

A Review of Digital Assessment in Education: Tools, Feature, and Effectiveness

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ABSTRACT

Technological advances have given rise to various innovations in education, especially in assessing student learning outcomes using tools/software provided by developers for Windows, MacOS, Android and iOS. This tool/software functions to help teachers assess student learning outcomes digitally, but each tool has differences in test types, features, ease of access and use, how to operate, costs for use and others. Analysis needs to be carried out on popular software widely used to guide teachers in choosing the tools/software that will be used to assess student learning outcomes digitally. This research aims to provide a critical analysis of what each digital assessment tool in the field of education available on the internet can and cannot do based on the ease of application and completeness of its features. The method used is a systematic literature review of educational websites, Google Scholar and Scopus, which mentions digital assessment tools from 2019-2022 with research stages: 1) research question; 2) searching literature; 3) carry out literature criticism using the PRISMA method; and 4) Article structuring. Analysis was carried out on the popularity, ease of access, types and forms of tests provided, scoring methods, and effectivity to assess student ability. From the results, it was found that both teachers and researchers often use 11 digital assessment tools in the education sector. The types of tests often used are closed-ended questions; the tester immediately knows the score obtained. Some tools can be monitored during implementation, while others cannot. Digital assessment tools can measure vary from low-order to higher-order thinking skills, depending on the form of questions the teacher provide, and can use to improve learning process, student motivation, collaboration, and interaction, and student-teachers ability. Further research is recommended to look directly at teacher and student responses to the effectiveness of digital assessment tools widely used to assess various student ability in the education sector.

Keywords: *digital assessment, tools, education, summative, formative*

1. INTRODUCTION

Education is a measurable process received by students with the hope that changes will occur for the better in the realm of students' attitudes, knowledge and skills (Timmis et al., 2016). The curriculum explains these three domains in graduate competencies outlined and described as learning objectives. Achievement of this learning objective is measured through a series of assessments by the teacher to students. Achieving learning objectives in the cognitive domain is usually done in two ways: summative assessment and formative assessment. Both assessments have different meanings regarding implementation time, but in practice, both are carried out to improve or increase the quality of learning (Elwood, 2006). Summative assessments are carried out at the end of each learning cycle to determine overall learning mastery, usually carried out at the end of the semester. Formative assessment is generally carried out to ensure students understand the material by involving teachers in paying attention, recognizing and responding to students' attitudes during the learning process and using the results as material for the teacher to take action, either in the form of remedial or enrichment (Cowie & Bell, 1999).

So, some people say that formative assessment uses the term "assessment for learning" because the aim is to improve the learning process and create in-depth learning in students through continuous feedback to enhance the learning process and student learning outcomes

(Rushton, 2005). Formative assessment should be an inseparable part of the education system so that all components that play a role in the educational process, such as teachers, students, school principals, and infrastructure, can implement the curriculum to facilitate learning (Bennett, 2011). Through formative assessment, students can also see what material has been mastered and which has yet to be mastered so that in the future, improvements can be made to the learning process so the same condition does not happen again (Zhorova et al., 2022).

Test questions are usually developed by teachers referring to Bloom's cognitive process dimensions, which are described as a hierarchy from simple thinking abilities to more complex thinking abilities: remembering, understanding, applying, analyzing, evaluating and creating, which some literature abbreviated as C1-C6. C1-C3 are grouped into low-order thinking skills, and C4-C6 are grouped into high-order thinking skills. The era of revolution 4.0 continues to develop into 5.0, where the education process is not only a process to produce people who memorize and understand the theory but also leads to people who can apply, evaluate and create new things from the theory they receive. Apart from that, 21st-century capabilities with four competencies known as 4C: creative thinking, critical thinking, communication and collaboration, so that the assessment process is no longer limited to low-level thinking abilities but rather more complex high-level thinking abilities (Sinta et al., 2022). Through the educational process, every student is sharpened to understand many things and relate one concept to another in an integral and integrated manner so that they are better prepared to face the uncertainties of life that will come. The recently developed test was the student literacy test to determine their ability to understand reading and analyze reading. This test is in line with 21st-century and higher-order thinking skills (Eyal, 2012).

