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PAPER

A Decision-Making Platform for Educational Content Assessment Within a Stakeholder-Driven Digital Educational Ecosystem

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ABSTRACT

The paper discusses the features of the implementation of a digital decision-making platform for evaluating educational content as part of a stakeholder-driven digital educational ecosystem. The authors propose a methodology of business process digitalization that considers a three-stage quality evaluation of educational resources regarding their content, as in traditional textbooks, digital educational resources, e-learning content, curricula, etc. The digital decision-making platform (DDMP) is at the core of the examination of educational content and resources through interactive voting by experts, which allows multi-criteria evaluation. DDMP is designed to provide experts with digitally intelligent services for expert assessment and objective decision-making, as well as monitoring the assessment process. The developed digital platform is integrated into any learning management system (LMS) by contributing to the improvement of a digital educational ecosystem.

KEYWORDS

textbook evaluation, digital decision-making platform (DDMP), digital educational eco-system, educational content quality, educational content assessment

1 INTRODUCTION

According to the studies conducted by the Organization for Economic Cooperation and Development (OECD), the educational systems of the future are portrayed by growing demands for the use and interpretation of an increasing number of sources of knowledge, the rapid development of teaching tools and methods, as well as support for students in their successful development [1]. At the same time, educational systems should highly consider the competency-based approach among stakeholders to ensure the quality of educational content. Particularly, the feedback from

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employers is significant since they are the main customers of the educational system and formulate requirements for the content of specialist training [2]. In such educational settings, the teacher is expected to have deep knowledge of educational content and skillfully operate with innovative teaching methods. Therefore, the latest digital solutions in the field of quality control of educational content should be applied by considering the opinions of experts in both the subject teachers and employers as experts [1] [3] [4] [5] [6] [7].

Not being limited to traditional textbooks, current educational content is delivered in a variety of formats, such as e-learning, digital educational resources, open educational resources, massive open online courses (MOOCs), and learning management systems (LMS) platforms. This is significantly influenced by recent digital solutions [8–13]. In this regard, many studies agree that such resources are still an important source of subject knowledge, the key to high academic performance, involvement, and success of students when the subject quality is a focal point and it matches modern requirements [14–16]. At the same time, high-quality educational content has a strong influence on the motivation of students to study the subject [15] [17] [18] on improving reading ability [13] [19] and on the development of cognitive abilities [14] [20]. For example, the reasons for poor mathematical literacy performance in England are explained by the fact that only 10% of British teachers use mathematics textbooks as the basis for teaching mathematics, compared to 70% in Singapore and 95% in Finland [21].

Thus, numerous studies emphasize that high-quality educational content plays a fundamental role in teaching, and, according to the technological, pedagogical, and content knowledge (TPACK) model [22], in collaboration with technological and pedagogical knowledge, it represents a powerful tool to affect academic performance and professional training of learners.

The evolution of educational systems from traditional to the future first requires the compliance of the quality of educational content with the new high-performing standards practiced in other parts of the world [5] [23]. According to OECD forecasts, educational systems of the future will be part of a larger ecosystem where decision-making and responsibility are shared among a wider group of stakeholders while students are active participants in their learning path [1].

Based on this, modern educational content is expected to meet the following basic requirements:

1. Generate deep subject knowledge.
2. Engage and motivate students to engage in learning and cognitive activities.
3. Contribute to the successful development and well-being of learners.
4. Meet the requirements of key stakeholders.

In this regard, meeting these requirements is possible when applying special digital solutions that will implement the principles of the educational ecosystem of the future and serve as a collaborative platform for making joint decisions regarding the quality of educational content.

The data from international studies PISA and TALIS that contributed to the formation of educational policy in preschool, secondary, and vocational education in the Republic of Kazakhstan for 2023–2029, reveal many issues related to the quality of educational content. In the era of information expansion, the problem of the quality of educational content, along with the need to improve

academic performance, reading ability, the role of teacher education, and the significance of dual education, are now prioritized in the world, including in Kazakhstan [24] [25].

The purpose of this study is to develop a modern digital decision-making platform (DDMP) for assessing the quality of educational content as part of an educational digital ecosystem, the principles of which are aimed at the implementation of the requirements for the quality of educational content by key stakeholders.

The authors of the paper aim to answer the following research questions:

1. What stages of expert assessment should be implemented by DDMP for assessing the quality of educational content and implementing a stakeholder-driven digital education ecosystem?
2. To what extent and what business processes should be considered when developing DDMP?
3. What criteria need to be developed in DDMP to implement a stakeholder-driven digital education ecosystem?
4. What is the impact and role of the proposed DDMP on the development of a digital educational ecosystem managed by stakeholders?

To answer the research questions, the authors conducted a series of studies on the research-based design and implementation of DDMP.

2 ANALYSIS OF RELEVANT RESEARCH AND PUBLICATION

Many researchers in the field of quality educational services are concerned about theoretical questions regarding the methodology and models of evaluation, digital solutions that improve the procedures for assessing the quality of educational content.

To date, research has revealed the influence of high-quality content on the following processes:

1. The effectiveness of overall learning, which includes improving the academic performance of students, increasing motivation and interest in the learning process, developing cognitive abilities, general cultural values, and meta skills
2. Effective formation and transfer of teachers' best practices in teaching methods
3. Accumulation of the basis of knowledge in a particular area
4. Successful development and dissemination of national values [26–31]

Furthermore, in the context of globalization, ensuring the quality of educational content becomes a fundamental prerequisite for executing the digital transformation of educational environments and achieving effective digital management of the educational process. This is accomplished through the integration of intelligent educational systems and tailored learning approaches that cater to the specific needs and interests of students [32].

In this regard, the examination of the quality of educational content in the framework of the digitalization of the educational process requires a thorough analysis of the current state of research.

In general, the existing research can be divided into three groups: the development of the methodology of expertise, the methodology of content analysis of educational resources, and the digitalization of expertise through the development of expert systems and systems advisors.

Regarding the first group, researchers focused on the methodological issues to examine the quality of educational content; in particular, thorough research work [26] [27] [29] [33] [34] was carried out on the selection of criteria for assessing the quality of educational content.

The criteria developed by researchers vary depending on the purpose of the examination of the quality of educational content:

1. To evaluate electronic resources in order to establish the degree of student satisfaction
2. To obtain an objective and accurate assessment of the effectiveness of the training course, an instant analysis of the obtained results, as well as clearly structured results and assessments
3. To evaluate textbooks in order to determine whether the content meets the needs of students and their socio-cultural conditions, in particular when studying the national Slovak language
4. To focus on localization and cultural sensitivity when teaching Chinese
5. For the implementation of an expert system for the evaluation of educational content in the conditions of distance learning

The second group of studies is aimed at confirming the pedagogical value of textbooks in the light of meeting the needs of students and providing good guidance for teachers. The study used a qualitative content analysis with the participation of stakeholders in the process of examination of the educational process, including both teachers and students [30] [31] [35]. Moreover, contextual interaction between various stakeholders, such as teachers, policymakers, and administrators, plays an important role in ensuring the quality of educational content [30].

One of the methods of examination of educational content found in research is the method of expert assessments, in which teachers act as experienced experts because they understand the shortcomings of textbooks better than others and they know the needs of students [28] [36]. In addition, it should be noted that teachers are primarily interested in assessing the quality of the didactic capabilities of textbooks, and, in this regard, simple digital solutions are needed [37].

