OER-Enabled Pedagogy with Multipurpose Digital LMS-Quiz-Activities for Mathematics

Ana Donevska-Todorova
HTW Berlin, University of Applied Sciences, Treskowallee 8, 10318 Berlin, Germany

Keywords: Instructional Design, Educational Content Creation, next Generation Teaching and Learning Environments, Feedback and Learning Support, Self-Regulated Learning, Synchronous and Asynchronous Learning, Mathematics, Abstract Algebra, Linear Algebra, Task and Item Generation, Quiz, Learning Management Systems (LMS), Dynamic Geometry Software (DGS), OER, OEP, OER-Enabled Pedagogy.

Abstract: On the boundaries between manual, adaptive and intelligent generation of e-quiz-tasks, this paper tackles their didactical potentials and encounters for open teaching and learning of undergraduate mathematics. The most flexible and personalized domain-specific learning content offering instantaneous assistive feedback is desirable, yet not easy to be provided with or without the use of Artificial Intelligence (AI). Today's "learners on the go" seek fast and granulated learning content. However, overproduction may lead to a quantity of drill-and-practice exercises that may be beneficial for procedural fluency, yet not enough to secure *conceptual understanding in mathematics* and the development of *21st century skills.* Therefore, based on *four theoretically defined criteria for OER-Enabled Pedagogy* according to Wiley & Hilton Iii (2018), this paper suggests *small scale open resources* combining Learning Management Systems (LMS) and Dynamic Geometry Software (DGS). Their *(1) added value* is seen in the *multi purposes* of LMS-Moodle-Quiz-Activities going beyond the commonly-accepted summative assessment: (i) self-regulated learning through instantaneous feedback, (ii) collaboration, (iii) creativity, and (iv) procedural and conceptual understanding in mathematics. The possible *(2) application, revision, remix, or re-creation of the OER* is discussed through illustrative examples in Abstract and Linear Algebra. The paper finalizes with outlying the *(3) share-ability of the resources publicly*, and their *(4) open-licencing.*

1 INTRODUCTION

The phrase "human-computer interaction" which refers mainly to instructors as creators of learning materials with the aid of technology and students as consumers of those productions, might sound somewhat outdated. The reality moves slowly, but surely towards a modern catchy name "human-AI tandem", unfolding the distribution of equivalent engagement of all parties: instructors, learners and technologies in instruction design and its consumption. If the technologies have become sophisticated enough to be able to 'feed' themselves with existing content and generate new, then it is instructors' responsibility to check their quality, promote critical thinking and provide a learning atmosphere for creative externalizations of thoughts and emotions. Yet, until technologies reach that level of intelligence, today's modest digital systems may undertake duties such as providing immediate personal feedback to learners and, with that, significantly unload the timely capacities of instructors. Creation of comprehensive, modular courses that accustom them to different learners' individual wants, styles, learning rhythm, and performance seem possible with the use of adaptive elements in Learning Management Systems (LMS). Although literature for Automatic Question Generation (AQG) was considered (e.g. Le, Kojiri, and Pinkwart, 2014) the aim of this work is not to discuss a machine-generation of questions. It is rather the consideration of didactical aspects that enable educators to re-use or remix existing quiz-tasks or create their own tasks and share them with others. Therefore, the paper considers theoretically grounded Open Educational Resources (OER) objectives and areas of actions (UNESCO, 2019) having in mind the 5R (reuse, redistribute, revise, remix and retain, according to Wiley, 2013). It also deliberates challenges when creating and applying OER,

Donevska-Todorova, A.
OER-Enabled Pedagogy with Multipurpose Digital LMS-Quiz-Activities for Mathematics.
DOI: 10.5220/0012689700003693

In *Proceedings of the 16th International Conference on Computer Supported Education (CSEDU 2024) - Volume 1*, pages 454-461
ISBN: 978-989-758-697-2; ISSN: 2184-5026

especially when learners face difficulties in self-regulation and adaptation to OEP (Open Educational Practices)-structured courses (Huang, et al., 2020). The paper continues with criteria that enable OER-Pedagogy for self-regulation, creativity, collaboration and gaining specific competences in mathematics.