The types of test instruments for assessing the cognitive domain vary, depending on what abilities the teacher wants to measure. The type of test can be multiple choice questions, essay, true-false, matching, blank text and so on. Multiple-choice questions and essays are more widely used in measuring student learning outcomes (Andriani et al., 2023). Multiple choice is most often used because it has the advantage of making it easier to correct and making it possible to measure more competencies/learning objectives (Stödberg, 2012). Essays are an open-ended question type because students can give varied responses, and this type of question can ensure students' abilities in a topic. The tendency to cheat or copy a friend's answer may be problematic. Based on this explanation, in measuring students' abilities, educators are expected to be able to choose the type of test that is appropriate to the learning objectives, student characteristics, time, effectiveness and efficiency.

Along with advances in science and technology, the educational process has become more flexible, where technology is used to support the learning process and even the core of learning itself, just like the educational process during the COVID-19 pandemic. The educational process is forced to adapt to circumstances so that various things are done with the help of technology, whether synchronous learning (Zoom meetings, Google Meet, etc), collecting assignments, or even tests. Tests are carried out using digital technology in the form of knowledge tests, performance tests, competency tests, and so on (Guàrdia et al., 2017; Jordan, 2013). Because of this, various digital assessment tools have been developed to carry out learning assessments online. This assessment is a real-time test and response where students work and find out the results right after they finish the test (Kahoot!, Quizizz, Google Quiz, Socrative, etc.). There are also scheduled tests provided by various learning platforms (Edmodo, Moodle, Blackboard, Google Classroom, Microsoft Teams, Etc.) (Rahmah et al., 2019).

Teachers, lecturers, tutors and instructors use this digital assessment tool to measure students' abilities because it has cost, time and effectiveness advantages (Buzzetto-More & Alade, 2006). Paper usage can be reduced, assessment becomes faster because grading of students' work can be done simultaneously, students can see the scores directly, and it doesn't take a long time to

implement (Alruwais et al., 2018).

Apart from that, digital assessment is quite interesting for students because they have involvement and provide valuable learning experiences; they have to take the test from their cellphone, anywhere and anytime at specified time intervals, and they can see the scores directly (Astalini et al., 2019; Çetin, 2018). Using digital assessment tools can also increase student motivation and learning outcomes (Faber et al., 2017; Faber & Visscher, 2018). Teachers must still understand that digital assessments have characteristics that are different from assessments carried out face-to-face because there is no direct interaction between teachers and students during the process. In addition to viewing learning outcomes, digital assessment tools can also be used to facilitate meaningful learning and still be able to measure high-level thinking abilities (Gikandi et al., 2011; Raaheim et al., 2019). The massive number of digital assessments currently means that teachers must be able to consider which digital assessment tools they will use. Therefore, it is felt necessary to map various digital assessment tools available on the internet that can be used by teachers in providing formative or summative tests to students, taking into account the completeness of the features, the type of test offered, ease of access, ease of use, and the effectiveness of the tools for measuring various student abilities. With this analysis, it is hoped that it can be a consideration for teachers when using digital assessment tools to assess student learning outcomes.

2. METHOD

This research is a systematic literature review on digital assessment tools, widely available on websites, applications and platforms. Searches were conducted on websites, articles, educational magazines and the Scopus database. This review was carried out in stages: 1) research question; 2) searching literature; 3) carry out literature criticism using the PRISMA method; and 4) Article structuring. This research answers five questions: 1) Which digital assessment tools are the most popular among researchers and educators? 2) how accessible is the digital assessment tool? 3) what tests can be carried out on this digital assessment tool? 4) what features do digital assessment tools have? 5) What student abilities can be improveby using the digital assessment tool in education?.

Sampling was carried out by conducting a Google search with the keyword "digital assessment tool", an electronic assessment tool that leads to several newspaper articles, magazines, and blogs that briefly review some of the most frequently used digital assessment tools. Each mentions various assessment tools; some are the same or not between one article and another. The author tabulated these digital assessment tools and found as many as 75 applications, tools, and platforms teachers can use to support formative assessment. It can be seen in Table 1.

Table 1. Tools, Applications and Digital Platforms for Formative Assessment

No	Feature	Tools, Aplication, and Platform Digital Assessment
1	Record Audio dan Video	Animoto, AudioNote, Edpuzzle, Flip, QuickVoice Record, Vocaroo, WeVideo
2	Create quizzes, polls, and surveys	Crowdsignal, Edulastic, FreeOnlineSurveys, Gimkit, Kahoot!, MicroPoll, Naiku, Obsurvey, Poll Everywhere, Poll Maker, ProProfs, Quia, Quizalize, Quizizz, Quizlet, Survey Hero, SurverMonkey, SurveyPlanet, Triventy, Yacapaca, Zoho Survey
3	Brainstorm, mind map, and collaborate	AnswerGarden, Coogle, Conceptboard, Dotstorming, Educreation Whiteboard, iBrainstrom, Miro, Padlet, ShowMe Interactive Whiteboard, Xmind