The results of research on the implementation of digital solutions in the framework of the examination of educational content are also known [32] [34] [38]. The predominant principle is the use of a digital platform for the publication of OER with a built-in content quality assurance system with the participation of stakeholders such as authors, students, and subject teachers. The platform includes four components, among which is a textbook quality assurance scheme. The platform is designed primarily to solve the problem of high prices and frequent revisions of textbooks [38].

One of the interesting options for implementing digital solutions for designing educational content for training courses is the development of a knowledge-based advisor system. The digital expert system, using the knowledge base of five different cultures, helps the developers of training courses (instructional design process)

adapt the pedagogical scenario to the culture of the student, thereby improving the quality of educational content in a cultural context [32].

One of the most complete digital platforms is considered part of the implementation of an expert system for evaluating pedagogical content in distance learning [34]. In this study, diverse work has been carried out: quasimetric models for evaluating educational resources have been developed with a careful selection of evaluation criteria; quality parameters have been selected and evaluated using the expert evaluation method; and a web-oriented expert system has been implemented that allows automating expert decision-making regarding the quality of pedagogical content of any type.

The review of available studies in the field of assessing the quality of educational content allows us to draw the following conclusions:

- Most studies are focused on the development of criteria for evaluating the quality of educational content according to the purposes of its use.
- The reviewed literature does not consider digital tools as part of a digital educational ecosystem that takes into account the interests of stakeholders in the content of education and multi-stage expertise.
- The implementation of expert systems does not consider monitoring the conscientious work of experts, multi-criteria evaluation parameters, or interactive voting by experts.

Taking into account the existing gaps in the research and implementation of digital platforms for making decisions on the quality of educational content and considering stakeholders' interests, a preliminary study was conducted to collect the necessary data to clarify the requirements for such systems. The results and conclusions of the study will be discussed in detail in the next section.

3 MATERIALS AND METHODS

Decision support systems (DSS) in education are quite common due to the need for accurate decision-making during uncertainty or when there is a multi-sided decision-making process [39].

To improve the examination process and develop a modern digital decision-making platform on the quality of educational content by considering the opinions of stakeholders, a "improving the examination process" Google survey was conducted. The purpose of the survey is to collect feedback from stakeholders (subject experts, students, and employers) on their knowledge and experience of examining educational resources to improve the examination process. Answers from 194 respondents were received and analyzed. Subject coverage and expertise of respondents are shown in the figures (Figures 1–3).

Overall, 36.6% of respondents have more than five years of experience reviewing educational publications (Figure 1). The largest number of respondents had experience conducting examinations in such subjects as computer science, mathematics, primary education, languages, and literature (Kazakh, Russian, and foreign). The distribution of experts by language of educational publications is as follows: Kazakh: 57.2%; Russian: 58.2%; English: 10.8% (Figure 2).

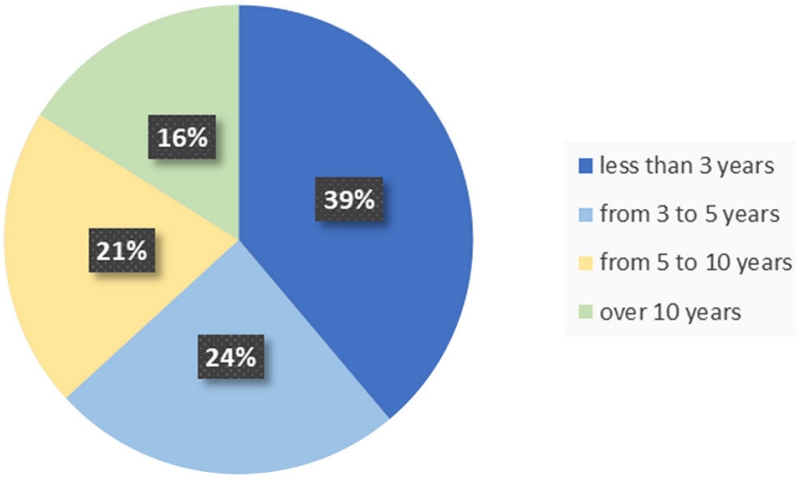

Fig. 1. Experience of experts in the examination of educational publications

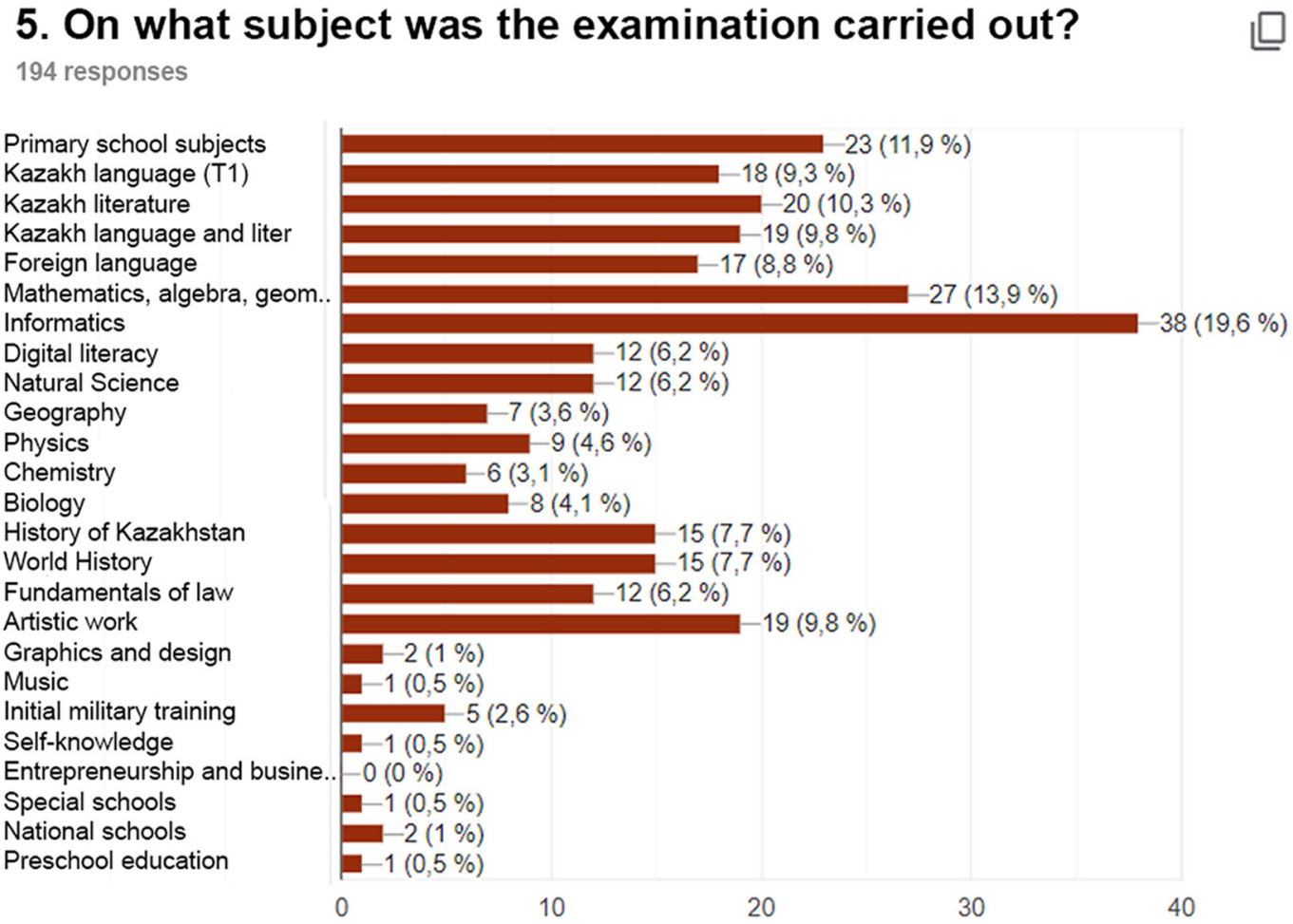

Fig. 2. Subject areas of examination of educational publications

The distribution of respondents' expertise by type of educational publication is as follows: paper educational publications: 88.1%, electronic textbooks: 67%, and digital educational resources: 33.5% (Figure 3).

