TEACHING INFORMATION TECHNOLOGIES IN MEDICINE IN A DIGITAL LEARNING ENVIRONMENT THROUGH A COMPETENCY BASED BLENDED LEARNING MODEL

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ABSTRACT

Background: The course Information Technologies in Medicine needs a clear relationship between digital tools, learning activities, and the professional tasks for which medical students are being prepared. Moving lecture materials online does not, by itself, establish this relationship.

Objective: To develop a pedagogically structured model for teaching Information Technologies in Medicine through a digital learning environment.

Methods: A focused narrative review of selected international educational frameworks and health workforce education publications was combined with conceptual instructional design. Sources were identified through targeted web searches on 12 October 2026. Course outcomes, learning tasks, feedback, and assessment evidence were mapped to one another. No institutional experiment or student-level data collection was conducted.

Results: The conceptual analysis produced a proposed model consisting of initial diagnosis, guided preparation, supervised practice, independent application, and feedback-informed revision. Four sample modules link information retrieval, spreadsheet analysis, database design, and digital communication to medical

education. The model specifies the role of the learning management system, differentiation for learners with different entry skills, and an evaluation plan.

Conclusion: The proposed approach makes the instructional purpose of digital resources explicit and provides a practical basis for course design. Its feasibility and educational effectiveness require prospective evaluation before claims of improved achievement or professional readiness can be made.

Keywords: medical education; information technologies in medicine; digital learning environment; blended learning; competency-based education; learning management system; instructional design.

INTRODUCTION

Information Technologies in Medicine occupies an important position between general digital literacy and the professional use of health information. A student may operate common software successfully yet remain unable to explain why a spreadsheet result is unreliable or why a medical information source is unsuitable. For this course, the educational problem can therefore be formulated as the transition from completing software operations to making defensible decisions about information.

The International Medical Informatics Association (IMIA) presents its educational recommendations as a framework for establishing and developing biomedical and health informatics courses and programmes [1]. This offers a disciplinary reference point rather than a ready-made local syllabus. The present article uses that distinction to propose a course model that can be adapted to institutional learning outcomes without assuming that all medical students need specialist informatics training.

The World Health Organization (WHO) emphasizes that the outcomes of digital education depend on implementation, learning objectives, delivery methods,

and the context of use. It also identifies unequal access as an important barrier [2]. Consequently, a defensible teaching model should specify what students do, what support they receive, and what evidence demonstrates learning.

The objective of this article is to develop a practical model for organizing Information Technologies in Medicine in a digital learning environment, with particular attention to the alignment of outcomes, tasks, feedback, and assessment.

MATERIALS AND METHODS

The article combines a focused narrative review with conceptual instructional design. Targeted web searches were used to identify IMIA educational recommendations, the European Framework for the Digital Competence of Educators (DigCompEdu), WHO publications, and UNESCO guidance. The search addressed medical informatics education, digital teaching competence, health workforce digital education, educational technology assessment, and generative artificial intelligence in education.

Selection was purposive. Sources were retained when they offered an explicit educational framework or directly addressed implementation, assessment, or responsible technology use. This was not an exhaustive systematic review: there was no preregistered protocol, duplicate screening, or formal study-level risk-of-bias assessment. Bibliographic details and relevant publicly accessible descriptions were checked; comprehensive full-text coverage is not claimed.

The design process had three stages. First, the course problem was expressed as observable learner actions. Second, each action was connected to a sample task and an assessable product. Third, teaching conditions and an evaluation plan were specified. Published principles were distinguished from the model developed in this article. The proposed modules, instructional sequence, and evaluation procedures are design outputs, not previously validated institutional practices.

No students were recruited, no patient records were used, and no experimental or control groups were formed. Results therefore refer to the conceptual model and its components. No effect sizes, significance tests, or improvement percentages are reported.

RESULTS

Proposed learning outcomes

The model defines four illustrative course outcomes. Students should be able to locate and justify the selection of a medical information source; organize and examine a synthetic dataset; represent a simple healthcare information process using related data tables; and communicate a digital result with appropriate explanation and access controls. These outcomes are proposals for local adaptation rather than claims about an existing institutional curriculum.

Each outcome combines an operation with a justification. For example, creating a chart is incomplete unless the student explains its variables, units, missing observations, and limitations. Similarly, identifying a website is insufficient without an account of its author, publication context, and relevance to the educational question. This requirement makes the student's reasoning visible alongside the final file.

Structure of the learning environment

The learning management system serves as the common location for module instructions, short explanations, practice files, submission deadlines, and feedback. Each module follows the same sequence so that students can focus on the disciplinary task rather than repeatedly learning new navigation arrangements. The proposed sequence is preparation, demonstration, practice, submission, feedback, and revision.

