Available on: https://jsshrs.ep-journals.org/ E-ISSN: 3051-3561 P-ISSN: 3051-3553

Journal of Social Science and Human Research Studies

Volume: 02 Issue: 01 January-2026

# Application of Information Technology in Teaching and Assessment of Natural Sciences

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**Published Date: January 26, 2026** **Article DOI: 10.65150/EP-jsshrs/V2E1/2026-10**

**ABSTRACT:** The purpose of this paper is to apply information technology in teaching, testing, and assessment within the Natural Sciences to enhance the objectivity, accuracy, and timeliness of learners' academic results. This paper outlines the current landscape of learner testing and assessment in Vietnam while analyzing the limitations inherent in existing practices. Consequently, the researcher conducted empirical studies and evaluations to propose innovative solutions for learner testing and assessment in Natural Science subjects. These solutions encompass the utilization of modern technologies, the application of competency-based assessment, and the integration of formative assessment throughout the instructional process. Tools such as online testing software, integrated assessment systems, and digital learning platforms facilitate the creation of diverse tests, automated grading, and learning data analysis. These advancements empower teachers to monitor progress, identify student strengths and weaknesses, and adjust pedagogical strategies for greater effectiveness.

**KEYWORDS:** Information technology, natural science subjects, teaching and learning, competency-based assessment, integrated assessment systems.

## 1. INTRODUCTION

The application of information technology (IT) in teaching, testing, and assessment is an inevitable trend in modern education. It plays a crucial role for both teachers and learners, enabling them to make timely adjustments to teaching and learning activities to meet the requirements and objectives of educational reform. Consequently, integrating IT into these processes is essential to satisfy the current demands of educational innovation. Testing and assessment hold value not only for instructors and learners but also for administrators. This is a pivotal stage that significantly impacts the process of enhancing training quality. Assessment results serve as the basis for making various decisions regarding learners, curricula, institutions, and educational policies. When conducted objectively, rigorously, accurately, and with proper orientation, assessment acts as a powerful motivator, encouraging learners to strive for academic excellence and fostering their continuous creativity and exploration (Nguyen *et al*., 2024). Furthermore, Decision No. 400/QD-BGD&DT issued by the Ministry of Education and Training (MOET) on February 3, 2016, regarding the promulgation of the MOET's 2016 work program, clearly stated in Item 7, Section III concerning the innovation of forms and methods of exams, testing, and educational assessment: Continue to implement periodic national assessment programs and international assessment programs oriented towards learners' competency assessment. Additionally, Official Dispatch No. 7991/BGDDT-GDTrH of the Ministry of Education and Training dated December 17, 2024, addresses the implementation of testing and assessment for lower and upper secondary levels. Thus, the Party and the State have identified the reform of testing and assessment as an imperative task in the current period (Dang & Tran, 2016).

Testing and assessment constitute a crucial stage and a vital task for educators in educational institutions today. The primary purpose of assessment extends beyond merely recognizing academic outcomes; more importantly, it assists learners in self-assessing their performance and perceiving their own progress throughout the learning journey. Simultaneously, it provides feedback that enables both instructors and learners to adjust the teaching and learning process appropriately, thereby meeting educational requirements and goals while contributing to the enhancement of educational quality. Therefore, proposing the application of information technology in teaching, testing, and assessing Natural Sciences is deemed essential. The results of this study provide a theoretical basis for applying IT in teaching, testing, and learner assessment. This encompasses utilizing modern technologies, implementing competency-based assessment, and integrating formative assessment into the instructional process, ultimately contributing to improving the quality of education and training in the current period.

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## 2. THEORETICAL OVERVIEW AND RESEARCH HISTORY

To implement competency-based learner assessment, teacher education institutions must first explicitly define the professional competency framework for teachers. This serves as the foundation to structure and design competency-oriented teacher training curricula, wherein learning outcomes must specify measurable competencies (Nguyen, 2020). Furthermore, it is essential to innovate the organization and assessment methods of pedagogical internships (or teaching practicums) within teacher education (Han, 2020). In recent years, numerous researchers have proposed recommendations aimed at improving the quality of educational testing and assessment. Specifically, these suggestions include: emphasizing the alignment between curriculum design and the assessment of learning outcomes; ensuring transparency and public disclosure of institutional learning outcomes; employing diverse assessment formats such as essays, practicums, oral presentations, projects, teamwork, and reflective or critical analyses, as well as various assessment methods like self-assessment and peer assessment; prioritizing the validity, reliability, and consistency of assessments; addressing the role of testing and assessment within the instructional process, while highlighting limitations and proposing measures for the effective management of testing and assessment activities in high schools (Duyen & Pham, 2015; Nawzad *et al.*, 2018). The findings of the aforementioned studies serve as a foundation for subsequent research on solutions to accelerate the positive and effective application of digital technology in testing and assessment at educational institutions, with the aim of innovating the forms of assessing learners' academic performance (March & Smith, 1995; Nguyen, 2022). To implement competency-based and application-oriented assessment, educational institutions must first design training curricula that are centrally focused on competency and application. On that basis, they must clearly establish the principles and processes for testing and assessing learners in alignment with this competency-based and application-oriented approach (Tran, 2017; Nguyen *et al.*, 2023; Nguyen & Tran, 2025).