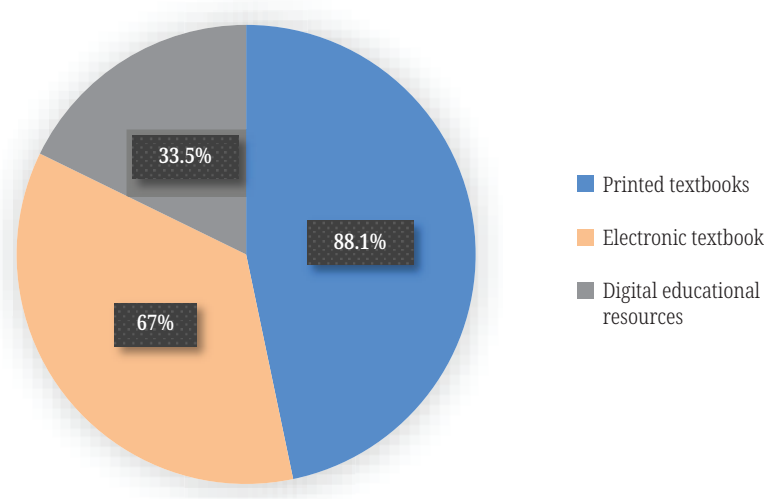

Fig. 3. Expertise by type of textbooks

Digital decision-making platform uses a matrix of expertise that includes 78 criteria in the following 10 sections (quality aspects):

1. The structure and organization of the textbook
2. Content
3. Didactic aspect
4. Methodological aspect
5. Language level
6. Psychological and psycholinguistic aspects
7. Cultural and value aspects
8. ICT integration
9. Aspects of differentiation
10. Layout and design

These criteria for the examination of educational publications received high appreciated from experts, with 75.8% of respondents giving a rating of 8 or higher. Only 4.6% of experts rated the current criteria as low, giving 5 points or less (Figure 4).

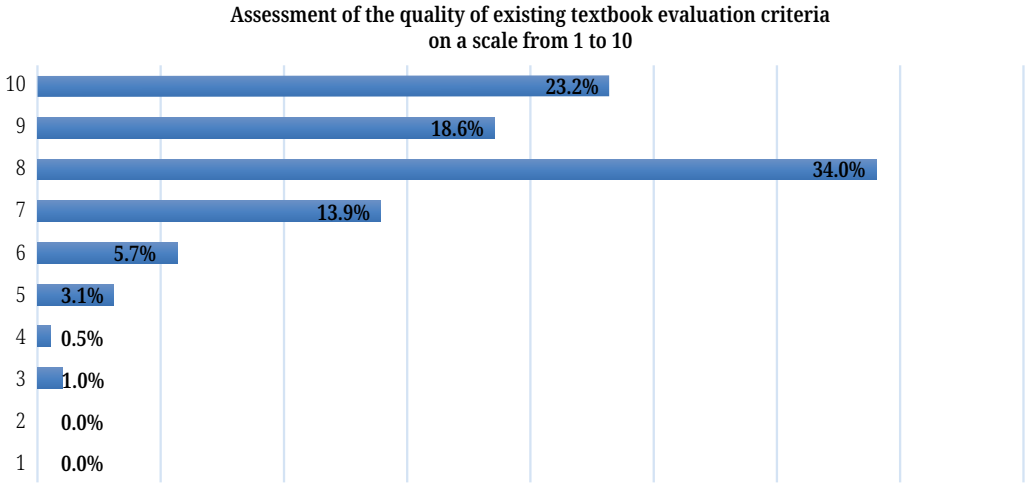

Fig. 4. Evaluation by experts of the existing criteria for the examination of textbooks

Nearly three-fourths (73.7%) of respondents provided a positive answer to the question, "Do the criteria for the examination of educational publications fully cover didactical and methodological principles?" In general, the experts noted the following suggestions and comments on the criteria:

- There are extra criteria and duplication of criteria.
- To supplement the criteria, specifications are needed.
- Differentiation in subjects and accounting is necessary.
- It is necessary to differentiate the criteria according to the levels of education.
- In the calculation of the criteria, errors, and inaccuracies in the publication are not considered.

Experts' proposals to improve the quality of examination of educational publications can be divided into the following groups:

- Expertise: Improvement and concretization of evaluation criteria (remove repetitive, unnecessary criteria); ensure that the criteria are understandable and measurable; enter descriptors by criteria; expand the scale of assessment; increase the criteria aimed at the formation of national values; apply various matrices by type of educational publications; keeping records in terms of the specifics of the subject
- Composition of experts: Extensive practical experience of experts; qualitative selection of experts based on the results of work; to involve experts from different cities and regions for one educational publication
- Examination process: Before the examination process, check for errors, inaccuracies, and plagiarism; qualitatively conduct an appraisal of educational publications and consider the opinions of subject teachers; strengthen the requirements for educational publications; increase the responsibility of publishing houses; strengthen the internal publishing expertise of educational publications; increase the responsibility of experts, maintain a rating of experts; and provide clear instructions for examination
- Organizational issues: To increase the terms of the examination; reduce the volume of educational publications for the examination per expert (no more than 3–4 units); carry out examinations during school holidays; conduct advanced training courses both for experts and textbook authors; organize joint meetings of authors, experts, and developers of standard programs; organize joint work of experts; hold seminars for the exchange of views; increase the payment for experts
- Automation of the work of experts: An electronic form of filling with sub-scores; an electronic database of necessary literature, documents, video recordings, and other information for experts; improvement of digital services and expertise tools

In addition, it was found that for the examination of educational publications, respondents mainly use digital tools and services such as electronic dictionaries, search engines, reference systems, cloud storage, word processors, and spreadsheets, which indicates the absence of specialized digital tools for the examination of educational content.

