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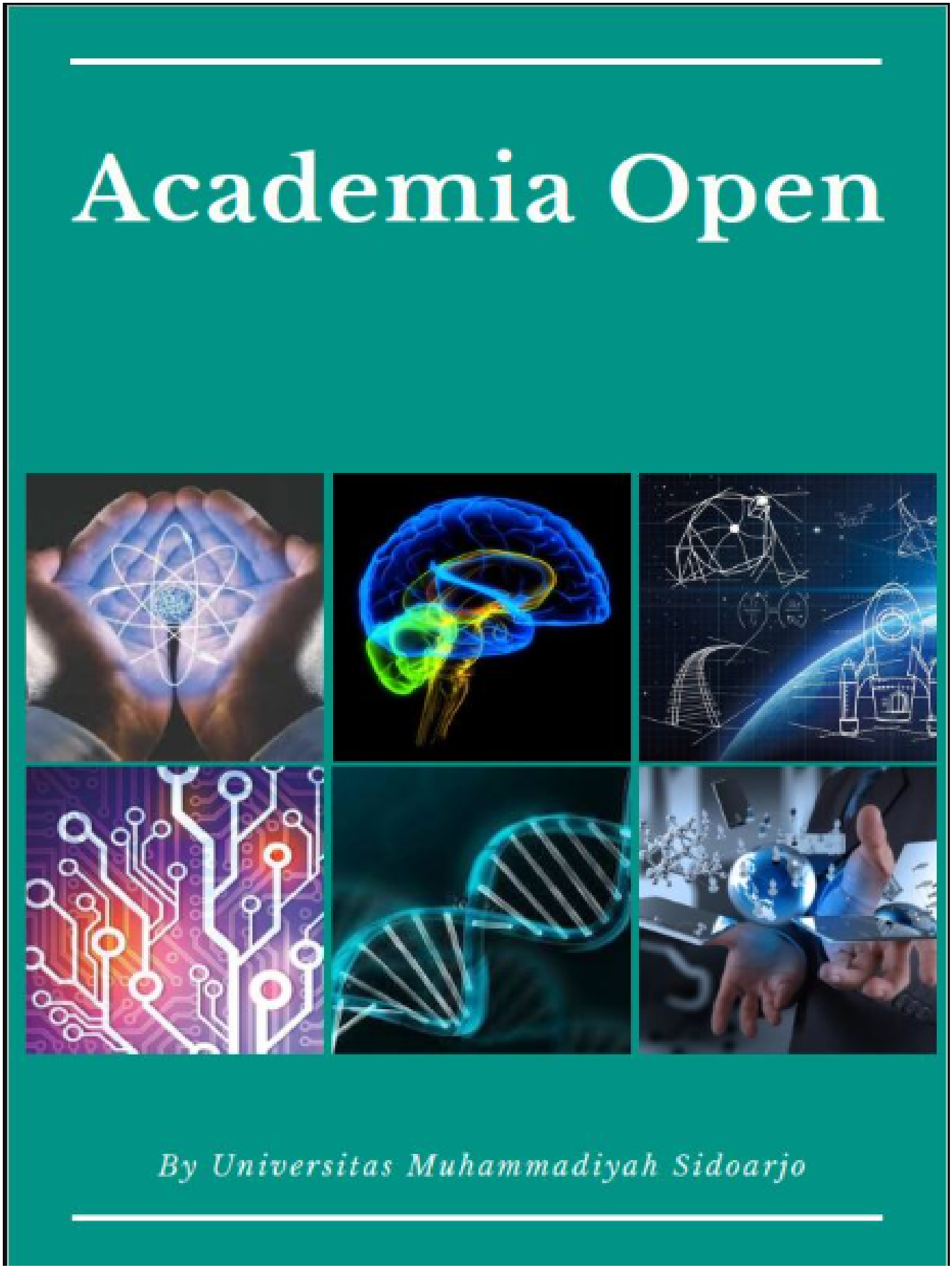

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Assessing the Digital Media Incorporation in teaching science at the intermediate level on Diyala Governorate: Descriptive-Analytic Study in the light of E-Learning Standards.: Penilaian Penerapan Media Digital dalam Pengajaran Ilmu Pengetahuan di Tingkat Menengah di Provinsi Diyala: Studi Deskriptif-Analitis Berdasarkan Standar E-Learning.

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Abstract

General Background The rapid expansion of digital technologies in education, particularly following the COVID-19 pandemic, has increased the need for systematic evaluation of technology integration in school environments. **Specific Background** In science education, digital media such as multimedia presentations, simulations, and online learning platforms are increasingly recognized as important instructional resources aligned with international e-learning standards. **Knowledge Gap** Despite this development, limited empirical evidence exists regarding the actual level of digital media incorporation in intermediate-level science classrooms within specific regional educational contexts. **Aims** This study examines the level of digital media integration in science teaching in intermediate schools in Diyala Governorate, Iraq, using internationally recognized e-learning standards as an analytical framework. **Results** Using a descriptive-analytical survey design and a structured questionnaire administered to science teachers, the findings indicate a moderate-to-low level of digital media usage, with teachers primarily relying on basic tools such as presentation slides and instructional videos. Advanced digital applications, including simulations and interactive technologies, are less frequently used. Teachers also reported significant barriers, including unstable internet connectivity, electricity interruptions, limited institutional support, and insufficient professional development opportunities. **Novelty** The study provides an empirical assessment of digital media practices in science classrooms through the lens of global e-learning competency frameworks. **Implications** The findings highlight the need for improved digital infrastructure, institutional policy alignment, and sustained professional training programs to support the systematic adoption of digital learning practices in science education.