Competency-based testing and assessment in Natural Sciences at junior high schools is a strategic orientation in general education aimed at meeting the current requirements of educational reform. Student assessment is essential for measuring individual progress and abilities, planning subsequent steps to improve teaching and learning, and sharing information with relevant stakeholders (Tran, 2019). Several authors have investigated the theoretical basis to establish a six-step process for designing a framework to test and assess the scientific research competency of secondary school students in Natural Sciences. Furthermore, they have proposed a student scientific research competency framework to serve as a foundation for teachers to conduct assessments during the implementation of activities (Pham & Le, 2022). In the current context of fundamental and comprehensive educational reform, testing and assessment must also be innovated towards developing learners' thinking competencies (Nhu, 2019). Teachers need to regularly update testing and assessment forms; however, they have not yet effectively utilized learner feedback to adjust assessment activities (Le & Nguyen, 2022). New trends in applying information technology to assess learner competency on technological platforms have garnered significant attention. Researchers have proposed three levels of IT application in education: (1) Classroom Assessment – Learning Management Systems (LMS); (2) Learner Competency Adaptive Assessment – Computerized Adaptive Testing (CAT); (3) Personalized Learning Ecosystem – A comprehensive solution for applying IT in teaching and learning (Nguyen *et al.*, 2024). In Vietnam, numerous legislative documents have been promulgated to establish requirements for the reform of general and higher education, with a specific emphasis on innovating the testing and assessment of learners' academic results (Dang, 2024). Concurrently, many studies have addressed the theoretical and practical aspects of testing and assessment of academic performance both globally and in Vietnam. Thereby, these studies propose solutions to reform testing and assessment in accordance with the learner competency-based approach (Nguyen, 2012; Ho, 2013; Nguyen, 2022).

In the instructional process, testing and assessment constitute a critical activity that assists in evaluating student competency and determining the extent to which educational objectives have been achieved. The application of digital technology is an inevitable trend in current global education systems; it is also an essential skill for teachers in the Industry 4.0 era and can be regarded as the key to innovation and the enhancement of educational quality (Nghiem, 2024). Research on digital transformation in management, instruction, learning, testing, and assessment at high schools emphasizes the adoption of digital technology within the upper secondary education environment. It focuses on exploring how technologies such as computers, the Internet, educational software, and mobile devices can be integrated to optimize various aspects of education (Luong, 2024). In recent times, numerous authors have researched and proposed methods for testing and assessing learners' academic results. Simultaneously, studies on developing computer-based learner competency assessment systems have demonstrated effectiveness, aligning with the goal of improving the quality of competency assessment in the current practical context (Nguyen & Trinh, 2022; Nguyen & Trinh, 2023; Nguyen & Trinh, 2024; Nguyen *et al.*, 2024; ). Thus, the application of information technology in teaching, testing, and assessment is an imperative requirement to enhance the quality of training and meet the demands of educational reform. In this study, the researcher focuses on the application of information technology in teaching, testing, and assessing Natural Sciences through a research-oriented approach. The aim is to improve forms of testing and assessment and refine processes to align with the requirements of educational innovation. The objective of this research is to propose the application of information technology in teaching, testing, and assessing subjects to satisfy the demands of educational reform in the current period.

## 3. RESEARCH SUBJECTS AND METHODS

The researcher focused on innovating student testing and assessment forms at Dong Hung A junior high school, specifically through regular and mid-term assessments in teaching Natural Sciences to 8th-grade students. Recently, the researcher has implemented and piloted the application of information technology in teaching, testing, and assessing Natural Sciences utilizing hybrid answer sheets, Quizizz (Wayground), and Google Forms. These follow a new structure comprising four parts: part 1 consists of multiple-choice questions (selecting one correct answer out of four); part 2 contains True/False questions; part 3 involves short-answer questions; and part 4 consists of essay questions.

In this study, the researcher employed a combination of the following methods:

**Data Collection and Statistical Method:** Documents and data related to testing and assessment in Natural Sciences teaching were collected, and scientific experimental results were classified and statistically analyzed.

**Analysis and Synthesis Method:** Based on the collected materials, data, and expert opinions, the researcher analyzed and synthesized information to propose forms of testing and assessment for the subjects.

**Expert Consultation Method:** During the deployment of testing and assessment forms in Natural Sciences, the researcher consulted experts in the field of educational measurement and evaluation, as well as lecturers and teachers at educational institutions.