2 OER-ENABLED PEDAGOGY

Initiatives about open, flexible, and distance learning (OFDL) originate in relation to the ideas about open universities at the middle of the 20th century, but have significantly changed since the COVID-19 pandemic (Naidu, 2023). According to Wiley & Hilton Iii (2018), *OER-Enabled Pedagogy* can be determined by *four criteria: (1) added value of the resources beyond its value for the author, (2) possible application, revision, remix, or re-creation of the resources, (3) share-ability of the resources publicly, (4) open-licencing for the resources* (Wiley & Hilton Iii, 2018, p. 137).

The added value of the developed *OER on small scale* (Weller, 2010) in this work that goes beyond the value of its author (the first author of this text) is seen as the following.

LMS-Quiz-Activities for developing 21st century skills and learning purposes:

i. Self-regulated learning through automated feedback
ii. Collaboration
iii. Creativity
iv. Procedural and Conceptual Understanding in Mathematics

The paper begins with explaining each of these values meeting the first criterion for OER-Enabled Pedagogy (Wiley & Hilton Iii, 2018). It then continues with discussions about each of the other three criteria for OER-Enabled Pedagogy (Wiley & Hilton Iii, 2018).

3 ADDED VALUE. MULTIPURPOSE OF LMS-QUIZ-ACTIVITIES

More than three decades ago, Hativa (1988) pointed out that computer-based drill-and-practice in Arithmetic may widen the gap between high- and low-achieving elementary school learners due to technical errors. As technologies have evolved, the didactical benefits of CAI (Computer Assisted Instruction) have also altered. Valuable contributions have raised novel questions and brought different viewpoints into the international debates. For example, expert guidance and feedback are seen as key factors for the drive from self-initiated practice to coached deliberate practice in mathematics (Lehtinen, et al., 2017).

3.1 LMS-Quiz-Activities for Self-Regulated Learning Through Feedback

Current trends in higher education teaching depict a movement from standardized assessment to automatic formative assessment (AFA). For example, LMS-Moodle quizzes are seen to be usable for formative assessment in academic writing (Fernando, W., 2020). The use of LMS-Moodle plugin STACK (System for Teaching and Assessment using a Computer Algebra Kernel) in university mathematics assessment was already known much before the COVID pandemic (e.g. Mäkelä, Ali-Löytty, Humaloja, Joutsenlahti, Kauhanen, & Kaarakka, 2016; Sangwin, 2015). It seems that potentials of (digital) tasks for mathematics that were previously not well known were uncovered during and after the pandemic (Engelbrecht, Borba, & Kaiser, 2023). For example, production of numerous mathematics exercises with specific step-by-step feedback (Pulido-Rodríguez, López-Bautista, & Gutiérrez-Rodríguez, 2021) received much attention, not only in mathematics education, but also in science education, programming and other non-mathematical subjects.

Based on a repetitive randomized control experiment, some authors "have not been able to demonstrate a positive or negative effect of personalized feedback on the grade performance of the first year students" (Riezebos, N. Renting, R. van Ooijen, A.J. van der Vaart, 2023, p. 50). These authors have "made the choice to provide feedback based on the achievement of module learning objectives, not on the detailed level of the question itself" (Riezebos, N. Renting, R. van Ooijen, A.J. van der Vaart, 2023, p. 50). Therefore, the tasks generated in this work provide different types of feedback on task and item level, besides on competences. This point is illustrated with examples in Sub-section 4.1.1.