To the question "What functions and tools do you want to have in a digital system to facilitate the work of an expert?" 63.4% of experts proposed that they would like to work with a convenient, understandable special service for the examination of educational publications that has the following functions:

- Convenient navigation
- Convenient viewing of educational publications and the ability to enter comments in the process of viewing
- The possibility of criteria-based assessment during the verification of educational publications
- Automatic error checking function and error search function
- The ability to indicate errors immediately on the page of educational publications through colour highlighting (green: no errors, yellow: inaccuracies, and red: errors), indicating the page or paragraph
- Recording different weights of errors and comments (critical, correctable, etc.)
- Verification of electronic links indicated in educational publications
- A system for evaluating educational publications, the choice of criteria, descriptors, and points for them
- Automatic scoring and autosave work
- Formation of an electronic examination form
- Printing, export of documents, and saving to the archive
- Saving all information on examinations in the personal account and cloud storage
- Review of standard curricula and normative documents
- Functions of interaction and communication among experts, a forum or a dialogue plat-form for experts
- Instruction on evaluation criteria and a sample provision
- Provide a list of frequently asked questions from experts with answers
- Inclusion of an electronic spelling dictionary for word search, necessary digital services, and links to the necessary resources
- Application of machine learning systems for evaluating the work of experts
- Anti-plagiarism system
- Use of electronic signature

Thus, the analysis of the survey results among experts showed their openness and readiness for dialogue. To improve the quality of the examination of educational publications, it is necessary to improve the criteria for the examination of educational publications and to conduct continuing education courses, meetings, and seminars for authors, experts, and curriculum developers on an ongoing basis. It is also necessary to increase the responsibility of authors, publishers, and experts.

More than half (63.4%) of experts indicate the need to establish an electronic platform for the examination, which will provide a convenient interface for work, automate routine processes, and save time for conducting an examination. Experts suggest considering interaction and communication tools, analytics, as well as a reference base of necessary documents and links on the platform.

Thus, the conclusion of the preliminary survey suggests that there is a need for a digital platform. Along with the collection of stakeholders' requirements for the quality of the future DDMP, the survey also established the validity of the criteria for the examination of educational publications and resources.

4 DEVELOPMENT OF BUSINESS PROCESSES MODEL ON EXAMINATION OF EDUCATIONAL RESOURCES

In order to implement the DDMP for evaluating educational resources in the form of an expert system that meets the conditions and requirements of all stakeholders,

we conducted an investigation into the metadata concerning the business processes involved in evaluating educational content. This data is primarily managed by the Republican Scientific and Practical Center for Evaluating the Content of Education, which is functioning under the Ministry of Education of the Republic of Kazakhstan. There we determined a list of object types, characteristics of objects, connections and dependence between objects exercised during the examination of educational resources. To digitalize the processes of examination of educational resources, the full cycle of examination processes was analyzed, and a list of expected changes was identified.

There are seven departments that are directly involved in the examination of educational resources, carrying out 15 business processes (Figure 5). Based on this business process model, the DDMP functionality for the examination of educational resources is defined, and the roles in the system and the access rights of platform users are defined.

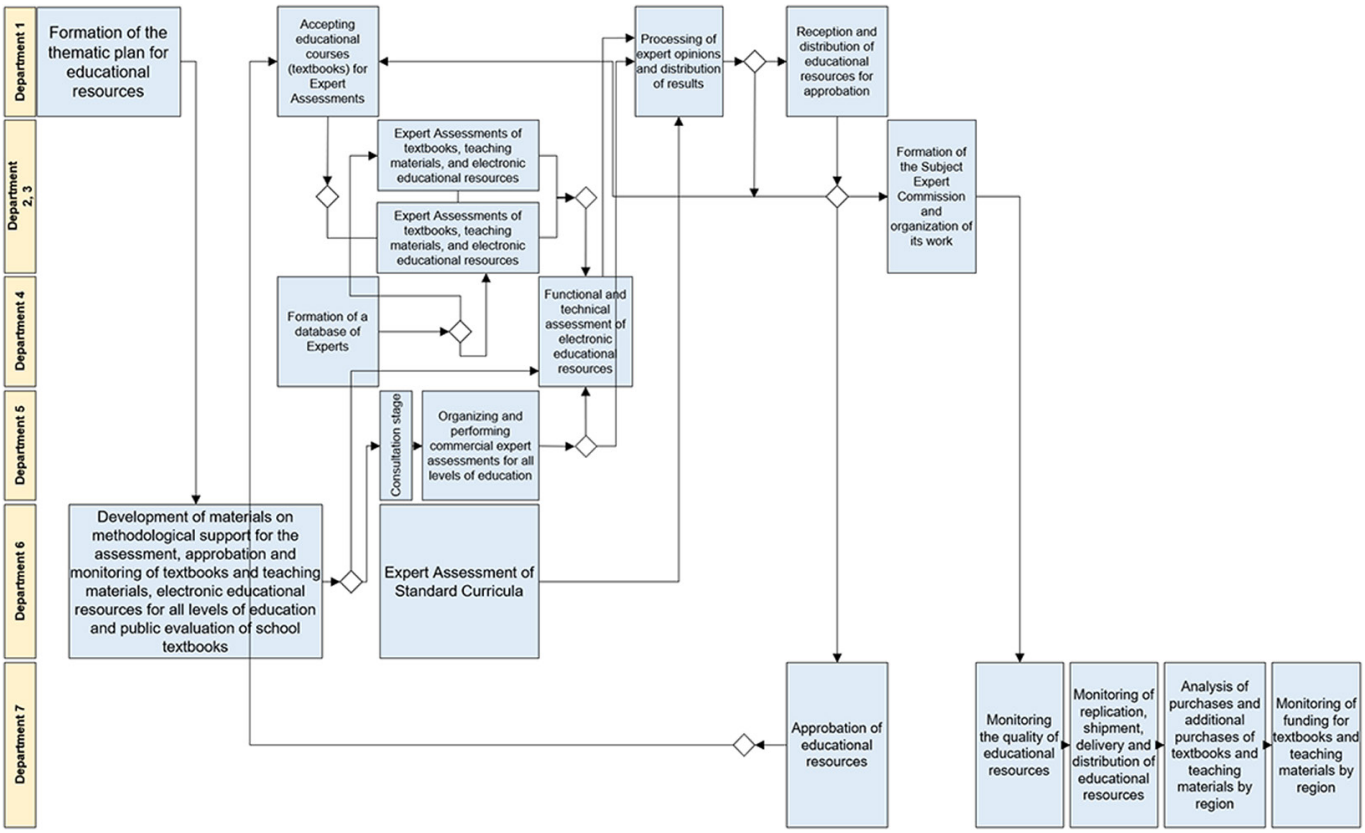

Fig. 5. Business processes model for the examination of educational resources

Based on the understanding of the algorithm and business processes for evaluating the quality of educational publications, a decision was reached concerning the architecture of the digital platform. This encompasses the arrangement of components within the computing system and the integration of software modules that execute the required stages of evaluating educational content in accordance with existing rules and regulations.

5 DIGITAL DECISION-MAKING PLATFORM ARCHITECTURE AND EXAMINATION STAGES

The DDMP for the quality of educational content is an expert system that embodies the experience of an expert in computer intelligence and is capable of generating recommendations and/or making an intelligent decision on a knowledge-based specific operation or function. DDMP implements interactive voting by experts and the possibility of multi-criteria evaluation of educational content based on a multi-factor analysis of the examination process in specific subjects by identifying the main vectors and components of expert evaluation. DDMP is designed to provide examiners with digitally intelligent services for conducting examinations and making objective decisions, as well as monitoring the examination process.

During the study, there were determined mathematical foundations and an algorithm for implementing the evaluation process through multivariate analysis.

For collegial examination procedures, DDMP provides a block of interactive online expert voting with automatic receipt of expert assessments, conclusions, and a protocol for making an expert decision based on the multi-criteria evaluation.