Keywords: Digital Media Integration, Science Education, E Learning Standards, Technology Integration, Teacher Readiness

Key Findings Highlights

1. Teachers rely mainly on presentations and instructional videos rather than advanced digital applications.
2. Structural barriers such as internet instability and electricity interruptions remain major constraints.
3. Positive teacher attitudes toward digital practices persist despite limited technological implementation.

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Introduction

The rising pace of the development of digital technologies has profoundly transformed the educational systems across the globe, especially following the COVID -19 pandemic. The crisis transition to remote and hybrid modes of learning showed systemic inequalities **[4]** in both digital preparedness and underlined the need to have a structured introduction of digital media into the realms of rigid schooling. The schools had no alternative but to embrace online learning media, digital platforms, and online communication systems to sustain learning. This shift has altered the nature of digital media as a supplement in the context of modern-day pedagogy into a structural element.

Digital media in education refers to multimedia presentation, instructional video, simulation of interactive learning, and web-based learning environments. Modern theories of learning, especially cognitive theory of multimedia learning **[5]**, affirm that properly designed multimedia learning environments can assist in facilitating conceptual knowledge, alleviating cognitive overload, and facilitating more meaningful learning when being pedagogical matched. Furthermore, cautious and interpolated digital integration has been linked to a higher level of engagement between learners **[6][7]**, better academic performance, and greater capacity to subsequently develop critical thinking skills in the science educational setting.

In the teaching of science in particular, digital media are of specific importance in pedagogy. The science concepts can entail abstract processes/phenomena or laboratory situations that cannot be reproduced in the usual classroom environment. As alternative representations, digital simulations, virtual labs, and multimedia visualizations **[8]** can allow conceptual clarity and experience of those who are to be understood. Nonetheless, to achieve good implementation, the access does not suffice to be effective, but also pedagogical competence must be agreed upon to the recognized e-learning standards.

Digital transformation in the development of educational systems has been faced with challenges in infrastructures, institutions, and professionals, including Iraq. It has been reported that internet access, electricity distribution, device access and teaching digital skills remain unequal **[9]**, and this hinders the optimum application of technology in schools. As a result, assessing the real situation of the digital media integration in particular regional conditions is critical in terms of the evidence-driven policy and professional development planning.

In this context, the current research aims to assess the level of the digital integration of the teaching of science in the intermediate grade in Diyala Governorate, based on the standards of e-learning development, specifically, the ISTE Standards of Educators (2019) and the UNESCO ICT Competency Framework. The research will set out to offer empirical evaluation which will seal the gap between theory of digital readiness and practice at classroom level.

A- Problem Statement

Although the world appears to have agreed on the essence of digital integration in education, in reality, when universities come to the field, there exists a gap between policy goals and what takes place in the classroom. Whereas international models pay special attention to systematic, pedagogically, and sequentially aligned application of digital tools, empirical research done in the Middle East shows inconsistency in the frequency and quality of digital media application in schools.

The integration of technology is still lopsided in Iraq, especially in governorates that are not in the major metropolitan centers. Even though, in science teaching, digital resources seem more apparent during the pandemic period and after it, sustainable integration seems to be limited. Teachers can mostly use simple presentation tools, more sophisticated systems, like simulations, digital assessments, interactive platforms, are not fully systematic.

Besides, there are a number of interrelated issues that remain:

- Instability in infrastructure (internet connectivity and power supply).
- The lack of access to modern equipment.
- Lack of professional development programmes.
- Lacking institutional oversight which is in accordance with international digital standards.
- Disjuncture between teachers on the positive attitudes and classroom practice.

Available literature supports the fact that the availability of technology does not necessarily lead to a successful pedagogical integration **[10][11]**. Instead, quality integration relies on the conformity to the professional standards, planning of instruction, and continuous development of digital competence.

On this basis, a significant research gap is revealed on local level in Diyala Governorate. The empirical evidence of the implementation of digital media in science classes in the intermediate stage is insufficient and has not been evaluated by comparing its implementation to the international e-learning standards.

As such, the research question that will be used as the central one in this study is:

And what is the current situation of digital media integration in teaching science in the intermediate level in Diyala Governorate against recognized e-learning standards?

B- Significance of the Study

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· **Theoretical Significance**

The research work is relevant to the modern discussion of digital transformation in science education by placing the assessment of digital media integration in the framework of internationally recognized competences. The research is not limited to the assessment of frequency of use but also to the assessment of the quality of the pedagogy and alignment between pedagogical standards and the ISTE and UNESCO standards, used as the evaluation criteria.

