IEEE Open, JSTOR, PubMed Central, SAGE, Academic Search Premier and many others.

The search process began broadly and was streamlined during the process due to the number of citations found. Initially using only relevant keywords, an unmanageable amount of studies was flagged. The keywords were kept but rather than search throughout the full document text, the location of the keywords in the publication was streamlined to yield more relevant publications The following inclusion criteria were identified:

- Journal article
- Written in English,
- Published in a peer-reviewed journal (with full-text access),
- Published between April 1, 2020 and April 1, 2024,
- Including one of a broad set of keywords,
- Referring to online assessment, and
- Implemented in PK-12 through undergraduate level.

Preliminary search terms were utilized to represent the core information, resulting in the broad set of initial keywords found in the first column of Table 1. Search criteria were modified to focus on the education-based populations of interest as shown in the second column of Table 1. Review articles were excluded, and articles with specific focus on assessment in the subject terms and abstract were retained. , resulting in 2,718 articles for initial consideration.

Table 1. Search terms

Initial Content Keywords (n = 595,944)	Additional Population-Based Keywords (n = 219,625)	Excluded variables
eLearning	Undergraduate	Systematic review (n = 215,612)
Virtual learning	University	Review (pub name) (n = 210,613)
Distance learning	Higher education	Literature review (n = 3,464)
Remote learning	School	
Online education	Secondary education	
Remote	High school	

Online	Secondary school	
Distance	Middle school	
Web-based	Elementary school	
Online classroom assessment	Intermediate school	
Online assessment	Primary school	
Remote assessment	PK12	
Virtual assessment	K12	
Additional Required Keywords	Abstract Keywords (n = 2,731)	Abstract Keywords (n = 2,718)
Assessment (subject) (n = 6,523)	eLearning	Online classroom assessment
Assessment (abstract) (n = 3,555)	Virtual learning	Online assessment
	Distance learning	Remote assessment
	Remote learning	Virtual assessment
	Online education	
	Remote	
	Online	
	Distance	
	Web-based	

The inclusion and exclusion criteria are summarized in Table 2. Of note, peer-reviewed journal articles were the only types of documents included. Studies conducted at the graduate or professional (e.g., medical school, law school) levels were not included. Review articles, systematic literature reviews, theoretical papers, conceptual papers, and other similar non-empirical studies were also excluded from consideration. Additionally, studies that were based on self-report data about student or faculty perceptions about online learning were excluded. This criterion was pre-set by the author as the focus of the current systematic review is to examine current practices in online assessment rather than perceptions. During the search process, the author found more studies based on self-report data summarizing perceptions about online instruction collected with interviews or questionnaires than studies summarizing practices. These descriptive studies based on self-report data were not included in the current review. Figure 2 highlights the search process.

Table 2. Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
Studies that focus on online classroom assessment practices	Studies that did not focus on online classroom assessment
Studies implemented in PK-12 and undergraduate settings.	Studies implemented at graduate level
Studies using quantitative and qualitative methods	Studies that used hybrid modality
Studies published since April 2020 (the COVID-19 pandemic)	Studies published before the year 2020
Studies in the English-language	Conference abstracts
Studies published in peer-reviewed journals, with an available full-text version	Not in a peer reviewed journal or manuscript not available
Primary research	Review / conceptual / theoretical papers
	Studies on MOOC
	Studies using blended learning
	Medical studies with patients
	Descriptive studies (surveys/interviews)