3.2 LMS-Quiz-Activities for Collaboration

Besides through interactions with resources, individual growth appears also through collaborative actions with peers. To facilitate cooperative actions, mathematical concepts that appear in the formulations of the Quiz-tasks can be directly linked

with their definitions in the *LMS-Moodle-Glossary-Activity*. Another possibility to meaningfully use the Glossary is to provide appropriate feedback. So, instead of stating the definition directly in the Feedback option, the Feedback is formulated first as a question and then linked to an appropriate concept definition in the Glossary. The terms in the Glossary can be offered by the instructor or suggested as a collaborative activity. That is to say, learners have an opportunity to enter new concept definitions in the Glossary and collaboratively upgrade their knowledge and support peers. Further explanations of how such a combination of tasks, and Feedback Options in Moodle Quiz activities and the Glossary may work follows through examples from Abstract Algebra in Sub-section 4.1.1.

3.3 LMS-Quiz-Activities for Creativity

Many of the default LMS-Moodle tasks ask learners to respond on quests by a single click with the mouse. To prevent passive learning and increase interactivity, a shift in the teaching-leaning perspective allowing students a role as designers was proposed by Damnik, Proske & Körndle (2017). The *LMS-Moodle-StudentQuiz-Activity* allows such alteration of roles and provides possibilities for learners to contribute their own quizzes, tasks, tasks- or feedback-items in the learning environment. This opportunity certainly opens questions about the quality of the resources (Trgalova, Donevska-Todorova, & Edson, 2023) that may be peer-reviewed, (dis)approved or revised by the instructor within the LMS-Moodle-Course. The LMS-Moodle-Statistics for this *StudentQuiz-Activity* provides *personal information* on the number of contributed and approved questions, rating average, number of given answers, percentage of corrected answers and personal progress. Further, the *StudentQuiz-Activity* affords *community statistics* about the number of all created and approved questions, community percentage of correct answers and average community progress. As building a LMS-Moodle-StudentQuiz may be overwhelming during a semester course, both the personal and community statistics may contribute to further development of the quiz by other groups of learners in other LMS-Moodle-Courses.

3.4 LMS-Quiz-Activities for Procedural and Conceptual Understanding in Mathematics

Active participation and interaction with dynamic mathematical objects like graphs of functions or geometric figures through connecting the LMS with external learning environments such as the DGS GeoGebra. By integrating GeoGebra files in LMS-Moodle-tasks, quizzes gain didactical quality due to possibilities for active engagement of learners. For example, incorporated DGS files into LMS-Moodle-tasks can enable transitions between different registers like, algebraic, geometric or abstract-structural registers of mathematical concepts in Linear Algebra. Thus, rather than focusing on knowledge acquisition, the OER embedding DGS and LMS in this work aim at stimulating switches between different modes of thinking about concepts like Vector spaces and their properties. Such an illustrative example is provided in subsection 4.1.3.

The next section elaborates the second criterion for OER-Pedagogy (Wiley & Hilton Iii, 2018).

4 APPLICATION, REVISION, REMIX, AND RECREATION OF LMS-QUIZ-ACTIVITIES

The modules Abstract and Linear Algebra are intensive on symbolic language use, formula-based routines, implementation of formal definitions, proofs of theorems and applications in real problems. All these characteristics make the creation of a digital domain-precise content for these modules not easy work for instructors. Moreover, the desired digital resources should foster development of the previously mentioned future skills like (i) self-regulation, (ii) collaboration, and (iii) creativity, besides the (iv) mathematical competences such as procedural and conceptual understanding in the specific subject-area of Algebra in OEP. Therefore, conceptualization of academic courses that significantly include created digital curricular resources seems to be of importance and the next subsection outlines possibilities for their practical implementation.

4.1 Application of LMS-Quiz-Activities

This paper suggests small scale (Weller, 2010) digitally-based learning materials that include LMS-Moodle-Activities like series of quizzes. They are based on Moodle-Question Banks that include non-STACK Moodle-tasks, such as curriculum-based Multiple True/False questions, MCQ, Drag-and-Drop tasks, Matching questions, and Numerical tasks with the necessary application of LaTeX for the

mathematical language and syntax and the CAS Maxima background. Further, for more complex tasks that consist of more sub-tasks, interactive Embedded answers (Cloze) Moodle-question type were developed. Such advance is enabled through a previously installed up-to-date Moodle Version 4.1 and appropriate plug-ins at the University of Applied Sciences HTW Berlin. The created prototypical LMS-Moodle-Course and the digital learning resources were offered to instructors at two departments at the university in the winter semester 2023/24.