4	Present, Engage, and Inspire	BrainPOP, Buncee, Five Card Flick, PlayPosit, RabbleBrowser, Random Name/ Word Picker, Socrative, Adobe Express, Typeform
5	Generate Word or Tag Clouds	EdWordle, Tagxedo, Wordables, WordArt
6	Get Real-Time Feedback	Formative, GoSoapBox, IXL, Kaizena, Mentimeter, Pear Deck, Plickers, Quickey
7	Foster Family Communication	Remind, Seesaw, Voxer
8	Stengthen Teacher-to-Student or Student-to-Student Communication	Biblionasum, Classkick, ForAllRubrics, Lino, Online Stopwatch, Peergrade, Spiral, Verso, VoiceThread,
9	Keep the Conversation Going with live chat Create and Store	Yo Teach, Chatzy
10	Document or Assignments	Google Form, Piazza

A number of these applications were then eliminated based on the following: 1) Their functions are limited; 2) The inability of the tool to create quizzes; and 3) The failure of the tool to enable teachers to monitor student responses or answers. From this elimination, 11 digital assessment tools were found: Kahoot!, Quizizz, Edulastic, Google Forms, Mentimeter, plickers, Socrative, Nearpod, Formative, Class Flow, and Quizalize. Further analysis was carried out by analyzing web traffic from the digital assessment tool site with the help of <https://www.similarweb.com/> to see the website ranking in the education category and the number of visitors. Apart from that, an analysis was also carried out regarding the number of studies conducted using this tool in the Scopus database with the help of Publish or Perish and VosViewer with search keywords by the name of 11 digital assessment tools that are known before, electronic assessment in education, contained in the title, abstract and keywords of articles in the period. 2019-2022.

Further analysis was carried out on the type of test, ease of access, and features of the 11 digital assessment tools based on information provided on the website, Playstore, Google Play, and the researcher's personal experience. Furthermore, the effectiveness of digital assessment tools in measuring student abilities is analyzed based on what abilities have been measured and how students respond to digital assessment tools based on articles in the Scopus database.

3. RESULT AND DISCUSSION

The Most Populer Digital Assessment Tools

The digital assessment tools most widely and frequently used by educators and researchers can be seen in Table 2. The total number of visitors and the number of Scopus articles that mentioned these tools were considered.

Table 2. Website Traffic and Scopus Mention of Digital Assessment Tools

No	Tools	Website	Category Rank (Education)	Total Visit	Scopus
1	Kahoot	https://kahoot.it	3	40.4M	194
2	Quizizz	https://quizizz.com/	37	58.4M	26
3	Edulastic	https://edulastic.com/	121	1.8 M	0
4	Google Form	https://docs.google.com/forms	N/A	N/A	39
5	Mentimeter	https://www.mentimeter.com/	353	4M	18
6	Plickers	https://get.plickers.com	5.789	105.2K	28
7	Socrative	https://socrative.com/	423	2.2 M	83
8	Nearpod	https://nearpod.com/	90	5.8 M	20
9	Formative	https://goformative.com/	592	524.4 K	3
10	Classflow	https://classflow.com/	3.850	46.2 K	1
12	Quizalize	https://www.quizalize.com/	3.824	404.1 K	1

Table 2 shows that Google Form, Quizizz, Kahoot, Nearpod, and Mentimeter are the Top 5 most visited digital assessment tools. Suppose we refer to its ranking in the education sector. In that case, Kahoot is ranked highest under Google Form (Google Form, Google Docs), followed by Quizizz, Nearpod, Edulastic, and Mentimeter. The most frequently mentioned assessment tools in the Scopus database are Kahoot, Socrative, Google Forms, Plickers, Quizizz, and Mentimeter. Only some Scopus articles talk about Edulastic, even though in terms of ranking, Edulastic is in fourth place among the 11 digital assessment tools sampled. Based on this, it is known that the most popular digital assessment tools among researchers and educators are almost the same: Kahoot, Quizizz, Google Form, Socrative and Mentimeter.

From research conducted by (Licorish et al., 2018) it is known that students' perceptions of Kahoot influence class dynamics, motivation, and the students' learning process. The use of Kahoot attracts students' attention to focus on the learning carried out in class, learning becomes more fun, with interaction, discussion and competition. Based on this, there are several considerations in choosing digital assessment tools carried out by researchers: accessibility, ability to attract students' attention, ability to increase interaction, and ability to create fun, enjoyable, non-stressful learning.