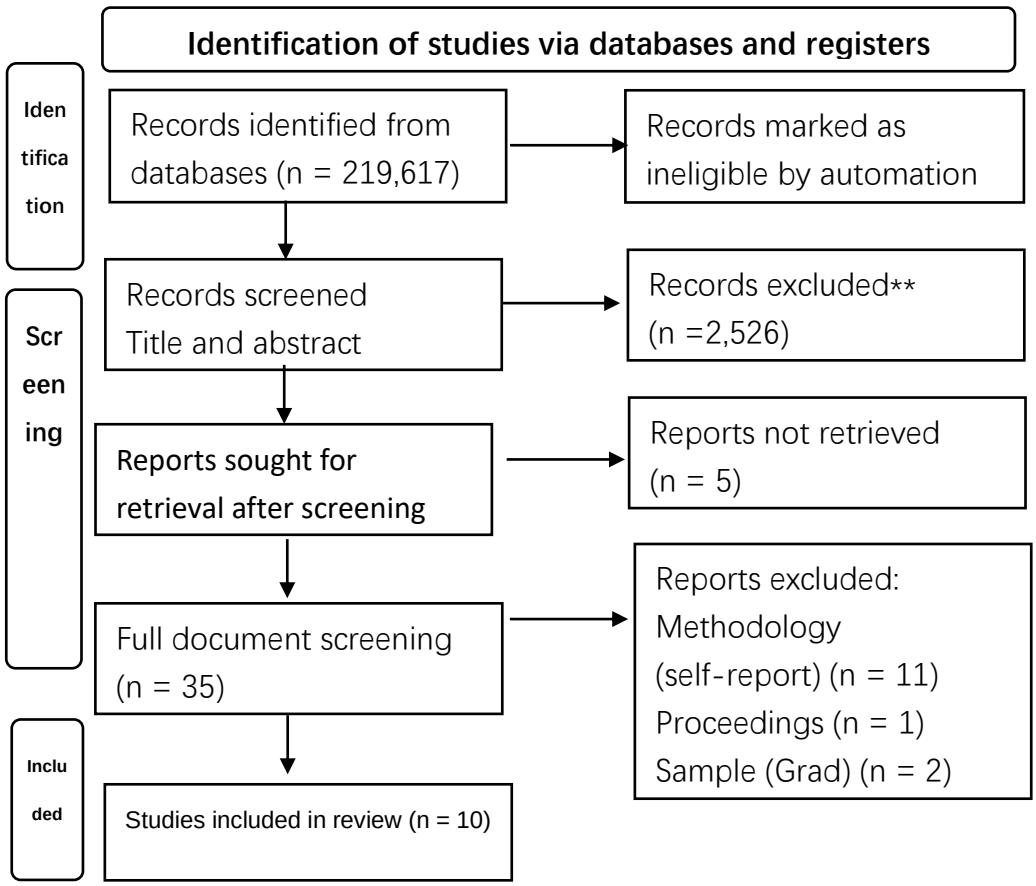

Figure 2. Application of PRISMA model for article screening

Data from each article were extracted and stored in a spreadsheet. The characteristics of reviewed articles include source, publication year, objectives, research methods/design, setting (post-secondary versus PK-12); purpose of assessment (summative, formative, mixed, other); sample; teacher and student roles / reflexivity; engagement; content focus; access available to technology (yes/no); technology requirements; outcomes; quality; cautions; and assessment literacy components; and appraisal score (Coombs et al., 2018; Darling-Aduana, 2021; Foster et al., 2021; Pastore & Andrade, 2019; Veugen et al., 2022). A list of items included in the data extraction sheet are found in Table 3. Manuscript author descriptions were utilized to provide data for several fields, and the current researcher determined data for other fields. Table 3 shows the fields that were extracted and/or summarized by the researcher.

Table 3. Data extraction for analysis, summary, and synthesis

ID	Engagement
Author	Content focus
Title	Access
Journal	Technology requirements
Type	Outcomes
Pub year	Quality of assessment
Setting	Cautions
Purpose	Assessment literacy classification
Scope	Limitations as reported by the authors.
Methods/design	Lessons learned as reported by the authors.
Teacher role	Conclusions as reported by the authors.
Student role	Quality of article
Teacher and student roles / reflexivity	

2.4 Data Summary and synthesis

Following is a comprehensive and systematic summary and analysis of current practices and crucial considerations for online assessment, grounded in the reviewed literature. A narrative description summarizes the data from the extraction form.