Moreover, recent research points to the significance of contextualized research of digital integration in developing countries, in which the context of infrastructures and institutional configurations vary significantly as compared to high-income contexts. The current research adds value to the literature on Arabic and regional education by offering the empirical data based on global standards but with the eye on local realities.

· **Practical Significance**

In a practical sense, the results will be useful to the decision-makers in the General Directorate of Education in Diyala Governorate by:

- Establishing the strengths and weaknesses of the existing approaches to integration of digital media.
- Educating the design of designed professional development programmes in line with ISTE and UNESCO competencies.
- Identifying the gaps in infrastructures and policies that cannot be implemented effectively.
- Promoting evidence based planning of sustainable digital transformation in intermediate science education.

Considering the positive attitude of teachers to digital media **[12][13]**, as it is reported in various international studies, the enhancement of structural and professional conditions can bring significant positive changes to the quality of science teaching.

C- Objectives of the Study

- To determine the degree of the usage of digital media among intermediate science teachers in Diyala.
- To evaluate the conformity to international standards of e-learning (ISTE, UNESCO).
- To determine the issues of teachers in the digital integration.
- To make effective suggestions on how to improve it.

D- Research Questions

Main Question:

- What is the level of integrating digital media in teaching science in the intermediate level within Diyala Governorate?

Sub-Questions:

- What is the level of digital media use by the teachers of science?
- How well is usage in line with international standards of e-learning?
- What are the key issues of teachers?

E- Operational Definitions

· **Digital Media**

- **Conceptual Definition**

Digital media Digital media are instructional forms created, interpreted, and transferred using technology in a digital form. Such formats are text, visual images, audio, animation, interactive simulating, and web-based. The digital media is not only conceptualised as the means of delivery but rather as an organized multimedia environment that shapes the cognitive processing and knowledge building as a part of the contemporary learning theory.

- **Operational Definition**

Digital media in the case of this study refers to the technological equipment used by intermediate science teachers in Diyala Governorate when delivering instructions. These consist of instructional videos, multimedia presentation, digital simulation, interactive board and online learning platforms. The extent of utilization is gauged by how the teachers answer the questions set in the questionnaire to assess this study.

· **Digital Media Integration.**

- **Conceptual Definition**

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Integration of digital media The digital media is the deliberate and pedagogically compatible application of digital tools in instructional planning, classroom interaction, and assessment procedures. The key features of successful integration include conformity to learning goals, student involvement and learning outcomes as opposed to technological presence.

- **Operational Definition**

In this research, digital media integration is the level and form of application of digital tools by the teachers in the science field during teaching lessons, such as instructional use (explanation, reinforcement, assessment, or interaction). It is measured, in a quantitative manner with a questionnaire in the domain of digital integration that is established.

· **E-Learning Standards**

- **Conceptual Definition**

E learning standards are globally designed professional models, which outline professional standards in the field of technology-enhanced instructions. These standards such as ISTE Standards of Educators and the UNESCO ICT Competency Framework define pedagogical, ethical and technical aspects that occur to support successful digital integration.

- **Operational Definition**

In this study, e-learning standards are the assessment dimensions, which are applied to measure the quality of digital media integration. These dimensions are instructional planning, interaction between learners, digital tools diversified, assessment integration and support to learners. Measurement is measured against questionnaire items which are aligned to these standards.

· **Intermediate Stage**

- **Conceptual Definition**

The second level is the intermediate stage which is the transitional level of formal schooling in the Iraqi educational system that is a phase between primary and secondary schooling. It has students who are generally in Grades 7-9 (First, Second and Third Intermediate).

- **Operational Definition**

The intermediate stage in this study is particularly meant to be the intermediate school which is under the Directorate General of Education within the Diyala Governorate in the academic year 2024-2025 in which the science teachers participating in the study work.

· **E-Learning**

- **Conceptual Definition**

E-learning can be described as a type of instructions that involves the use of digital networks and information technologies to deliver the content, communicate, interact and be assessed in a synchronous or asynchronous manner. The modern definitions focus on flexibility, autonomy of learners and technology mediated communication.

- **Operational Definition**

E-learning in this research will take the form of all types of technology-based teaching in science education, both in the traditional classroom and online delivery. It is tested by teacher-reported practices which are represented in the research tool.

· **Blended Learning**

- **Conceptual Definition**

Blended learning may be defined as a teaching method that is used strategically by merging face-to-face classroom instruction with some digital or online elements of learning in order to improve pedagogy. It is a deliberate integration that aims at using the strengths of the two modalities.

- **Operational Definition**

In the paper, blended learning implies the application of digital media in addition to traditional classroom learning of science in Diyala intermediate school, such as the application of computers, projectors, mobile technologies, or digital information in classroom learning.

· **Instructional Challenges**

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- **Conceptual Definition**

Instructional challenges refer to structural, institutional or professional restraints that lead to a lack of effective teaching practice. Such hurdles in the context of technology integration could be a lack of training, infrastructural deficiency, vague policies or change opposition.