Accessibility

The accessibility of digital assessment tools is a matter of consideration in their use by researchers and educators. This accessibility is related to the ability of digital assessment tools to be used on various devices (web, Android, iOS) and their availability in free or paid versions (Basic and Premium/Pro). This data was obtained from the websites of the 11 digital assessment tools, which were then analyzed and tabulated to facilitate data presentation. Data on the accessibility of the digital assessment tool can be seen in Table 3.

Based on the data in Table 3, it is known that all digital assessment tools are available in various versions and can be used on multiple devices: laptop (desktop), Android, and iOS. Some tools require users to register before downloading the application in their application stores. All tools are available in the web version, so users do not need to download them in their application store. In terms of access version, all applications have a free basic version and a paid version—the difference is in the completeness of the features provided. The more premium the tool version, the more complete the features offered.

Kahoot memiliki versi berbayar paling banyak yaitu, pro, premium, dan premium+. The basic version of this digital assessment tool can generally be used with the Android operating system rather than the iOS operating system. Formative is not available in both Android and iOS versions. However, Formative can still be used on these devices using Chrome (Android) or Safari (IOS) search pages.

Table 3. Accesibility of Digital Assessment Tools

No	Tools	Web Version	Android Version	Ios Version	Version
1	Kahoot	https://kahoot.it	√	√	Basic, Pro, Premium, Premium+
2	Quizizz	https://quizizz.com/	√	√	Basic, Premium
3	Edulastic	https://edulastic.com/			Free, Premium, Enterprise
4	Google Form	https://docs.google.com/forms	√	√	Free
5	Mentimeter	https://www.mentimeter.com/	√	√	Basic, Pro
6	Plickers	https://get.plickers.com	√	√	Basic, Pro
7	Socrative	https://socrative.com/	√	√	Basic, Pro
8	Nearpod	https://nearpod.com/	√	√	Basic, Pro
9	Formative	https://goformative.com/	-	-	Bronze, Silver, Gold
10	Classflow	https://classflow.com/	√	-	Basic, Pro
11	Quizalize	https://www.quizalize.com/	√ ²	√ ²	Basic, Premium

Note: ¹ Paid, ² You need to register on the site first before you can download it on the Play Store and App Store

Types of Test

The types of tests and components that can be added for each question in each digital assessment tool can be seen in Table 4.

Table 4. Type of Tes on 11 Digital Assessment Tools

Type Test/ Digital Assessment Tools	Kahoot	Quizizz	Edulastic	Google Form	Mentimeter	Plickers	Socrative	Nearpod	Formative	Classflow	Quizalize
Multiple Schoice/ True-False	√	√	√	√	√	√	√	√	√	√	√
Short Answer	√*		√	√	√		√		√	√	
Fill in the blank		√	√					√			
Multi Select (Checkbox)	√	√	√	√	√						√
Open Ended		√ ¹	√	√	√ ²			√	√	√	
Discussion								√			
Matching			√					√	√*	√	

Sorting	√*							√*	√	
Ordering (Sequencing)			√					√*	√	√
Polling (Survey)	√*				√	√		√	√	
Image Supported	√	√	√	√	√	√*	√*			√
Video Supported	√			√						

*Paid version; ¹ Limited-1000 character; ² Limited-250 character

Table 4 shows that of the number of test types provided by the free version, Google Form, Edulastic, and Nearpod are superior to other tools with multiple choice, true-false, short answer, fill-in-the-blank, open-ended questions (Edulastic can do its scoring by entering keywords or rubrics), matching, ordering, and teachers can insert pictures in the questions they create. Multiple-choice and true-false tests are available on all tools. All tools can show feedback and scores obtained by students right after completing the work. For open-ended questions, some tools limit the number of characters that can be entered, so students must answer clearly without rambling.