3. Results

Narrative and quantitative summaries were employed to analyze and synthesize the characteristics, strengths, and weaknesses of online classroom assessment practices. Findings are organized according to the research questions, focusing on how online assessment is utilized, factors influencing quality assessment practices, and the level of teacher assessment literacy that seemingly underlies current research based on the scope of assessment and measurement content addressed by the authors.

A total of 10 studies were found to meet the criteria of interest in the current review study. The selected studies addressed online classroom assessment, where undergraduate students' achievement was examined. No studies in the final pool examined online assessment in PK-12 classrooms. More studies related to online classroom assessment that did not directly implement specific assessments were found during the review stage. These studies reported on survey and interview data from educators and students about their perceptions of online assessment, but the studies did not summarize specific online course assessments that were implemented. Instead, they sought to examine general perspectives about online assessment. Those studies were not targeted in the current review so were not included in the summary. Instead, only studies that examined practices were included.

All of the final studies took place in higher education setting (not PK-12) in various countries. Most of the studies took place due to COVID-19 disrupting traditional face-to-face instruction in favor of online coursework. Several of the studies compared pre-COVID-19 data to post-COVID-19 data for their classes, and used grades and other summative assessments including tests for these comparisons. Table 4 shows a summary of study characteristics.

Table 4. Descriptive summary of included studies (All based in higher education)

Year of Publication	Took Place Due to COVID-19	Compare Pre/post COVID-19 Data	Country	Forms of Assessment
2020 (*n* = 1)	Yes (*n* = 8)	Yes (*n* = 7)	China (*n* = 2)	Test only (*n* = 2)
2021 (*n* = 3)	No (*n* = 2)	No (*n* = 2)	India (*n* =2)	Form only (*n* = 1)
2022 (*n* = 4)		Unclear (*n* = 1)	Iran (*n* = 1)	Sum only (*n* = 4)
2023 (*n* = 2)			Mexico (*n* = 1)	Mixed (*n* = 3)
			Netherlands (*n* = 1)	
			Spain (*n* = 2)	
			UK (*n* = 1)	

Several of the studies implemented analysis that would suggest some levels of educator assessment literacy, based on the measurement concepts utilized in the study. Other studies did not focus on as many underlying measurement or assessment concepts. The objective of each study as noted by the author(s) and analyses related to assessment data collected in the study is summarized in Table 5.

Table 5. Article summaries

Author and Date	Objective	Assessment(s)	Analysis	Recommendation(s)
Abedi et al. (2022)	Examined the quality of online assessments	Online Tests	Item difficulty Item discrimination Desc statistics Cluster analysis	Expand item types
Arnold (2022)	Compare online to face-to-face proctored assessment	GPA Grades Exams (Final counts 70% or more)	Desc stats Regression Cheating detection algorithm	Proctor online tests
Balseiro et al. (2022)	Compare academic outcomes of online face-to-face assessment	Exam scores Final grade Online formative self-checks	Desc stats of student activity and achievement Pass rates	Monitor cheating Develop more robust forms of assessment
Chen et al. (2021)	Examine student engagement, learning outcome, and students' perceptions of an online course featuring frequent tasks, quizzes, and tests as formative assessment	Formative quizzes Oral/written discussions Peer evaluation Real-time quizzes Prepared speech	Desc statistics Pre/post tests Interrater agreement	Design frequent and progressive formative assessment activities in online settings; Predict performance and prepare feedback in advance for rapid response
Cruz Ramos et al. (2022)	Use a quantitative quasi-experimental design to compare online oral exams to face-to-face	Oral assessments	Interrater reliability Desc statistics Inferential statistics	Embrace the capabilities of online language courses by providing online assessment options that are congruent with the principles of online instruction
García-Peñalvo et al. (2021)	Compared student learning and satisfaction with face-to-face and online classes	Online teamwork Student discourse Formative checks	Desc statistics Inferential statistics	Face-to-face assessments can be adapted effectively to online courses to promote active learning