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**Practical Research Method:** Data was gathered from teachers at general education schools and lecturers at higher education institutions. The implementation process was monitored to evaluate the practical effectiveness of the testing and assessment forms in Natural Sciences. Subsequently, information technology was applied to teaching, testing, and assessment in selected classes to evaluate feedback from both teachers and learners.

## 4. RESULTS

The application of information technology in teaching, testing, and assessing Natural Sciences during the 2024–2025 academic year at Dong Hung A junior high school has yielded positive results. This implementation was conducted through regular and mid-term assessments utilizing hybrid answer sheets, Quizizz (Wayground), and Google Forms. Under the competency-based approach, learners are evaluated not solely on their knowledge retention but also on their ability to creatively apply that knowledge in real-world contexts. These innovations have empowered learners to become more proactive in their studies while simultaneously enhancing the overall quality of education. These outcomes can be specifically illustrated as follows:

### 4.1 Utilizing Hybrid Answer Sheets for Testing and Assessment

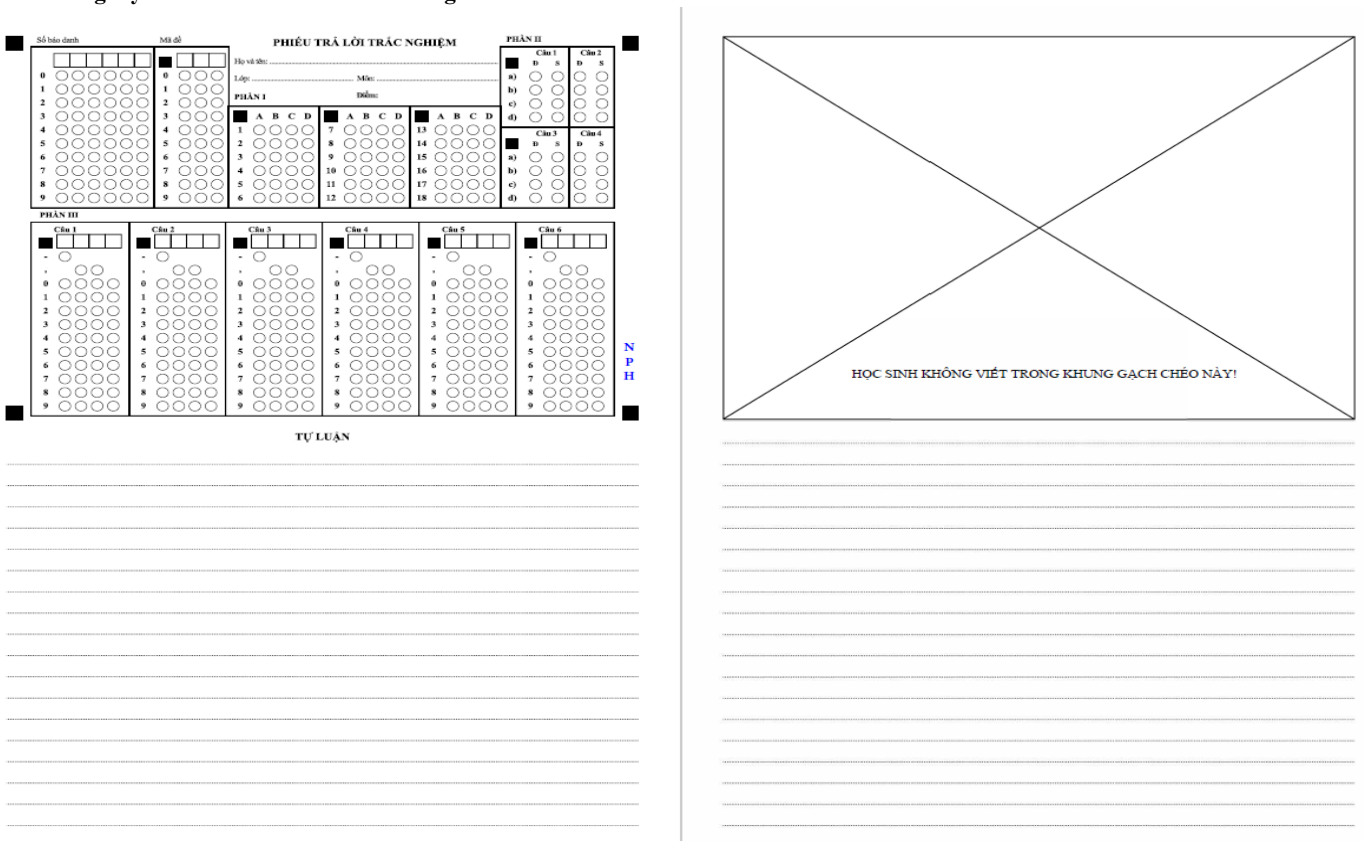



**Figure 1. A sample hybrid answer sheet**

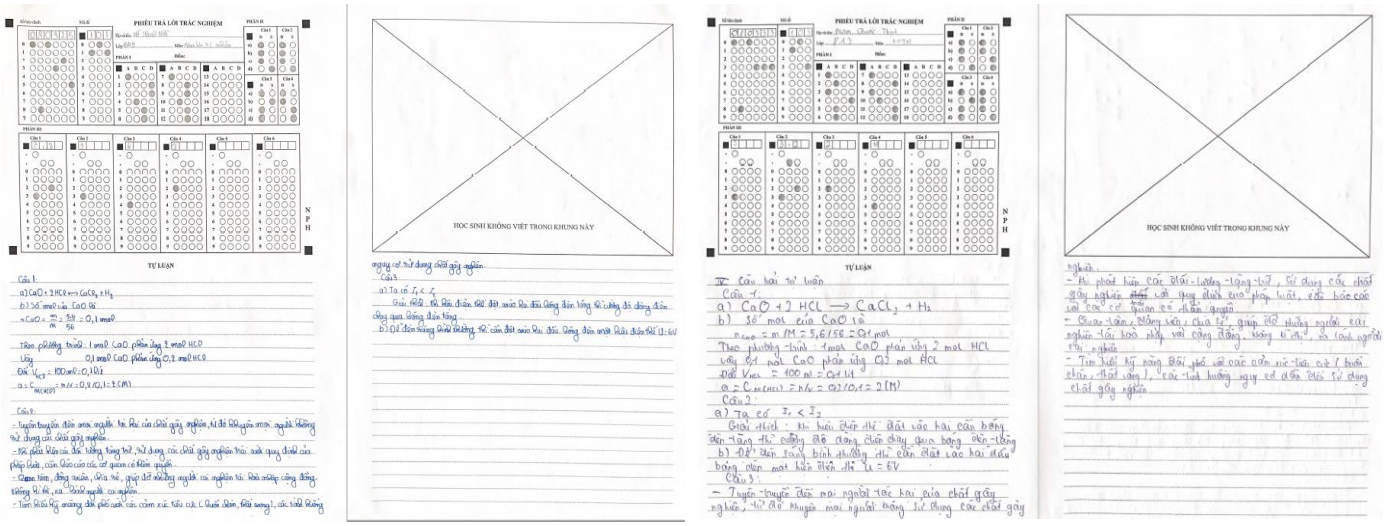


**Figure 2. Student's answers on the hybrid answer sheets**

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The researcher employed a hybrid answer sheet combining multiple-choice and essay formats, following a new structure consisting of four parts: Part 1: Multiple-choice questions (selecting one correct answer from four options); Part 2: True/False questions; Part 3: Short-answer questions; Part 4: Essay questions (constructed-response questions). This instrument was utilized to conduct regular and mid-term assessments for students at Dong Hung A junior high school. The answer sheets can be graded using a dedicated optical mark reader (scanner) or via a smartphone application. Upon completion of grading, instructors can view and download the assessment results in Excel and PDF formats to their computers or mobile devices for data archiving.