Analyzing the business processes involved in evaluating educational content and studying each stage through the constructed technological maps allowed us to delineate the primary modules of the forthcoming expert system and define its functionality. Their functionality is considered in more detail as follows:

Module 1. "Formation of the database of educational publications for examination"

- Acceptance of applications for examination
- Creation of a database of educational publications for examination, correction, and review
- Assignment of external experts by order and distribution of messages

Module 2. "Examination of educational publications"

- Preview
- 1st stage of examination (identification of errors and identification of types of errors);
- 2nd stage of expertise (Assessment by criteria)
- 3rd stage of expertise (formation of an expert decision and coordination)
- Approval of the expert opinion and distribution among customers
- Viewing the status of decisions on educational publications
- Review of the report on the work of external experts

3rd module is "interactive voting"
4th module is "approbation of educational publications"
5th module is "subject committee panel":

- Protocol formation
- Downloading the subject committee panel decision
- Formation and review of the list of educational publication houses
- Formation of an archive of the database of educational publications with decisions

One of the main modules is the 2nd module, "Examination of educational publications" (Figure 6), which implements the functions of a three-staged examination of educational publications.

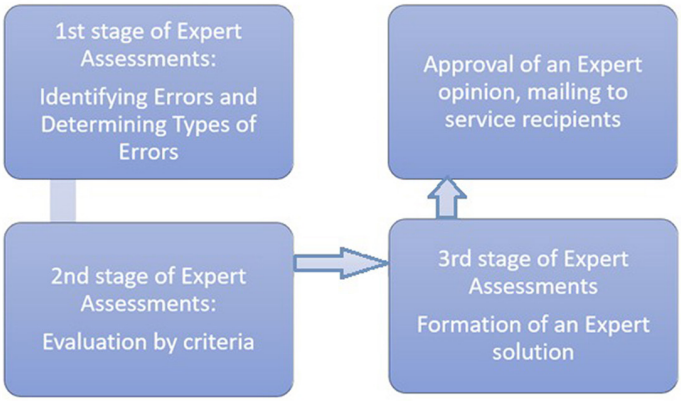

Fig. 6. Stages of examination of educational publications

The main computing architecture was determined during the assessment of the main purpose and functions of the expert system.

The "client-server" architecture was chosen as the basis for the network interaction of the expert system. Within the framework of this architecture, the separation of the processes of providing services and sending requests for expert system services from different devices in the network is provided, where each performs its tasks independently from others.

The interaction between the client and server subsystems is carried out in the REST architectural style. Sending and receiving requests on the network will be carried out through standard HTTPS requests, and the transfer of the necessary data will be carried out as parameters.

The computing architecture of DDMP is illustrated in Figure 7.

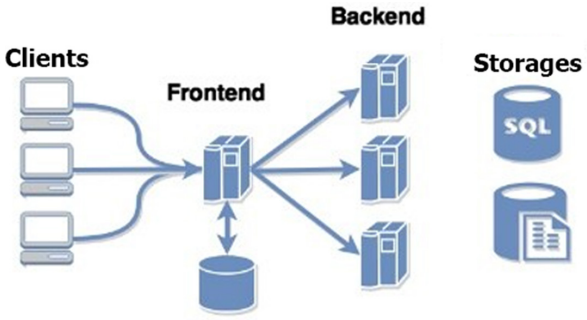

Fig. 7. General architecture of DDMP

6 SYSTEM INTERFACE

The main functions of the expert system are implemented through a user-friendly platform interface.

A fragment of the first stage of interface examination for detecting errors and determining types of errors is shown in Figure 8.

At this stage, you can view the educational edition (a file in pdf or e-pub format scrolls in a frame). If an error occurs, a fragment and the type of error are selected and followed by entering a comment.

All entered comments are displayed on the right side with a page indication. During the examination, all comments and errors are included in the expert decision on the educational publication.

Coding and debugging of an expert system for assessing the quality of educational resources with interactive experts' voting and the possibilities of multi-criteria evaluation are implemented based on empirical studies.

Knowledge-based DDMP helps educational content experts make decisions by fulfilling its main purpose.

An expert system structurally consists of the following components: a knowledge base and an "engine" program that provides knowledge-based advice to experts. The knowledge base consists of facts and rules. Particularly for this expert system, additional programs were developed; one of them collects rules and facts into a knowledge base. Based on this, the second program, the expert system engine, calculates the score for the criterion using the knowledge base.

Expert systems should have the properties of high performance, clarity, and reliability [39]. The expert system should be able to come to the aid of a person in making decisions through the interpretation of input, the prediction of results, and providing a recommendation.

The process of interaction with physical experts in our expert system of educational content expertise is similar to classical expert systems [40].

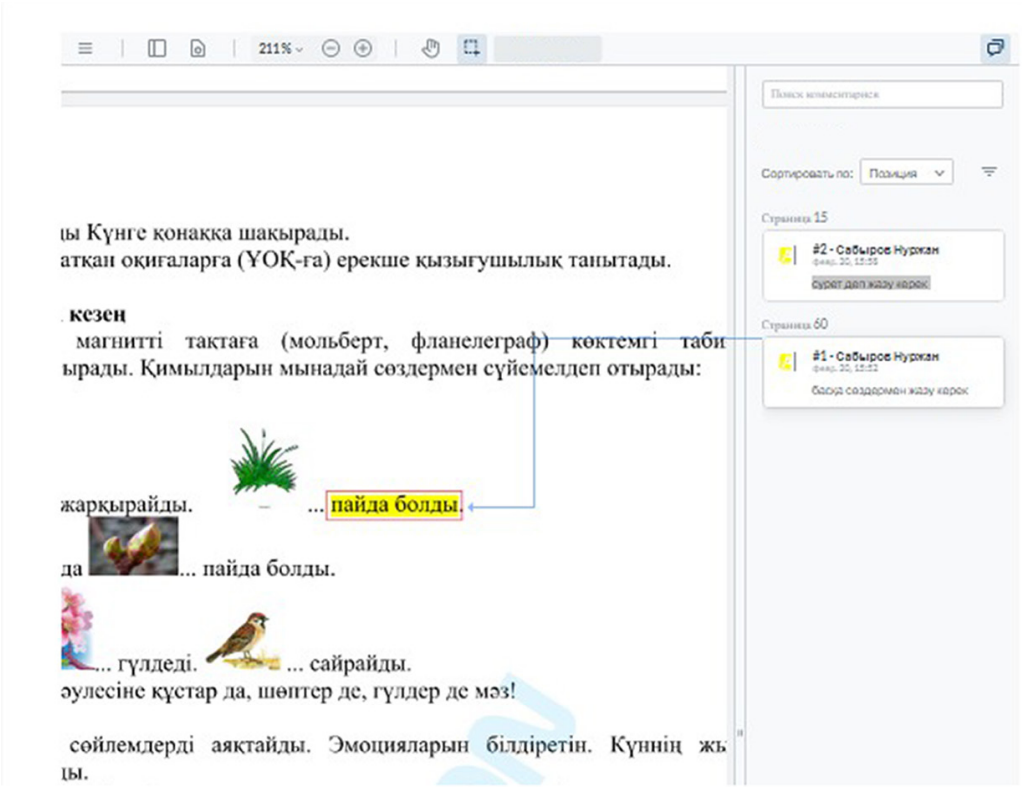

Fig. 8. Interface of the 1st stage of the examination: Detection and fixation of errors-side

As it is known, no technology can offer a simple and complete solution to issues. Specialized systems are expensive because they require significant computational and material costs for development. Nevertheless, a group of researchers and developers created the first version of an expert system for evaluating the quality of educational content based on the results of methodological studies of criteria and indicators of the quality of educational resources and publications.