		Oral exam Tests Project Satisfaction survey		
Kempegowda et al. (2023)	Examine the quality of online practical assessments	Short answer items aligned with levels of Bloom's Case analysis Opinion survey	Content validity index Coefficient alpha Desc statistics Inferential statistics	Online practical assessments could be conducted at par with the offline assessment Trial sessions with technology can be helpful
Lin et al. (2020)	Compared student performance on face-to-face and online assessment	Test scores	Desc statistics Inferential statistics	Advantages may exist for assessments in online settings Cheating and plagiarism are concerns Ensure online assessments are application based rather than recall
Orsi & Juliano (2021)	Compared pen and paper formative activities with digital alternatives	Student attendance rates Test items	Desc statistics Inferential statistics	Online modules can increase attendance (engagement)
Tamilmani et al. (2023)	Compared academic performance in n person and online assisted	Formative tests Surveys Various formative assessments	Desc statistics Inferential statistics	Online modules can increase achievement

Abedi et al. (2022) examined item level data for tests moved online by conducting item analysis. They expressed concern about the possibility of cheating. Arnold (2022) also examined tests moved from face-to-face to online format with the main purpose of examining whether cheating had increased. These authors did not address other components of their assessment systems, but Arnold (2022) noted that the final exams count for at least 70% of the course grades, allowing little room for other assessments. Some instructors used assignments and other tests towards course grades. Neither author found strong evidence of cheating, but both addressed this as a concern with online tests. Balseiro et al. (2022) also compared student performance in face-to-fact and online sections, found higher performance online, cautioned against cheating, and recommended including more robust assessments

methods. These three studies do not suggest broad implementation of formative or varied assessments.

Chen et al. (2021) studied students in an online class designed with various formative assessments and found high student engagement and improved teaching effect. She recommended designing frequent and progressive formative assessment activities in online settings, as well as anticipating student responses and errors so that proper educator feedback can be shared in real time during formative checks. Chen recommended controlled studies to examine the effects of embedded formative assessment in online courses. Chen's use of regular and aligned formative feedback and examination of inter-rater reliability suggested high levels of classroom assessment literacy.

Similarly, García-Peñalvo et al. (2021) examined student achievement and satisfaction with the adaptation of active course projects to the online environment, and found face-to-face assessments can be adapted effectively to online courses to promote active learning. García-Peñalvo also used a variety of instruction and assessment activities.

Several studies explored moving assessments to online modality. Cruz Ramos et al. (2022) examined the assessment of students' oral communicative competence in an online course and found positive outcomes. Kempegowda et al. (2023) examined an online practical assessment, also finding positive outcomes associated with designing and implementing the assessment online. Students reported less anxiety with online assessments, but some students had network connectivity issues. Lin et al. (2020) examined the impact of moving of an assessment from traditional pen-and-paper mode to an unproctored online mode and found better performance online, cautioning against possible issues with plagiarism or grade inflation. Orsi and Juliano (2021) examined differences in attendance with online modules and found increased attendance. They did not examine achievement. Tamilmani et al. (2023) also compared performance on online assessments to face-to-face data. These studies did not utilize a wide variety of assessments or discuss a wide range of measurement or classroom assessment topics. e.

4. Discussion

4.1 Research Question 1: How is online assessment being utilized in PK-12 and post-secondary settings?

In addressing the first research question, all of the studies that met inclusion criteria were from higher education. The published literature included in this review related to rapid changes in course and testing modality from face-to-face to online. As such, the majority of studies examined student performance on summative assessments including tests, rather than showing expanded focus on a variety of formative and summative assessments. This could be due to the pressing nature of transition from in-person to online at the start of the pandemic, and not enough time passing to examine more detailed studies of online modalities.

Higher education faculty who were new to online teaching saw promise with online assessments, as performance on the online assessments was generally equivalent or higher than corresponding on-ground assessments. Several of the authors indicated they would be considering online assessments that moved away from lower level knowledge to assessments that required more critical thinking.

Some of the studies that were found during the literature search but were not included in this systematic review did address PK-12 teacher and student perceptions of online assessment, but published research in the area of direct measures describing and evaluating online classroom assessment practices at the PK-12 level seems scarce.