- **Operational Definition**

Instructional challenges in this study will be the challenges that were mentioned by the science teachers in Diyala Governorate when trying to incorporate digital media. These difficulties are gauged by questionnaire domain of dealing with infrastructural, administrative and pedagogical barriers.

· **Digital Divide**

- **Conceptual Definition**

Digital divide is used to refer to the aspect of differentiating the degree of access to, expertise in, or material utilization of digital technologies among individuals, organizations, or areas. The modern definitions of access have gone beyond access to competence and quality of use.

- **Operational Definition**

The digital divide in this paper is used to denote disparities in schools or teachers in the Diyala Governorate in terms of access to the digital infrastructure, internet reliability, and teachers professional readiness to digital integration.

Delimitations of the Study

To maintain the methodological rigor and the accuracy of analysis, the current study falls within well-operationalized contextual boundaries.

· **Spatial Delimitation**

The study is limited to Diyala Governorate, Republic of Iraq. It includes the intermediate schools under the supervision of the Directorate General of Education in Diyala both the urban and the rural districts.

· **Human Delimitation**

The target population will be restricted to male and female science teachers who hold intermediate educational level positions in the 20242025 academic year. Other subject-area and other educational level students, administrators and educators are actually avoided.

· **Temporal Delimitation**

The collection of data will occur in the first semester of the 2024-2025 school year, namely in July-October 2025.

· **Thematic Delimitation**

The research is limited to assessing the incorporation of digital media in the instruction of science in the intermediate level, as per the accepted e-learning standards. The system of digital education and other academic disciplines at large is not taken into account.

Theoretical Framework and Literature Review

A- Digital Media and E-Learning Conceptual Underpinnings.

· In order to explain the theme of digital media, it is necessary to conceptualize what digital media is.

The modern discourse in education extends the concept of digital media beyond the technical definition of computer-oriented communication tools and suggests them as an organized cognitive space in which knowledge is produced, processed and restructured. Digital media in this paradigm is perceived to be multimodal, made of textual, visual, auditory and interactive representations, which are structured into networked technological systems, which enable dynamic transfer of knowledge **[1]**.

New theoretical views hold that digital media cannot be viewed as a delivery medium, but its educative worth is determined by how much it mediates significant cognitive activity. Literature on multimedia learning establishes that teaching can be effectively implemented when there is a coordinated effort between visual and verbal representations in helping cognitive integration and reduce extraneous processing **[1]**. Digital media is therefore an instructional structure and not a set of discrete tools.

The digital media has evolved considerably over the past few years to encompass virtual labs, augmented and virtual reality programs, adaptive learning systems and collaborative cloud-based systems. The developments are an indication of a shift in the presentation of the stagnant content to the interactive and immersive learning ecosystems. In science education, in particular, these tools would allow students to visualise abstract processes, create complex systems as a simplification strategy, and be able to interact with such representations that otherwise could not be accessed in a traditional classroom setting.

Digital media plays an epistemic role in the sciences where abstraction of concepts and experimentation are the key aspects. It allows modeling of molecular structures, astronomical events, ecological systems, and chemical reactions and concepts that are difficult to be directly done in typical school laboratory setups. Empirical evidence suggests that conceptual change through dynamic simulations can be induced in case of inquiry-based learning that is well-structured **[8]**. Based on this, the idea of digital media in science education must not be judged by its availability but also by its ability to improve conceptual restructuring and higher-order thinking.

Achieving the educational goals through digital media is important as it enables the teacher to teach in a way that is both more engaging and more active and interactive than conventional teaching methods.

Pedagogical Significance of Digital Media in Science Education Achieving the educational objectives using the digital media means that the teacher can teach in a more engaging and active and interactive manner than the traditional teaching approaches.

The pedagogical importance of digital media in the teaching of science is that it can alter the learning process to be more of an active construction as opposed to passive. Although there are empirical studies that indicate that the instructional effects of digital tools are contingent on the level of pedagogical integration. It is possible to analytically distinguish 3 progressive levels of digital use:

- Representation use - digital devices draw or depict information without changing the teaching format.
- Interactive Use Interactive use involves the interaction of the learners with digital content, by manipulation, response, or a feedback mechanism.
- Transformative Utilization- digital tools integration standarization inquiry, experimentation and testing, group problem-solving and authentic evaluation.

Transformative integration requires a conscious redesign of instruction, whereas most classrooms are using representational digital practices (e.g., slide-presentations or video displays) **[14]**. Research on technology integration shows that the conceptual gains in science are substantially greater with digital simulations placed in guided inquiry models as opposed to digital simulations being applied as supplementary visual images [1, 2].

Digital media also helps in motivating the learners, especially through interactive and gamified environments. However, better motivation is not sufficient to achieve better conceptual mastery, instead organized scaffolding, conformity to the learning goals, and inclusion in the assessment systems are all that is needed to achieve better results. Based on this, the consideration of the digital integration should not adequately be based on the frequency of use but also should be based on the qualitative aspect of pedagogical fit.

- Digital Media on the post-pandemic educational environment.