Feature

Table 5. Feature of Digital Assessment Tools

Feature/ Digital Assessment Tools	Scoring Closed- Ended Question	Scoring Open- Ended Question	Gami- fication	Real- time Feedback	Learner Analytics
Kahoot	√	×	√	√	Groups, individuals, questions that are difficult to answer, results obtained by all participants, analysis based on questions
Quizizz	√	×	√	√	Ranking, score, number of correct and incorrect answers for each question, average time spent working on each question, questions that are difficult and take the longest to answer
Edulastic	√	√		√	Correct and incorrect answers to each question, total score obtained, conclusion of participant results (in paid version more complex analysis is available regarding question analysis, student analysis)
Google Form	√	×		√	Mean, Median, range, graphic, total score
Mentimeter	√	×	√	√	The number or percentage of correct and incorrect answers to each question and the total score obtained by the participant
Plickers	√	×		√	Response to each question, overall score, graph
Socrative	√	×	√	√	Percentage of correct answers, quiz completion rate, and percentage of participants who answered the questions correctly

Nearpod	√	×	√	Ratio of correct answers, details of individual participation in each activity (Individual Report)
Formative	√	√	√	Response given by each participant (score)
Classflow	√	√	√	The number or percentage of correct and incorrect answers for each question, total score
Quizalize	√	-	√	Percentage of mastery of test for individuals, groups and classes

Scoring for close-ended questions can be done by all tools, but for open-ended questions it is limited to only a few tools: edulastic, formative, and classflow. The paid version of Edulastic also offers various features where teachers can analyze student abilities based on questions, difficulty, and the easiest and most difficult questions. Using tools with game features to motivate students, provide a different, fun learning experience, and foster a spirit of competition and collaboration, Kahoot and Socrative are the best choices. Using Kahoot and Socrative, learning can be done individually or in groups. The scores of each individual or group will be displayed directly (forming competition among students), and the learning process will be more interesting, fun and exciting.

Mentimeters with student responses can be displayed directly to motivate students' learning, and music can be added to Mentimeter to make it more enjoyable. Apart from that, Quizizz provides a learning experience like a game where a funny meme will appear every time you complete a question, and the tests are no longer stressful. Having time settings for taking tests also makes it easier for teachers to monitor the test. The grade a student gets depends on the student's correctness in answering and the length of time needed to answer the question. The longer the time spent answering questions, the smaller the score obtained.

Effectivity to Assess Student Ability

The effectiveness of digital assessment tools in measuring students' abilities in the realm of formal assessment is quite good, where there is time control on quizizz, direct response on Mentimeter and Kahoot, and the detection of keywords for open-ended questions on formative, shows that application development has considered various possible errors or bias in the results obtained by students. Several digital assessment tools can also be connected to Zoom/Microsoft Teams when implementing synchronous learning. For example, Mentimeter and NearPod are two handy tools that allow teachers to make interactive presentations of material by asking questions, which can then display student responses in real time. Most tools can add images to questions so that the form of questions the teacher gives can vary beyond words or sentences. Several studies conducted by researchers related to using tools to improve students' abilities, it is known that: 1) the use of Kahoot can increase student learning results (Baszuk & Heath, 2020), Students who take Kahoot quizzes more often have better test scores (Tóth et al., 2019); 2) Kahoot can also improve learning outcomes, students' ability to interact and collaborate in class, class dynamics, student and teacher attitudes, and student anxiety (Wang & Tahir, 2020; Zhang & Yu, 2021); 3) The use of Quizizz can improve student learning, and teachers have a positive response to the effectiveness of Quizizz as an assessment tool (Jiemsak & Jiemsak, 2020; T. M. Lim & Yunus, 2021; Purba, 2020; Szee Huei et al., 2021); 4) mentimeter can enhance teaching and learning and improve student critical thinking skill (Anggraini et al., 2022; Mayhew, 2019); 5) Socrative can support collaborative, active, enriching the teaching-learning process and promoting interactive learning, Improving student engagement (Christianson, 2020; W. N. Lim, 2017; Roman et al., 2021).

4. CONCLUSION

Based on this research, it is known that there are 11 assessment tools most frequently used by education and 10 digital assessment tools mentioned by researchers. According to researchers and teachers, the most popular tools are Google Forms, Kahoot, and Quizizz. Each assessment tool is easy to access and available for desktop (website), Android and iOS. Each tool is also available in basic (free) and pro versions, where the basic version has various limitations. Based on the number of tests that can be carried out, Google Forms, Edulastic and NearPod are superior to the basic version. The pro version of each digital assessment tool has almost the same amount except Plicker.

Regarding features and ability to analyze test results, Edulastic is more than other tools. The tools' ability to motivate and provide a teaching experience that attracts students' attention are Kahoot, Mentimeter, and Quizizz. Digital assessment tools can measure vary from low-order to higher-order thinking skills, depending on the form of questions the teacher provide, and can use to improve learning process, student motivation, collaboration, and interaction, and student-teachers ability. Further research is recommended to look directly at teacher and student responses to the effectiveness of digital assessment tools widely used to assess various student ability in the education sector.

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