A reason for the dearth of studies in PK-12 could be related to long-term interest in online learning by families. In the United States, during the 2022-23 school year, data show only 2.5 percent of students ages 5 through 17 with a PK–12 grade equivalent were enrolled in full-time virtual education (NCES, 2024b), suggesting online enrollments had returned to pre-pandemic levels.

4.2 Research Question 2: What factors contribute to and detract from quality online classroom assessment systems and practices?

The abrupt change to online assessment seems to have been the impetus for most of the studies in this review. Several of the studies compared performance on online assessments to face-to-face. The assessment systems examined in these studies used online tests and modules but most did not implement (or discuss the implementation) of assessment systems that used a wide variety of assessment types.

However, several studies found during the literature search showed perceptions of online instruction and assessment and found students should be made familiar with technologies and formats of exams (Aristeidou et al., 2023). Students see having multiple opportunities on assessments as fair (Eltahir et al., 2023). They also enjoy engagement with various technologies (Alshehri, 2023; Pascu et al., 2023).

Primary teachers reported concerns about overcrowded curriculum, and saw potential with online technologies, but were concerned with training (Redmond et al., 2021). Assessment without a systematic plan and without planned and explicit ties to the curriculum can be problematic (Pu & Xu, 2021).

4.3 Implications

The studies reviewed in this systematic review suggest lower levels of assessment literacy in that the studies neither incorporated a wide variety of assessments nor accounted for assessment by including evidence of reliability and validity. At the same time, this was not the case universally. Authors of the quantitative designs that compared test scores conducted item analyses or more advanced statistical analyses to examine quality of their assessments, suggesting high levels of assessment literacy related to item analysis. The lack of explicit descriptions of formative and summative assessment quality could be due to the types of studies that were published in the short timeframe since the pandemic addressed in this review.

Few studies were found that examined online assessment systems in PK-12 and higher education settings in the four years during and after the COVID-19 pandemic. Descriptive research published in that time frame suggests positive attitudes and experiences with online courses and online assessments, and other research suggests online education will remain at both levels, but especially in higher education (NCES, 2022a, 2022b; Rattan, 2023). It is possible that more research examining online

assessment systems in education will arise as time passes and online course take shape. However, this seems more likely in higher education than PK-12, given post-pandemic enrolments in online classes at both levels. The authors of the studies reviewed herein reported positive outcomes about online assessment and seemingly planned to continue to work with and revise their course level online assessments

5. Conclusion

The studies found in this review overwhelmingly represented higher education rather than PK-12 classrooms, and several of the researchers compared tests or other summative assessment data in their pre- and post- pandemic classrooms. These comparisons seemingly occurred due to the access to data and immediate relevance of research questions to the researchers, at the start of the pandemic. Most of the studies compiled in this review did not show evidence of utilizing a wide range of formative and/or summative assessment tools. Two of the studies were working towards this framework. Authors of the studies that examined a shift administering summative assessments in a traditional face-to-face to online format saw potential in the online modality in terms of achievement and flexibility of the assessments. Survey data related to perceptions of online assessment pointed out concerns and advantages. It is likely that these perceptions will change over time as more teachers engage in online course development and more students take online courses.

The main challenge in the current study was finding the appropriate literature to examine online classroom assessment practices. As assessment is a common term across fields like medicine, athletics, psychology, psychiatry, and counseling, choosing appropriate keywords that yielded studies related to classroom assessment in the time period since the start of the COVID-19 pandemic proved difficult. The majority of studies found related to online classroom assessment used survey and interview data to report teachers' or students' perceptions about online assessment, which while relevant, were not included in the scope of this systematic review. This review attempted to uncover current online classroom assessment practices.

This review suggests a need for more robust online classroom assessment systems. A focus on assessment literacy by online educators will improve the instruction and assessment systems in online classes. As instructors plan online courses, more emphasis should be placed on including multiple types of assessments aligned with course objectives and instruction. As researchers conduct future research on online courses, a main focus should be on the examination of the quality of those assessment systems, with consideration of assessment literacy.

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