**4.2 Utilizing Quizizz (Wayground) for Testing and Assessment**



**Figure 3. Utilizing Quizizz (Wayground) to test and assess learners in the classroom**

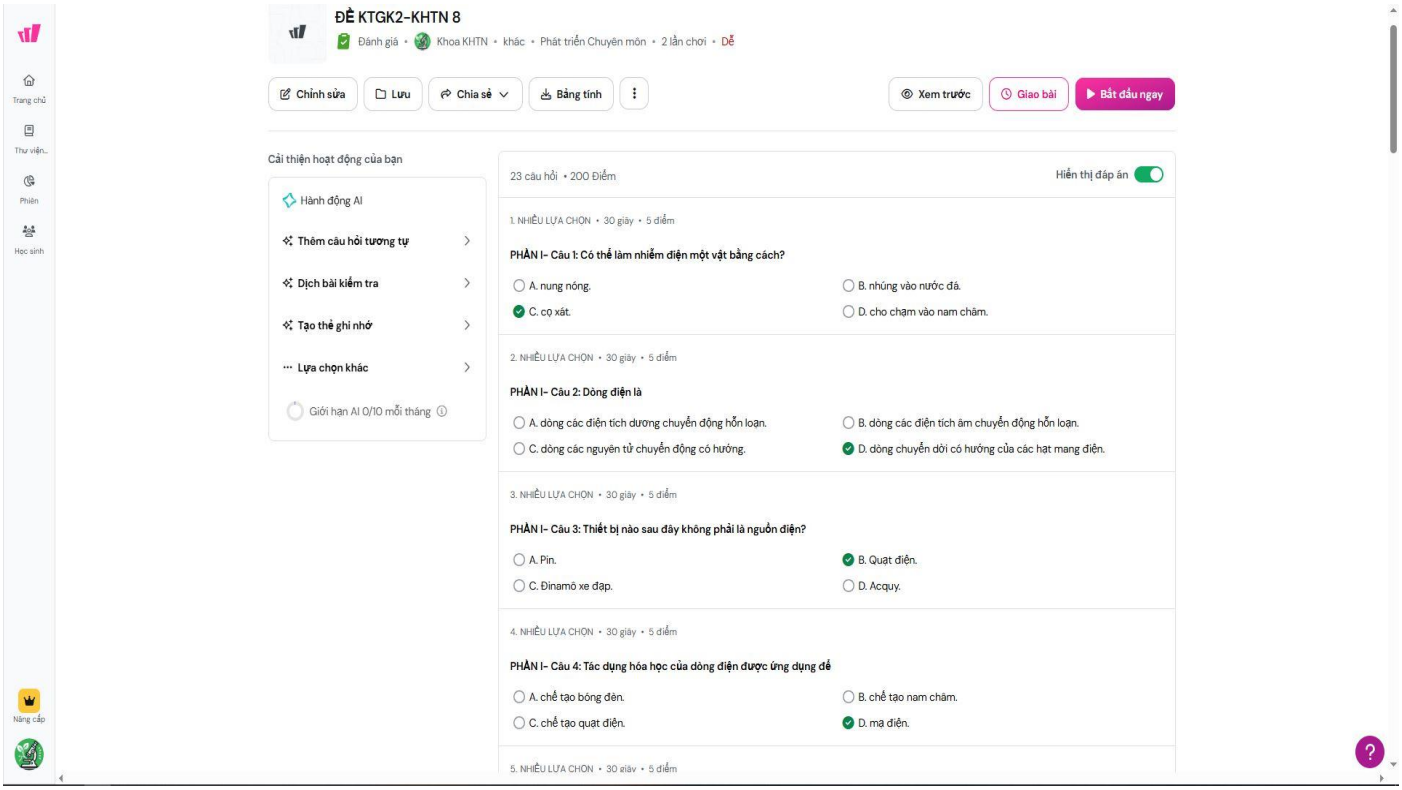



**Figure 4. Content of the learner's test questions on Quizizz (Wayground)**

Quizizz is a highly convenient online tool for generating tests and assignments, enabling users to create questions in various formats for learners to answer. Upon providing learners with the access code, questions are presented either as a timed examination or assigned as homework with a specific deadline. After completing the assessment on Quizizz, learners can review their responses. Furthermore, Quizizz facilitates the compilation of student responses into a