The Moodle version used for the creation of the LMS Quiz Activities and the Question banks is 4.1, which has a user-friendly interface and provides barrier free elements such as superior optical appearance compared with the previous Moodle versions. The new navigation without the cogwheels, the fresh look in which hidden elements are not framed gray, but marked more conspicuously, providing increased contrasts and space contribute to improved possibilities for inclusion of all learners. The usage of the created Question banks and Quiz Activities does not require previous experience with HTML or XML or programming skills.

Figure 1 shows a Homepage of an exemplary OER-Moodle-Course in a development phase of selected themes in Set Theory, Logic, Number Theory, Abstract Algebra and Linear Algebra in introductory mathematics for bachelor study programs developing at the University for Applied Sciences HTW Berlin. Appropriate icons were selected and implemented to enable easy navigation and create a user-friendly interface for the course (Figure 1, left). For example, an icon presenting the ordering aspect of natural numbers or an icon with the number ten suggesting the number system with base 10 (Figure 1, left) aims to attract the learners' attention.

The created Moodle activities are characterized with a double randomization of the tasks within a quiz and of the answer-choices within MCQs, Drag-and-Drop or Matching tasks. That can be achieved by activating the function shuffle both when creating the quiz and each of the tasks. Each task has three attributed tags that enable easier search of the question bank: a mathematical concept, a question type and language (English or German).

Differentiated approaches for learners in heterogeneous groups or individual learners are facilitated through multiple attempts carefully guided by specific feedback items and hints in a Moodle-Quiz-Activity and through and Moodle-Student-Quiz-Activity (Figure 1, right).

4.1.1 LMS-Quiz-Activities for Self-Regulated Learning Through Feedback and Collaboration: An Example for Abstract Algebra

Questions within the quizzes are created to behave *interactively permitting multiple tries* within the quiz. This is advantageous compared to the *adaptive mode* or the *adaptive without penalties mode* because it allows feedback in addition to the possibility for multiple attempts. It is also more beneficial for learning compared to the *deferred feedback mode* for the reason that it displays the feedback messages directly after each answer submission rather than all of them once the whole quiz is completed. The created quizzes permit unlimited number of attempts enabling the option *each attempt builds on the last*. This consents learners on the different attempt to concentrate exclusively on those tasks that were answered erroneously on the prior attempt and rework the tasks in the same ordering, regardless of randomisation settings.

A Moodle-Quiz-Multiple-True/False-Task is posed about monoids and Abel semigroups (Figure 2). Students are asked to make decisions about the algebraic structure of the set of Natural numbers and the binary operations standard addition, i.e. multiplication.

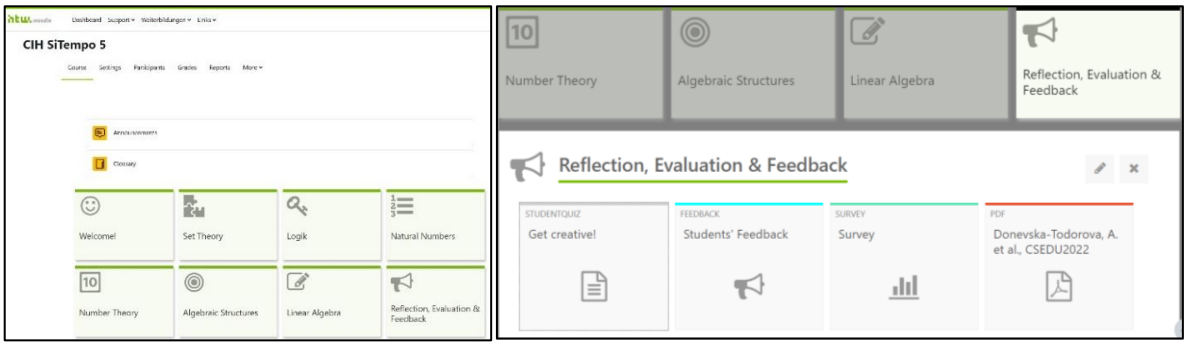

Figure 1: An exemplary OER-Moodle-Course for introductory university mathematics.