Figure 9 shows a fragment of the assessment according to the criteria of the educational edition. For each educational publication, a corresponding matrix of expertise is displayed, which is necessary to evaluate according to the criteria.

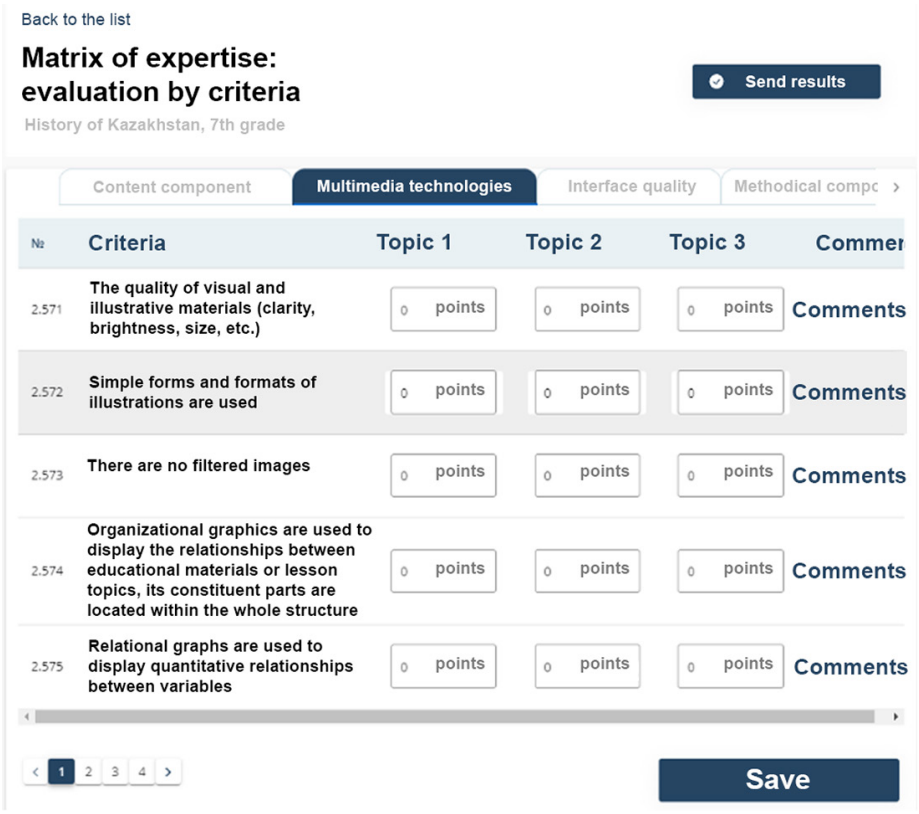

Fig. 9. Interface of the 2nd stage of the examination: Evaluation by criteria

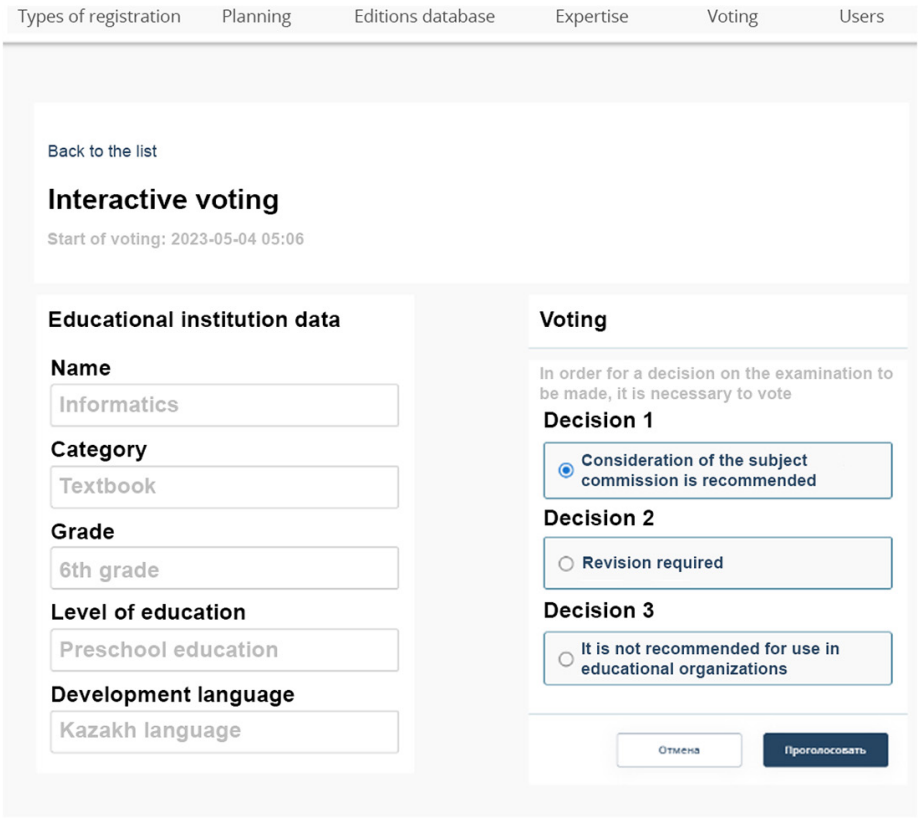

Fig. 10. Interactive voting interface

If the opinions of experts diverge while forming an expert decision, then interactive voting will be held (Figure 10).

7 THE IMPACT AND ROLE OF THE PROPOSED DDMP ON THE DEVELOPMENT OF A STAKEHOLDER-DRIVEN DIGITAL EDUCATION ECOSYSTEM

The feasibility of developing and implementing specialized digital tools to ensure the quality of the educational content examination procedure is driven by an objective necessity. To begin with, the examination of educational publications is conducted regularly. After that, each year, approximately 1000 experts review over 400 printed educational publications and about 100 electronic educational publications. This upward trend in volume is pertinent due to the ongoing changes in education content, alignment with national values, and continuous enhancement of learning outcomes' quality [24].

Due to globalization in the field of education, it is obvious that the developed digital decision-making platform for the quality of educational content is designed to further expand and integrate with existing digital services in educational systems into a single educational digital eco-community.

By integrating with the existing electronic services of the educational system in Kazakhstan, DDMP is designed to have a positive impact on expanding the potential of the digital educational ecosystem, because it:

- allows for the development of valuable and timely decision-making, which is the most important in achieving any organization, including educational ones [39] [41]
- allows to implement such activities as collection, direction, preparation, examination, and other activities through the digitalization of business processes in educational systems and is a special expert system based on the knowledge that is used independently by a person or together with him to make decisions [42]
- allows improving the process of examination and assessment of the quality of educational content [43]
- can be integrated with the platforms of MOOC courses aimed at the implementation of lifelong learning, advanced training courses, online lessons, and courses for secondary and vocational education implemented by national educational online platforms and evaluate the quality of their content [9] [24] [44] [45] [46]
- allows the collection of analytical data to improve the effectiveness of training through the use of machine learning and data science methods [3] [44]
- towards standardization, open interfaces, and digital ecosystems, it will allow more smooth integration with other information systems, turning into a global education industry and contributing to the development of a global digital ecosystem [4]
- open digital educational platforms will allow for the involvement of key stakeholders in the process of internal improvement of the educational ecosystem: students, administrative staff, teachers, representatives of business structures, and employers [8] [45] [46]

Thus, the role of the developed DDMP in the development of a digital educational ecosystem that is managed by stakeholders is quite evident.