The COVID-19 outbreak accelerated the move toward digitization across the world, changing digital media as something to add value to, into a necessary item of the instructional infrastructure **[1]**. On-distance education in the situation of an emergency, in turn, revealed structural inequality in digital and professional preparedness.

The swift transition in most developing education systems such as Iraq exposed instability in the infrastructures, low internet connectivity, and insufficient teacher training based on pedagogical and not technical functioning. According to international reports, the post-pandemic educational reform needs to shift towards the emergency adaptation to sustainable digital institutionalisation [4, 5].

Catalyst and diagnostic mechanism, the pandemic therefore. It confirmed that access to technology may not be sufficient, meaningful integration will need to include professional competencies, clarity of policy in institutions and alignment with recognized digital standards. As a result, the systematic analysis based on the international frameworks is required to draw the line between superficial technological use and the pedagogically productive digital transformation.

B- E-Learning Standards as an Analytical benchmark.

Digital media has led to the growth of the digital media in the education sector, which has created the necessity of professional standards that guarantee quality, coherence, and sustainability. Lack of organized benchmarks may lead to disintegration of digital integration and making it tool-based instead of learning-based.

The e-learning standards should serve as normative models that would help teachers to correlate the application of technology with teaching goals. There are two internationally recognised frameworks, which offer the basis of reference points:

· ISTE Standards on Educators (2019)

The concept of ISTE Standards involves educators as participants of digital transformation, not as operators of technologies **[6]**. The model establishes six professional identities, which are learner, leader, citizen, designer, facilitator, analyst. These positions predetermine the digital integration with a more extensive professional identity that is accompanied by the ethical responsibility, the innovation of instruction, and the data-driven decision-making. It implies that its standards propose learner-centered facilitation, personalization, collaborative inquiry, and evidence-based evaluation.

Notably, the ISTE framework makes technological presence a less significant factor in evaluation and makes a pedagogical influence more important. The major point is whether digital tools can facilitate deeper involvement, independence, and critical thinking and not just exist.

UNESCO ICT Competency Framework of Teachers.

The UNESCO framework presents a developmental model of digital competence sorted into the progressive level **[7]**:

- Technology Literacy- functional use of electronic tools.
- Deepening of knowledge - pedagogical integration on the basis of the curriculum.
- Knowledge Creation- innovation and systemic transformation.

Each level cuts across six domains that include curriculum design, pedagogy, assessment, leadership, classroom management, and professional development. This multidimensional model takes into consideration that digital competence is more than technical proficiency to institutional and instructional transformation.

There are numerous educational systems who stand between the first and second level as the technology is present but not well implemented in inquiry-based and transformative pedagogies. Therefore, the use of such frameworks as assessment instruments allows the researcher to define the usage pattern, as well as maturity of digital integration.

- Reason behind Standards-Based Evaluation in the Current Study.

In order to assess the digital media integration in science teaching, the criteria used to distinguish between non-pedagogical and pedagogically significant practice. The fact of having digital devices is not sufficient to ensure effective instruction. To integrate well, there must be:

- Purposive planning of instruction.
- reorientation of quantifiable learning objectives.
- Digital expression of information.
- Organized interaction between the learner-teacher and learners-content.
- Inclusion of electronic evaluation instruments.

Locating the study within the guidelines of ISTE and UNESCO takes the assessment out of the descriptive reporting to competency-based research, improving the methodological rigour and contribution the study will have on digital transformation research in Iraqi educational settings.

C- Digital Media Use in Science Teaching: Analytical View.

Digital media use in science teaching can be analysed as analytically grouped based on the instructional role of the tool, as opposed to the tool type.

- Visual-Explanatory Applications

Conceptual visualisation is mostly supported with the help of instructional videos and multimedia presentations. They minimize the cognitive ambiguity and enhance the conceptual integration when properly planned **[1]**. Passive watching of videos without systematic interrogation, however, inhibits cognitive formulations.

- Simulation-Based Applications

Scientific simulations and virtual laboratories allow the manipulation of variables and the study of the results in digital environments that can be controlled. Experiments show that simulations increase the comprehension of abstract scientific phenomena when incorporated in a guided inquiry **[2]**.

- Platform-Based Applications and Collaborative Applications.

Digitally based learning and learning management systems intensify learning outside the classroom. They facilitate asynchronous discussion, online evaluation and sharing of resources. Their success lies in moderation and structural design of instructions.

- Gamified Learning Environments.

Competition, feedback systems and progression systems are motivational systems that are incorporated in gamification. Although it makes it more engaging, its conceptual efficacy relies on its correlation with the curriculum goals, not on the value of entertainment only.

- Social Media in the role of Supplementary Learning Space.

Moderated educational use of social networks could help to improve the communication and informal learning opportunities. However, such application would be prone to fracturing of academic interest in the event that there is no pedagogical organization.

Analytical Synthesis

A variety of digital applications indicates the enlarged pedagogical opportunities in science education. However, the literature is consistent that effective integration requires three interactive conditions namely an infrastructure stability, professional digital competence, and standards-based pedagogical alignment. Without these conditions then digital integration is representational not transformative.