The online component carries material that students may need to revisit: terminology, worked examples, brief demonstrations, and annotated solutions. Supervised sessions are reserved for examining decisions, diagnosing errors, and attempting unfamiliar tasks. The model does not prescribe a universal percentage of online instruction; the balance should be determined by the task and the support required.

Diagnostic entry assessment and differentiation

An initial low-stakes task is proposed to identify entry skills. Students organize a small folder, interpret a spreadsheet formula, identify a source, and explain an appropriate way to share a file. The purpose is to plan support, not to label students permanently as weak or strong. Results are combined with a short access survey covering devices, connectivity, and accessibility needs.

Learners who need support receive stepwise demonstrations and a simplified practice dataset. More experienced learners receive an extension requiring error detection or comparison of alternative solutions. Both routes lead to the same core outcome. Differentiation changes the amount of scaffolding, while the central expectation of an accurate and explainable result remains common.

Illustrative teaching modules

The information retrieval module begins with an educational question about a medical topic. Students record search terms, compare two candidate sources, and submit a short justification of their selection. Assessment concentrates on the search process and source evaluation; students are not asked to provide independent patient-management advice.

The spreadsheet module uses a wholly synthetic dataset containing deliberately inserted problems such as duplicated identifiers, inconsistent units, or missing entries. Students preserve the original file, document their cleaning decisions, calculate descriptive summaries, and select a suitable graph. A successful

submission includes an annotated workbook and a brief explanation of what cannot be concluded from the dataset.

The database module asks students to represent a simplified outpatient appointment process. They identify entities, define primary and foreign keys, and explain how related tables reduce unnecessary duplication. The final product can be a small database or a schema accompanied by example records. Software complexity is secondary to the correctness of the relationships and the clarity of the explanation.

The digital communication module requires a concise report combining a table, a figure, and a source list. Students choose an appropriate file format, apply consistent headings, and explain the intended recipient's access. A short peer review is followed by revision. The task evaluates how effectively the document conveys information rather than its decorative complexity.

Feedback and educator responsibilities

Feedback identifies the location of an error, explains its significance, and directs the learner toward a corrective action. Students resubmit a revised product with a short account of what changed. The proposed assessment record retains both versions, allowing the teacher to distinguish the initial difficulty from the student's response to feedback.

DigCompEdu describes educator competence across six areas and 22 competences, including teaching, assessment, and support for learners [3]. Within this model, that framework is used to identify faculty development needs: preparing accessible resources, managing practical work, interpreting student submissions, and giving actionable feedback. It is not used as a direct measurement scale for students' clinical competence.

Implementation and evaluation plan

A pilot should begin with one module and a limited set of reusable materials. Teachers should document preparation time, support requests, submission difficulties, and the accessibility of files. An offline package containing the same instructions and practice data should be available where needed; assessment conditions should be equivalent across access routes.

The proposed primary educational outcome is performance on an unfamiliar practical task scored against predetermined criteria. Secondary measures include delayed performance, revision quality, completion, and student perceptions. A future comparison should control teaching time and assess baseline competence. The present article provides no estimated effect because such data have not been collected.

DISCUSSION

The model's main contribution is an explicit connection between digital activity and assessable reasoning. A student who submits a correct spreadsheet by following a demonstration may not yet be able to identify an incorrect formula in a different file. Requiring an unfamiliar transfer task and a short explanation is intended to distinguish imitation from independent application. This distinction remains a design proposition until tested.

The model also separates participation from competence. Login counts and submission timestamps can help identify a learner who may need support, but they do not demonstrate accurate interpretation or responsible data handling. Teachers should use such traces to initiate a conversation and examine work products, rather than automatically award competence scores for online activity.

WHO's work on educational technology assessment emphasizes the need to evaluate practical, safe, scalable, and cost-conscious implementation [4]. For the proposed course, a local evaluation should therefore record educator workload and

technical support alongside learning outcomes. A sophisticated platform is not justified solely by its feature list; the relevant question is whether it supports the intended learning process within available resources.

Generative artificial intelligence may be incorporated as an object of critical analysis. A teacher could provide a generated explanation containing a planted inconsistency and ask students to verify it against an approved reference. Any permitted use in student assignments should be disclosed, with responsibility for the submitted work remaining with the learner. This proposed practice is consistent with UNESCO's emphasis on human agency and responsible educational use [5].

The framework has important limits. It has not been tested at Andijan State Medical Institute or elsewhere as a complete intervention. The selected sources do not establish the effectiveness of the proposed combination. Language, timetable, faculty capacity, and software access require local adaptation. Future evaluation should also examine whether performance persists after course completion and transfers to later supervised medical learning.

CONCLUSION

Teaching Information Technologies in Medicine in a digital environment can be organized around explicit outcomes, medically contextualized tasks, guided practice, feedback, and revision. The proposed blended learning model provides a coherent instructional structure and an evaluation plan. It should be treated as a testable pedagogical design rather than evidence of achieved improvement.

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