8 FUTURE WORK

As a result of this comprehensive study, there were identified ways to optimize the procedure for the examination of educational content through the development of a digital decision-making platform that allows to:

- develop and introduce a technology for selecting experts and monitoring the activities and evaluating the results of the work of experts, which allows, through the internal recording of the expert system, to observe the dynamics and provide support to real experts in the process of examination
- use qualitative and quantitative criteria for the examination of the quality of any educational publications, implementing the multi-criteria assessment
- conduct context-sensitive expertise
- implement interactive voting by experts
- save both material and time resources in the process of examination

Thus, the product developed by us provides an increase in the quality and speed of examination analytics.

This research is promising and will be developed in the future through:

- application of elements of artificial intelligence (AI) in evaluating the expertise of educational content
- ensuring the objectivity and confidentiality of information during the examination through the introduction of blockchain technology

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10 REFERENCES

[1] M. Fuster, *Education Fast Forward: Building a Future That Works for All*, OECD Publishing, 2022. Available: https://www.oecd.org/education/trends-shaping-education-22187049.htm. [Accessed: Jan. 25, 2023].

[2] CC2020 Task Force, *Computing Curricula 2020: Paradigms for Global Computing Education*, Association for Computing Machinery, New York, NY United States, 2020. https://doi.org/10.1145/3467967

[3] B. Williamson, “Making markets through digital platforms: Pearson, edu-business, and the (e)valuation of higher education,” *Critical Studies in Education*, vol. 62, no. 1, pp. 50–66, 2020. https://doi.org/10.1080/17508487.2020.1737556

[4] A. Chirumamilla and G. Sindre, “E-exams in norwegian higher education: Vendors and managers views on requirements in a digital ecosystem perspective,” *Computers & Education*, vol. 172, no. 104263, pp. 1–19, 2021. https://doi.org/10.1016/j.compedu.2021.104263

[5] K. Howells, *The Future of Education and Skills: Education 2030: The Future We Want*, OECD Publishing, 2018. Available: https://www.oecd.org/education/2030/E2030%20Position%20Paper%20(05.04.2018).pdf. [Accessed: Jan. 25, 2023].

[6] M. C. Johnson-Glenberg, C. Megowan-Romanowicz, D. A. Birchfield, and C. Savio-Ramos, "Effects of embodied learning and digital platform on the retention of physics content: Centripetal force," *Frontiers in Psychology*, vol. 7, no. 1819, pp. 1–22, 2016. https://doi.org/10.3389/fpsyg.2016.01819

[7] L. Harvey, "A history and critique of quality evaluation in the UK," *Quality Assurance in Education*, vol. 13, no. 4, pp. 263–276, 2005. https://doi.org/10.1108/09684880510700608

[8] M. A. Malik and S. Recker, "Analysis of dynamic resource allocation in digital education ecosystems," in *IEEE European Technology and Engineering Management Summit (E-TEMS)*, Bilbao, Spain, 2022, pp. 136–141. https://doi.org/10.1109/E-TEMS53558.2022.9944430

[9] Z. Wang and J. Liu, "A teaching quality evaluation system of massive open online courses based on big data analysis," *International Journal of Emerging Technologies in Learning*, vol. 14, no. 14, pp. 81–91, 2019. https://doi.org/10.3991/ijet.v14i14.10818

[10] L. N. Fewella, L. M. Khodeir, and A. H. Swidan, "Impact of integrated e-learning: Traditional approach to teaching engineering perspective courses," *International Journal of Engineering Pedagogy (iJEP)*, vol. 11, no. 2, pp. 82–101, 2021. https://doi.org/10.3991/ijep.v11i2.17777

[11] R. McGreal, "Special report on the role of open educational resources in supporting the sustainable development goal 4: Quality education challenges and opportunities," *The International Review of Research in Open and Distributed Learning*, vol. 18, no. 7, pp. 292–305, 2017. https://doi.org/10.19173/irrodl.v18i7.3541

[12] R. S. Jhangiani, F. N. Dastur, R. Le Grand, and K. Penner, "As good or better than commercial textbooks: Students' perceptions and outcomes from using open digital and open print textbooks," *The Canadian Journal for the Scholar-Ship of Teaching and Learning*, vol. 9, no. 1, pp. 1–20, 2018. https://doi.org/10.5206/cjsotl-rcacea.2018.1.5

[13] S. Barteit, D. Guzek, A. Jahn, T. Bärnighausen, M. M. Jorge, and F. Neuhann, "Evaluation of e-learning for medical education in low-and middle-income countries: A systematic review," *Computers & Education*, vol. 145, no. 103726, pp. 1–18, 2020. https://doi.org/10.1016/j.compedu.2019.103726

[14] J. Khlaisang and P. Koraneekij, "Open online assessment management system platform and instrument to enhance the information, media, and ICT literacy skills of 21st century learners," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 14, no. 7, pp. 111–127, 2019. https://doi.org/10.3991/ijet.v14i07.9953

[15] K. H. Lau, T. Lam, B. H. Kam, M. Nkhoma, J. Richardson, and S. Thomas, "The role of textbook learning resources in e-learning: A taxonomic study," *Computers & Education*, vol. 118, no. 10–24, 2018. https://doi.org/10.1016/j.compedu.2017.11.005

[16] N. B. Colvard, C. E. Watson, and H. Park, "The impact of open educational resources on various student success metrics," *International Journal of Teaching and Learning in Higher Education*, vol. 30, no. 2, pp. 262–276, 2018. https://www.isetl.org/ijtlhe/pdf/ijtlhe3386.pdf

[17] M. A. Almaiah and I. Y. Alyoussef, "Analysis of the effect of course design, course content support, course assessment and instructor characteristics on the actual use of e-learning system," *IEEE Access*, vol. 7, pp. 171907–171922, 2019. https://doi.org/10.1109/ACCESS.2019.2956349

[18] M. Giatman, S. Siswati, and I. Y. Basri, "Online learning quality control in the pandemic Covid-19 era in Indonesia," *Journal of Nonformal Education*, vol. 6, no. 2, pp. 168–175, 2020. https://journal.unnes.ac.id/nju/index.php/jne/article/view/25594

[19] R. Uygarer and H. Uzunboylu, "An investigation of the digital teaching book compared to traditional books in distance education of teacher education programs," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 13, no. 8, pp. 5365–5377, 2017. https://doi.org/10.12973/eurasia.2017.00830a

[20] L. Fan, J. Cheng, S. Xie, J. Luo, Y. Wang, and Y. Sun, "Are textbooks facilitators or barriers for teachers' teaching and instructional change? An investigation of secondary mathematics teachers in Shanghai, China," *ZDM–Mathematics Education*, vol. 53, pp. 1313–1330, 2021. https://doi.org/10.1007/s11858-021-01306-6

[21] T. Oates, "Why textbooks count," A Policy Paper, 10. 2014. Available: https://www.cambridgeassessment.org.uk/Images/181744-why-textbooks-count-tim-oates.pdf. [Accessed: Jan. 25, 2023].