The current research expands upon this theoretical framework to investigate the digital integration as a method of teaching intermediate science at Diyala Governorate using a standards-based evaluation framework, therefore, filling a locally situated research gap within the Iraqi educational literature.

D- Review of Previous Studies

- International Studies

The sudden international transition to remote education in the face of the COVID−19 pandemic has produced a considerable amount of empirical research on digital education practices in a wide range of different contexts. Although the studies are quite different in terms of their approach and scopes, there are a few common patterns of analysis.

A study carried out in Southeast Asia including Fauzi and Khusuma (2020) **[1]** has found that primary school teachers expressed conceptual approval of remote learning, but structural barriers severely restricted the quality of implementation. Educators claimed that the internet was not always stable, there was a lack of parental involvement and institutional readiness. A large percentage of the respondents were not satisfied with the general experience, which shows that the theory and practice of sustainability are not equal.

In a similar study, Demuyakor (2020) **[2]** studied the experiences of Ghanaian international students having online learning in China. Despite moderate levels of satisfaction by participants, some of the limitations that have been noted include financial strain connected to the cost of the internet, and network instability. The results explain that inequalities in digital access are not limited by the infrastructure of the country, and they might be intertwined with socioeconomic and geographic conditions.

Mohalik (2020) **[3]** evaluated the preparedness of teacher-education learners to remote learning in the Indian context. In spite of the large percentages of device ownership, qualitative weaknesses included poor connectivity, low advanced digital competences, and isolation. This trend supports the suggestion that access does not mean pedagogical effectiveness.

Similar dynamics were also established by European studies. The issues of poor quality of instruction and lack of previous experience with digital platforms were revealed by Hyseni Duraku and Hoxha (2020) in their study of the Kosovo setting **[4]**. Similarly, Michal et al. (2020) **[5]** reported that even though medical students enjoyed the freedom of learning online, they reported their discontent with the lack of interaction and development of practical skills.

Pakistani (Mukhtar et al., 2020) **[6]** and multi-country studies (Onyema et al., 2020) **[7]** also found similar results, which indicated that digital education provided continuity under crisis circumstances but failed to deliver an equitable experience and interactivity of face-to-face teaching. The major restrictive variables in contexts were a system of infrastructure instability, inadequate professional training, and digital illiteracy.

Taken collectively, these findings at the international level lead to three analytical conclusions:

- Online platforms also provided continuity in teaching even at times of crisis.
- The reliability of infrastructure had a great impact on perceived effectiveness.
- Digital competence between professionals proved to be a decisive factor in quality of instruction.

These themes are directly important when analyzing the digital integration of intermediate science education in the developing contexts.

· Arab and Regional Studies

Empirical studies on the topic of digital transformation in the pandemic environment have also been conducted within Arab educational systems, but with specific contextual factors.

In a research that was carried out in Jordan and Saudi Arabia, Almaiah et al. (2020) **[8]** found organisational, and personal factors determined the effectiveness of e-learning. Digital adoption success was meditated by system quality and user self-efficacy and institutional trust.

Al-Shabab (2021) in Jordan (p. 9) discussed how distance education is implemented by TV and online. Results showed that there were minimal sustained uses, which were mainly caused by the difference in technological resources among households.

The study of Abu Shkheidem (2021) **[10]** also indicated moderate perceived e-learning effectiveness in higher education and the necessity to organize teacher training and technological infrastructure.

The need to align policies, invest in digital infrastructure, and educate teachers as additional means to ensure sustainable digital transformation was further supported by studies in Saudi Arabia and Egypt in 20212022. In all the regional analyses, there is similar tendency: educators and learners have good attitude to digital tools, but the limited accessibility of systems restrains the extent of integration.

· **Synthetic Analysis and Gap in Research.**

The analyzed literature indicates a number of overlapping insights:

To begin with, the digital media and e-learning platforms were critical to educational continuity in different international and regional settings in the face of the COVID-19 crisis **[1][7]**.

Second, the infrastructural issues, such as poor internet connectivity, poor device access and poor power supply were a constant source of poor instruction **[2][9]**.

Third, professional readiness and systematic training was called upon the several times as a decisive factor in successful integration **[3][8]**.

Fourth, whilst many studies determined perceptions, the level of satisfaction and readiness, relatively few used internationally accepted competency frameworks, which include ISTE or UNESCO ICT standards, as an evaluation tool. This methodological drawback is clearly apparent in Middle Eastern cases. The majority of the studies used descriptive, tools of perception, and did not have a systematic evaluation of the correspondence to professional digital standards.

Empirical studies on the nature of standards-based digital integration of intermediate science education are rare, particularly in the Iraqi context. A case in point, Diyala Governorate does not seem to feature significantly in the scholarly literature on technology-integration.

In this regard, the current study fills in a two-fold gap:

A gap in context - scanty empirical data of Diyala Governorate.

Lack of methodological rigor- lack of standards based assessment based on international competency models.

This research can contribute to the literature review in the region by developing the concept of perception-based reporting to competency-based assessment using the descriptive analysis and ISTE and UNESCO standards.

Research Methodology and Procedures.