spreadsheet, enabling teachers to easily assess student academic performance. During the instructional process, the researcher also employed Quizizz to test and assess students at Dong Hung A junior high school. The assessment content was structured into four parts: part 1 consisted of multiple-choice questions (selecting one correct answer from four options); part 2 contained True/False questions; part 3 involved short-answer questions; part 4 consisted of essay questions. Upon completion, instructors can view and download the results as an Excel file to their computers for data archiving, analysis, and evaluation of learners' academic performance.

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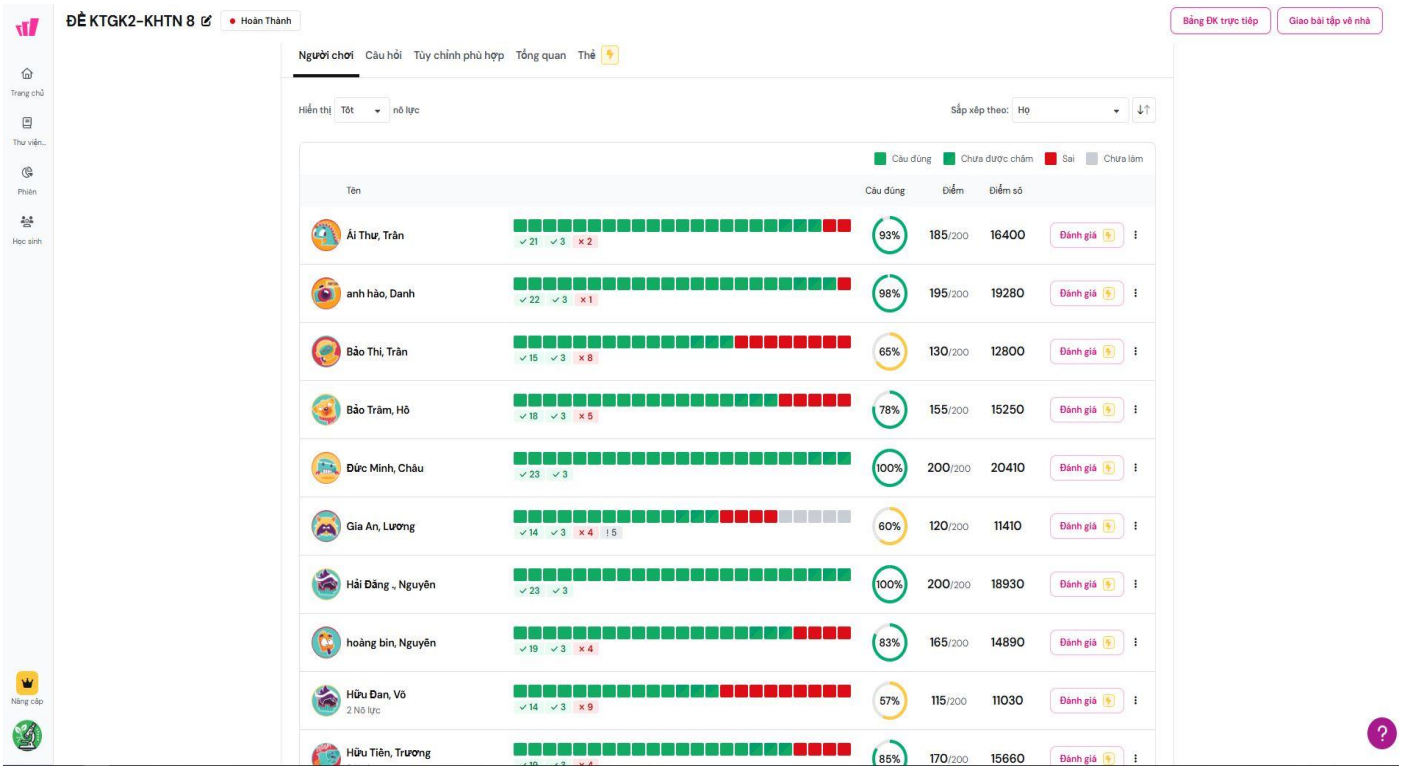