[22] P. Mishra and M. Koehler, "Technological pedagogical content knowledge: A framework for teacher knowledge," *Teachers College Record*, vol. 108, no. 6, pp. 1017–1054, 2006. https://doi.org/10.1111/j.1467-9620.2006.00684.x

[23] D. Vlachopoulos and A. Makri, "Quality teaching in online higher education: The perspectives of 250 online tutors on technology and pedagogy," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 16, no. 6, pp. 40–56, 2021. https://doi.org/10.3991/ijet.v16i06.20173

[24] "The concept of development of preschool, secondary, technical and vocational education of the republic of Kazakhstan for 2023–2029," Decree of the Government of the Republic of Kazakhstan Dated March 28, no. 249, 2023. Available: https://adilet.zan.kz/rus/docs/P2300000249#z80. [Accessed: Jan. 25, 2023].

[25] "TALIS-The OECD teaching and learning international survey." Available: https://www.oecd.org/education/talis/. [Accessed: Jan. 25, 2023].

[26] E. Martínez-Caro, J. G. Cegarra-Navarro, and G. Cepeda-Carrión, "An application of the performance-evaluation model for e-learning quality in higher education," *Total Quality Management & Business Excellence*, vol. 26, no. 5–6, pp. 632–647, 2015. https://doi.org/10.1080/14783363.2013.867607

[27] Z. Sucháňová and M. Vlčková, "Criteria for selecting an English language coursebook: A meta-analytic review of evaluative checklists," in *Proceedings of 13th annual International Conference of Education, Research and Innovation, (ICERI2020)*, Trnava, Slovakia, 2020, pp. 3373–3382. https://doi.org/10.21125/iceri.2020.0763

[28] Z. Nemrawi, M. A. Musa, and Y. Jaradat, "The evaluation of mathematics textbooks from the perspective of mathematics teachers in Jordan," *Information Sciences Letters*, vol. 11, no. 5, pp. 1427–1433, 2022. https://digitalcommons.aaru.edu.jo/isl/vol11/iss5/11

[29] N. Dassanayake, "Development of an evaluation checklist for localized Chinese language textbooks in Sri Lanka," *Lingua Cultura*, vol. 16, no. 2, pp. 257–269, 2022. https://doi.org/10.21512/lc.v16i2.8778

[30] H. Shi, "A metaphor analysis of EFL graduate students' beliefs about an EAP textbook," *Frontiers in Education*, vol. 7, pp. 1–10, 2022. https://doi.org/10.3389/feduc.2022.972996

[31] Y. Jiang, "Evaluation of pedagogical impact of business English text-books on teaching critical thinking skills," *Heliyon*, vol. 8, no. 11, pp. 1–8, 2022. https://doi.org/10.1016/j.heliyon.2022.e11419

[32] I. Savard, J. Bourdeau, and G. Paquette, "Considering cultural variables in the instructional design process: A knowledge-based advisor system," *Computers & Education*, vol. 145, p. 103722, 2020. https://doi.org/10.1016/j.compedu.2019.103722

[33] A. A. Drozdova and A. I. Guseva, "Modern technologies of e-learning and its evaluation of efficiency," *Procedia – Social and Behavioral Sciences*, vol. 237, pp. 1032–1038, 2017. https://doi.org/10.1016/j.sbspro.2017.02.147

[34] A. Guraliuk, I. Varava, S. Holovko, L. Shapenko, and V. Oleshchenko, "Expert assessment of the quality of remote educational resources," *International Journal of Engineering Pedagogy (iJEP)*, vol. 13, no. 1, pp. 34–44, 2023. https://doi.org/10.3991/ijep.v13i1.36121

[35] M. Mohammadi and H. Abdi, "Textbook evaluation: A case study," *Procedia – Social and Behavioral Sciences*, vol. 98, pp. 1148–1155, 2014. https://doi.org/10.1016/j.sbspro.2014.03.528

[36] A. Ahmadi and A. Derakhshan, "EFL teachers' perceptions towards textbook evaluation," *Theory and Practice in Language Studies*, vol. 6, no. 2, pp. 260–267, 2016. https://doi.org/10.17507/tpls.0602.06

[37] M. C. S. Fuster, "Necesidades formativas en evaluación de materiales didácticos: Percepciones de los maestros," *Revista Interuniversitaria de For-Mación del Profesorado. Continuación de la antigua Revista de Escuelas Nor-males,* vol. 97, no. 36.3, pp. 231–246, 2022. https://doi.org/10.47553/rifop.v97i36.3.91636

[38] S. K. Cheung, K. S. Yuen, K. C. Li, E. Y. Tsang, and A. Wong, "Open text-books: Engaging education stakeholders to share learning resources," *International Journal of Services and Standards*, vol. 10, no. 4, pp. 225–239, 2015. https://doi.org/10.1504/IJSS.2015.072433

[39] K. A. Fakeeh, "Decision support system (DSS) in higher education system," *International Journal of Applied Information System (IJAIS)*, vol. 9, no. 2, pp. 32–40, 2015. https://doi.org/10.5120/ijais15-451366

[40] L. A. Elvey and W. T. Colon, "Expert systems: A review and discussion of marketing applications," in *Proceedings of the 1989 Academy of Marketing Science (AMS) Annual Conference*. Developments in Marketing Science: Proceedings of the Academy of Marketing Science, Springer, Cham, 2015, pp. 654–658. https://doi.org/10.1007/978-3-319-17055-8_133

[41] J. Manar, B. Mouna, A. M. Naima, H. Samy, S. Zineb, and B. O. Mohammed, "Evaluation of the decision support systems," *Journal of Communication and Computer*, vol. 14, no. 3, pp. 129-136, 2017. https://doi.org/10.17265/1548-7709/2017.03.004

[42] K. Xie, M. K. Kim, S. L. Cheng, and N. C. Luthy, "Teacher professional development through digital content evaluation," *Educational Technology Research and Development*, vol. 65, pp. 1067–1103, 2017. https://doi.org/10.1007/s11423-017-9519-0

[43] N. Huang, "Analysis and design of university teaching evaluation system based on JSP platform," *International Journal of Education & Management Engineering*, vol. 7, no. 3, pp. 43–50, 2017. https://doi.org/10.5815/ijeme.2017.03.05

[44] S. Assami, N. Daoudi, and R. Ajhoun, "Implementation of a machine learning-based MOOC recommender system using learner motivation prediction," *International Journal of Engineering Pedagogy (iJEP)*, vol. 12, no. 5, pp. 68–85, 2022. https://doi.org/10.3991/ijep.v12i5.30523

[45] N. Thanachawengsakul and P. Wannapiroon, "Development of a learning ecosystem using digital knowledge engineering through MOOCs knowledge repository system," *International Journal of Engineering Pedagogy (iJEP)*, vol. 11, no. 1, pp. 35–48, 2022. https://doi.org/10.3991/ijep.v11i1.15011

[46] D. Gamage, I. Perera, and S. Fernando, "MOOCs lack interactivity and collaborativeness: Evaluating MOOC platforms," *International Journal of Engineering Pedagogy (iJEP)*, vol. 10, no. 2, pp. 94–111, 2020. https://doi.org/10.3991/ijep.v10i2.11886

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