The *Correctness of the Answer Feedback (CF)* appears below the task (the orange area on Figure 2). It is presented with a red colour, because the entered answer is incorrect (Figure 2). The *subject-specific Feedback* of such an incorrect solution is presented in the form of a question on each task item (on the right side of Figure 2 with a yellow colour). The feedback items refer to mathematical concepts that are underlined and connected with their appropriate definitions in the Moodle-Glossary-Activity (Figure 3). The underlying colouring, changing fonts into bold or italic is a task-design-matter aiming to attract the attention of the learner so that the term may be clicked, and guidance is provided. The Glossary is organized alphabetically and can be searched by terms (Figure 3). Bearing in mind the suggested definition, learners can resolve the given task in the next attempt correctly. If so, they are shown the *Correctness of the Answer Feedback (CF)* again. This time the answer is "Correct" and the CF is presented with a green instead of red colour together with the scored points.

4.1.2 LMS-Quiz-Activities for Creativity

As previously discussed, LMS-Quiz-Activities may offer a way to design and share personally created tasks or items. A LMS-Moodle-StudentQuiz-Activity called "Get Creative!" is suggested within the OER LMS-Moodle-Course (Figure 1, right, above in Section 4.1). It can be easily accessed and appears in the second layer of the Moodle-Course-Tiles.

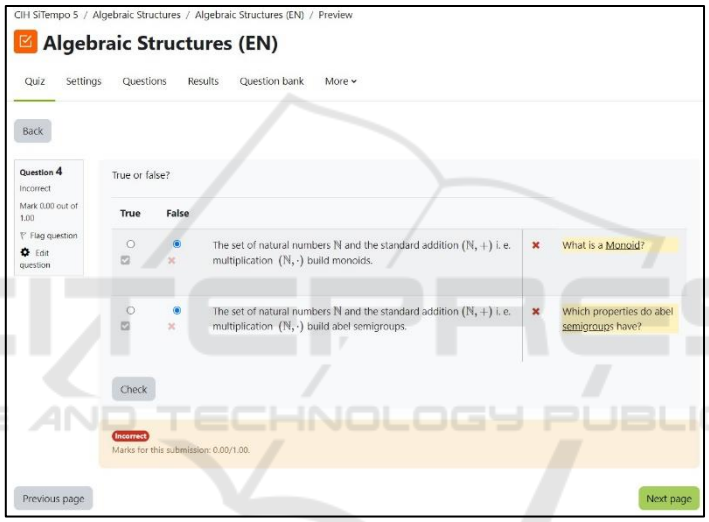

Figure 2: Subject-specific feedback to an incorrect answer of a Moodle-Quiz-Multiple True/False-Task appearing in a form of a question (yellow area).

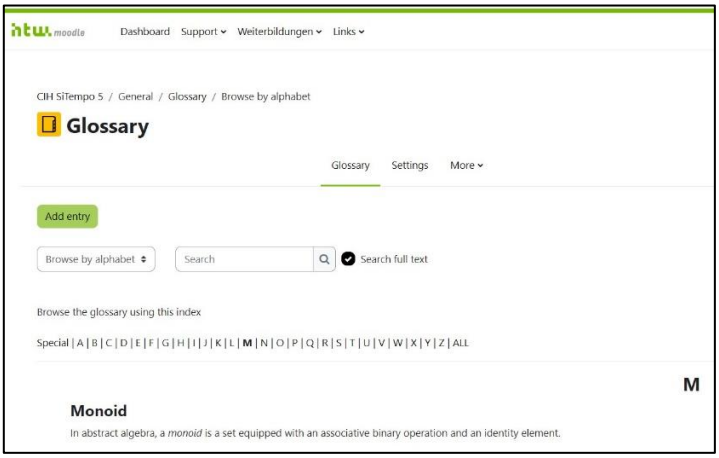

Figure 3: Collaboratively defining mathematical concepts in the Moodle-Course-Glossary, linking and using tasks or feedback items.