**Figure 5. Student test results on Quizizz (Wayground)**

### 4.3 Utilizing Google Forms for Testing and Assessment

Google Forms can be simply defined as a web-based application that enables users to efficiently create and manage forms, thereby facilitating the rapid collection of necessary data. During the instructional process, the researcher utilized Google Forms to conduct testing and assessment for students at Dong Hung A junior high school. The assessment content was similarly structured into four parts: part 1 consisted of multiple-choice questions (selecting one correct answer from four options); part 2 contained True/False questions; part 3 involved short-answer questions; and part 4 consisted of essay questions. Upon completion, instructors can view and download the test results as an Excel file to their computers for data archiving, analysis, and evaluation of learners' academic performance.

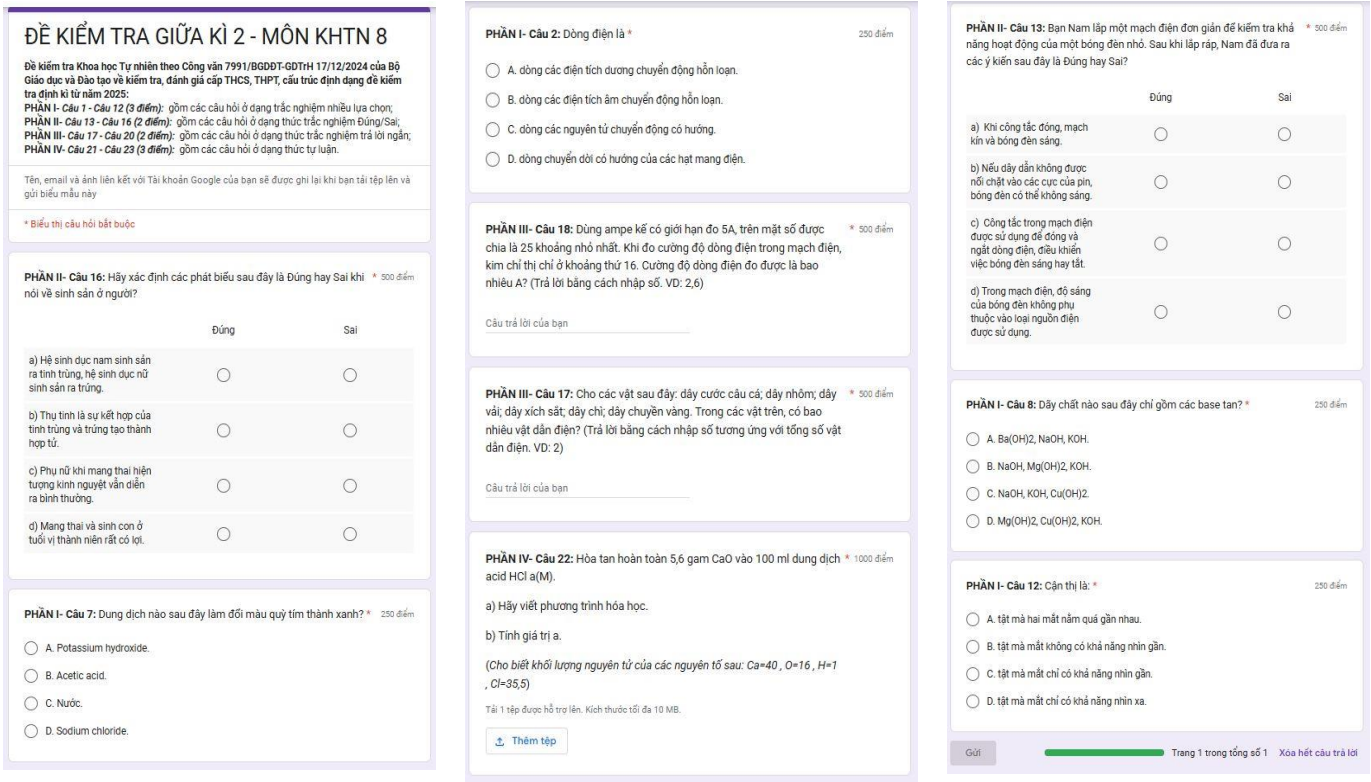
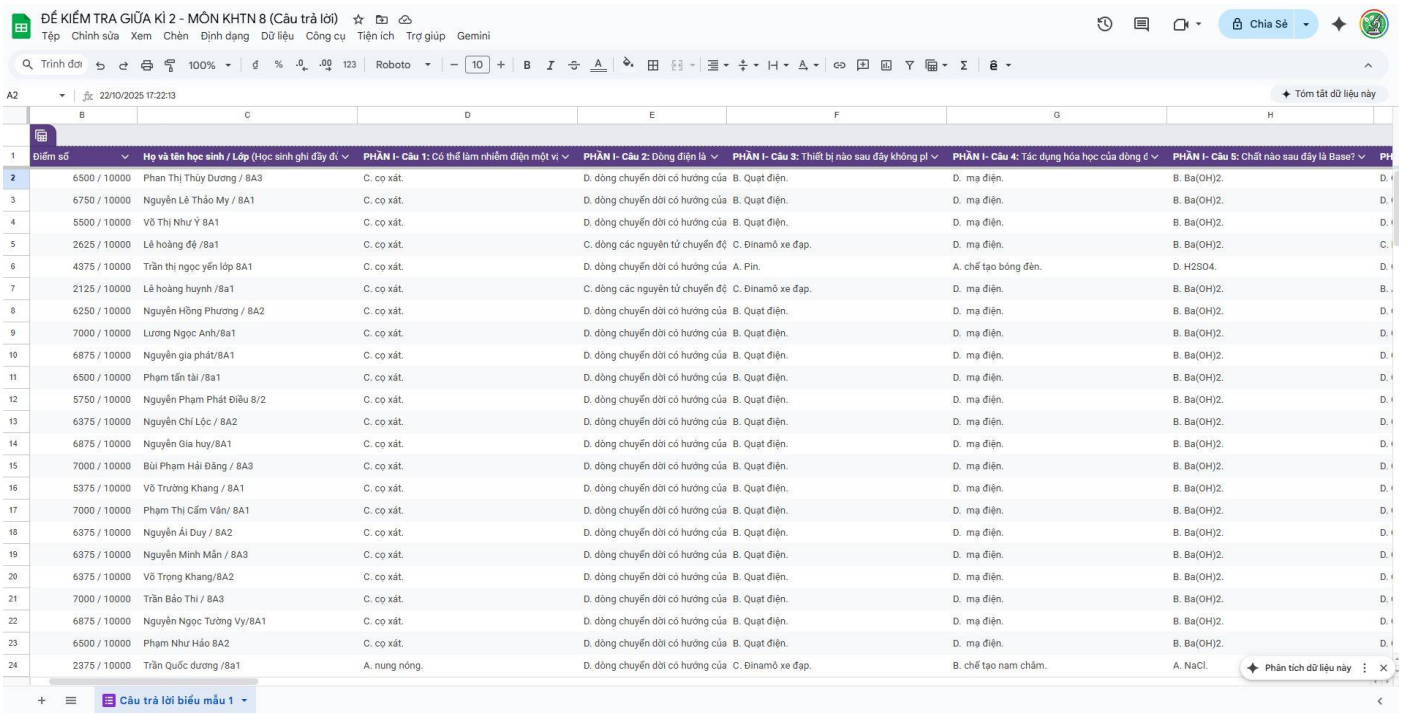