A- Research Design

The research design that was used in this study was a descriptive survey. The descriptive research method is suitable when the researcher is interested in the systematic study of the existing practices without any experimental control. To be specific, it was decided to use the survey model to obtain the quantifiable information about a specified population of science teachers in terms of their digital media integration behavior.

The choice of the survey design is explained by its appropriateness to the discovery of patterns of use, perceived problems, and attitudinal orientations in naturally existing educational settings. This kind of methodology is also used in localized digital education research that has done the measurements on teacher preparedness and technology use **[1][2]**. The current research applies the same method, but introduces the element of standards based evaluation criterion to the survey design.

A- Population of the Study

The study population involved teacher of science in the intermediate level in schools that are under the Directorate General of Education in Diyala Governorate in the academic year 2024-2025.

B- Sample of the Study

Sixty-three (63) male and female teachers of science were sampled to take part in the study. The participants were selected in intermediate schools in the Diyala Governorate. The sample size will be adequate to perform descriptive statistical analysis in order to determine the patterns of central tendency and variability in the target population.

C- Research Instrument

· Instrument Development

A structured questionnaire was used to collect data in accordance with the recent literature concerning the digital media integration and international e-learning standards. The instrument was developed based on the review of empirical literature covering the findings of the studies on digital education practices and teacher technology readiness **[1][3]**.

In the last questionnaire, the number of questions was thirty (30) and they were administered in three areas:

- Digital Media integration level (10 items)
- Instructional Challenges, Barriers, and obstacles (10 items)
- Attitudes of teachers toward Digital Media (10 items).

The scale used was a five-point Likert scale (Strongly Agree to Strongly Disagree) with the option to quantitatively measure the degree of agreement.

· Validity and Reliability

Establishment of content validity was done by reviewing it by experts in educational technology and curriculum studies. Some slight adjustments were done to make it contextually relevant and linguistically clear.

· Reliability Analysis

Cronbachs Alpha coefficient was used to measure internal consistency reliability of the questionnaire using the response of 63 teachers of intermediate science. The results of the reliability were as follows:

Domain	Number of Items	Cronbach's Alpha
Digital Media Integration	10	0.683
Instructional Challenges	10	0.823
Teachers' Attitudes	10	0.672
Total Instrument	30	0.837

Table 1.

The total reliability coefficient (alpha = 0.837) means that the instrument has good internal consistency. Reliability of the separate domains was in the range of 0.672 to 0.823, which is accepted as a good opportunity to use in the descriptive research in the field of education.

D- Data Collection Procedures

The research methods were conducted in the following steps:

- **Design of instruments grounded on theoretical and empirical basis.**
- **Expert validation review.**
- **Electronic delivery through the use of Google Forms to the concerned science teachers.**
- **Statistical data processing and compilation.**

The participation was voluntary and the responses were confidential.

E- Statistical Analysis

Descriptive statistics methods were used and they included:

The extent of integration of the digital media, the perceived difficulties, and attitudinal inclinations were determined using these measures.

Results and Discussion

· Descriptive Results

Sixty-three (63) intermediate-level science teachers were used as the sample.

Overall Domain Results

Domain	Mean	Standard Deviation

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Digital Media Integration	2.93	0.73
Instructional Challenges	4.00	0.50
Teachers' Attitudes	4.06	0.47

Table 2.
The conclusion of results is moderate-low level of digital media integration, high level of perceived challenges, and strongly positive attitudes of digital media integration.

· **Analysisipe of the Research Questions.**

First: Degree of Digital Media integration.

Digital media integration scored 2.93/5 which was a moderate use with a trend towards less implementation. A response analysis at item level shows that there is a tendency of using simple digital tools instead of using complex interactive technologies.

Digital Tool	Agreement (%)	Rank
PowerPoint Presentations	86%	1
Instructional Videos	82%	2
Digital Images/Illustrations	78%	3
Virtual Experiments	65%	4
Interactive Boards	61%	5

Table 3.
The prevalence of presentation software and instruction based on video imply representational in lieu of transformative integration. A higher use of more advanced tools like simulations and interactive boards was also not common presumably because of infrastructural and trainings limitations.

Second: Instructional Problems.

The perceived challenges mean was 4.00/5, which implies that the degree of agreement on structural barriers was high.

Challenge	Agreement (%)	Rank
Weak Internet / Electricity Interruptions	90%	1
Lack of Professional Training	84%	2
Limited Technological Equipment	81%	3
Limited Instructional Time	77%	4
Weak Administrative Support	73%	5

Table 4.
The data indicates that structural and institutional variables are major limitations to the successful digital integration. Observably, instability in infrastructures was described as the most important impediment.

Third: the Attitudes of Teachers toward Digital Media.

The average attitude score on teachers was 4.06/5 and it was high with positive perceptions.

Statement	Agreement (%)	Rank
Digital Media Increases Student Motivation	88%	1
Simplifies Complex Scientific Concepts	85%	2
Enhances Classroom Interaction	82%	3
Supports Individual Differences	79%	4
Increases Teacher Workload	70%	5

Table 5.
Though the attitude was positive, there was a belief that the effect of digital integration on teacher workload is conditional and it relies on institutional support.