**Figure 6. Content of the learner's test questions on Google Forms**

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ĐỀ KIỂM TRA GIỮA KÌ 2 - MÔN KHTN 8 (Câu trả lời)

| Điểm số | Họ và tên học sinh / Lớp (Học sinh ghi đầy đủ | PHẦN I- Câu 1: Có thể làm nhiễm điện một vị | PHẦN I- Câu 2: Dòng điện là | PHẦN I- Câu 3: Thiết bị nào sau đây không pl | PHẦN I- Câu 4: Tác dụng hóa học của dòng đ | PHẦN I- Câu 5: Chất nào sau đây là Base? |
|---|---|---|---|---|---|---|
| 6500 / 10000 | Phan Thị Thùy Dương / 8A3 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 6750 / 10000 | Nguyễn Lê Thảo My / 8A1 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 5500 / 10000 | Võ Thị Như Ý 8A1 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 2625 / 10000 | Lê hoàng đệ /8a1 | C. cọ xát. | C. dòng các nguyên tử chuyển độ | C. Đinamô xe đạp. | D. mạ điện. | B. Ba(OH)2. |
| 4375 / 10000 | Trần thị ngọc yến lớp 8A1 | C. cọ xát. | D. dòng chuyển dời có hướng của | A. Pin. | A. chế tạo bóng đèn. | D. H2SO4. |
| 2125 / 10000 | Lê hoàng huynh /8a1 | C. cọ xát. | C. dòng các nguyên tử chuyển độ | C. Đinamô xe đạp. | D. mạ điện. | B. Ba(OH)2. |
| 6250 / 10000 | Nguyễn Hồng Phương / 8A2 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 7000 / 10000 | Lương Ngọc Anh/8a1 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 6875 / 10000 | Nguyễn gia phát/8A1 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 6500 / 10000 | Phạm tấn tài /8a1 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 5750 / 10000 | Nguyễn Phạm Phát Điều 8/2 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 6375 / 10000 | Nguyễn Chí Lộc / 8A2 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 6875 / 10000 | Nguyễn Gia huy/8A1 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 7000 / 10000 | Bùi Phạm Hải Đăng / 8A3 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 5375 / 10000 | Võ Trường Khang / 8A1 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 7000 / 10000 | Phạm Thị Cẩm Vân/ 8A1 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 6375 / 10000 | Nguyễn Ái Duy / 8A2 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 6375 / 10000 | Nguyễn Minh Mẫn / 8A3 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 6375 / 10000 | Võ Trọng Khang/8A2 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 7000 / 10000 | Trần Bảo Thi / 8A3 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 6875 / 10000 | Nguyễn Ngọc Tường Vy/8A1 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 6500 / 10000 | Phạm Như Hảo 8A2 | C. cọ xát. | D. dòng chuyển dời có hướng của | B. Quạt điện. | D. mạ điện. | B. Ba(OH)2. |
| 2375 / 10000 | Trần Quốc dương /8a1 | A. nung nóng. | D. dòng chuyển dời có hướng của | C. Đinamô xe đạp. | B. chế tạo nam châm. | A. NaCl. |

Câu trả lời biểu mẫu 1

**Figure 7. Student test results on Google Forms**

## 5. DISCUSSION

The utilization of the testing and assessment forms presented above can be implemented for regular and mid-term assessments in Natural Sciences as well as other subjects in general education schools. Furthermore, these methods can be applied to regular and periodic assessments of course modules in higher education institutions (colleges and universities). Simultaneously, the approach can be expanded to include various other applications beyond Quizizz (Wayground) and Google Forms to innovate learner assessment during the instructional process. Consequently, employing modern technologies in competency assessment and integrating formative assessment into the teaching process will foster creativity, critical thinking, and problem-solving skills in learners, thereby contributing to enhancing the quality of education and training in the current period. The results of this study not only contribute significantly to innovating teaching and improving assessment quality in general education subjects and higher education modules but also allow for a more comprehensive evaluation of learner outcomes and the teaching process, aiming to meet the requirements of fundamental and comprehensive educational reform.

## 6. CONCLUSION

The application of information technology in teaching, testing, and assessing learners in the current period is a pivotal factor in realizing the goals of educational reform. This shift necessitates the diversification of assessment methods and tools, extending beyond traditional examinations to emphasize regular assessment, formative assessment, practical activities, and IT application. The transition from quantitative to qualitative assessment, and from knowledge testing to the assessment of competencies and qualities, will provide educators with a more comprehensive perspective on learner development. Concurrently, innovating assessment forms creates opportunities for learners to demonstrate their creative capabilities, self-assessment skills, and collaboration, thereby promoting proactiveness, engagement, and learning interest. This ultimately meets the increasingly high demands of society and the labor market in the context of deep international integration.

## ACKNOWLEDGMENT

We would like to express our sincere gratitude to everyone who contributed to the completion of this research paper. We also extend our thanks to the experts who dedicated their time and shared their experiences for this study. Their willingness to participate was a pivotal factor that enabled us to collect the necessary data. Furthermore, we wish to express our appreciation to the teachers and students at Dong Hung A junior high school for providing valuable feedback and suggestions during the development of this paper. Their insights have assisted us in refining our ideas and enhancing the overall quality of this work.

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