- **Implication and Relation to the Past Studies.**

The result is in line with global studies that have shown that digital integration in an environment where there is instability in the infrastructural systems tend to be at intermediate levels **[4][5]**. The positive attitudes that have been recorded to be strong in this research are in line with the previous research that indicated willingness by teachers to embrace digital tools in cases where structural conditions allow them to do so **[1]**.

The trend toward representational digital tools is also indicative of trends seen in the creation of educational systems where integration is focused on content presentation, and not on digital transformation through inquiry. Moreover, the fact that infrastructural barriers are in agreement is a point that was widely supported by other literatures on digital divide in developing areas **[6]**.

The presence of positive attitudes and low implementation are indicative of a structural and not a motivational impediment. Thus, an increase in the infrastructure and organized professional development programmes can produce a quantifiable

change in the level of digital integration.

Future Research Directions, Conclusions, and Recommendations.

A- Major Conclusions

Results of the current research provide an insight into a structurally limited concept of digital media integration in intermediate science classrooms of Diyala Governorate.

First, there is an average to low level of digital media integration (M 2.93/5). The statistics show that instructors mostly use simple representational tools like presentation slides and teaching videos. The less common are advanced applications, especially simulations and interactive technologies. This trend indicates that the digital integration is still on the representational level as opposed to the interactive or transformative level as stipulated in the international competency frameworks.

Second, the perceived instructional challenges are quite high (M = 4.00 5). Unstable internet connection, power outages, lack of professional training, and inadequate technological equipments are the prevailing factors of constriction. These obstacles imply that digital integration barriers are also largely structural and not attitudinal.

Third, educators show very favorable attitudes in the digital media integration (M = 4.06/5). Most people view the idea that digital tools make students more motivated, help them learn complex sciences, and interact in the classroom better. This positive direction indicates readiness to digital transformation in case there are systemic conditions.

Fourth, the unequal distribution of the digital infrastructure among schools leads to the unequal patterns of implementation. Disparities in the availability of devices and connectivity integrate teachers unevenly, which supports the effects of the digital divide on the institutional level.

Lastly, there is a wide discrepancy between theory and practice. Though, teachers are aware of the pedagogical worth of digital media, the infrastructural and administrative constraints do not allow the translation of positive attitudes into regular instruction practice. This contradiction supports the idea that digital change will need systematic change and not individual intervention.

B- Recommendations

According to the results of the study, the following strategic recommendations are offered:

· **Empowering Digital Infrastructure.**

The education officials must focus on ensuring constant internet connectivity, power supply, and the current digital hardware in the intermediate schools in Diyala Governorate. The basic requirement in terms of sustainable integration is infrastructure stabilization.

· **Harnessed Professional Development Programs.**

Current training programs must shift to less technical training to pedagogical training as per ISTE and UNESCO competency level standards. There should be a focus on inquiry-based digital science learning as well as formative strategies of digital assessment.

· **Policy Integrity and Accountability.**

Teacher performance evaluation frameworks should also be digitally media integrated so that they can be incentivized to implement it in a structured way. Consistency and less variability in the digital practices can be supported by clear institutional policies.

· **Support Institutional and Financial.**

Funding mechanisms at the directorate level ought to provide special budgets on technological upgrades and repairs. Digital reform needs to be long term planning, as opposed to distribution of resources but not at random.

· **University-School Partnerships**

The university-level partnerships with local education directorates could improve the knowledge sharing, offer technical advice, and support pilot-level digital innovation initiatives in science education.

· **Monitoring and Evaluation Systems.**

The creation of periodic standards-based assessment systems will allow tracking the digital integration progress with data and assist in making evidence-based policy changes.

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C- Future Research Suggestions.

The present research paper raises a number of research possibilities:

· **Comparative Urban Urban Studies.**

The differences in digital integration between urban and rural intermediate schools may be studied in the future to better comprehend the differences in infrastructure between regions.

· **Digital Interactive Tools Experimental Studies.**

Experimental designs can be controlled, where the influence of the simulation-based instruction or interactive video modules on scientific reasoning and mastering the concept are evaluated.

· **Correlation of Digital Competency and Student Achievement Studies.**

Quantitative studies can be used to examine whether there is a correlation between the level of teacher digital competence and the student measurable academic performance in science.

· **Post-Training Impact Evaluation.**

Research on longitudinal studies on the efficacy of the professional digital training programmes to be applied after 2025 would be valuable in terms of policy.

· **Qualitative Studies of Student opinions.**

Individual interviews or focus group research may be conducted among the students to identify their views on digital science teaching and how it affects engagement and control over learning.

Concluding Reflection

The data produced by this research highlights that the problem of teacher resistance is not limiting the digital transformation of science in the education system in Diyala Governorate, but structural barriers. Positive professional attitudes are a vital enabling factor but to be able to work in a sustainable digital integration, there must be coordinated investments in infrastructure, standards-based professional development, and institutional alignment of policy. This study will help to improve standards-based digital reform in Iraqi intermediate education by locating the evaluation within the international competency frameworks.

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