4.1.3 LMS-Quiz-Activities for Procedural and Conceptual Understanding in Mathematics

It is often the case that the formulation of a mathematical task requires a content-related visualisation, e.g. a geometric figure, a diagram, or a graph of a function. Implementation of such images is possible in a Cloze type of Moodle-tasks. For example, a Moodle Embedded answers (Cloze) type of task consisting of three sub-tasks is shown in Figure 4. It contains three Matching questions and two Numerical questions for fostering learners' competences in Linear Algebra (Donevska-Todorova, 2018) (Figure 4). The first sub-task is about the definition of the Euclidean vector space and the standard operation of vector addition and scalar multiplication. After exploring the dynamic visualization with algebraic and geometric interactive elements in a GeoGebra file that is linked to the Moodle-Cloze type of task, students are expected to provide a correct answer on Task 2a) that changing the order of any three vectors does not influence their sum (Figure 4). However, a common mistake is considering an operation to be commutative if it is associative. Therefore, this is explicitly formulated as a statement in sub-task 2b) (Figure 4) which is to be confirmed as true if rejected as a false one. By selecting "True", which is an incorrect answer, feedback (in orange colour in Figure 4) will appear immediately after the answers are submitted. The sub-task 3 is about the dot product of orthogonal vectors.

A second Cloze type of Moodle-task, consisting of three sub-tasks is presented in Figure 5. The first sub-task extends the concept of dot product to arbitrary vectors in the Euclidian *3D* vector space. The second sub-task is about orthogonality of specific and arbitrary vectors. The third sub-task is related to linear independence of vectors, base, span of a vector space and subspace (Figure 5).

4.2 Revision, Remix and Recreation of the Resources

Currently, tasks and quizzes in the LMS Moodle are generated and edited through a web-based HTML editor, exclusively possible via the internet. Discontentment may appear due to the fact that all information about an entire quiz cannot be visible as a whole, but in a separate webpage for each task and the dissatisfaction may grow when managing graphics (Hendrickson & Guerquin-Kern, 2016). Hendrickson & Guerquin-Kern (2016) suggest automatic generation of different types of LMS-Moodle-Questions including Cloze Questions, by using special moodle packages via LaTeX. Other authors propose developing Web applications for easily creating quizzes involving Cloze format questions in PHP where Moodle is also written such as Ajax (Asynchronous JavaScript + XML) as a graphical user interface (GUI) technique that easily performs quiz editing (Yuuichi, et al., 2006). Bachiri & Mouncif, 2023) offer an AI system in aid of pedagogical engineering for knowledge assessment on MOOC platforms: open EdX and Moodle. The time-consuming task revision and re-creation by typing LaTeX mathematical formulas in LMS can become easier and faster with the aid of generative AI

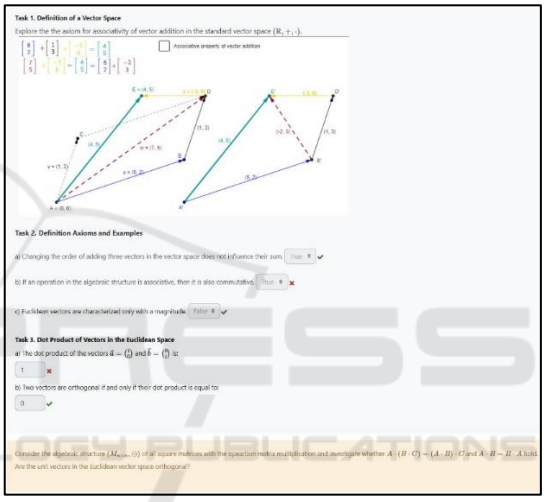

Figure 4: LMS-Moodle-Cloze-Task about Vector Space Definition with an integrated DGS File with algebraic, geometric and axiomatic elements.

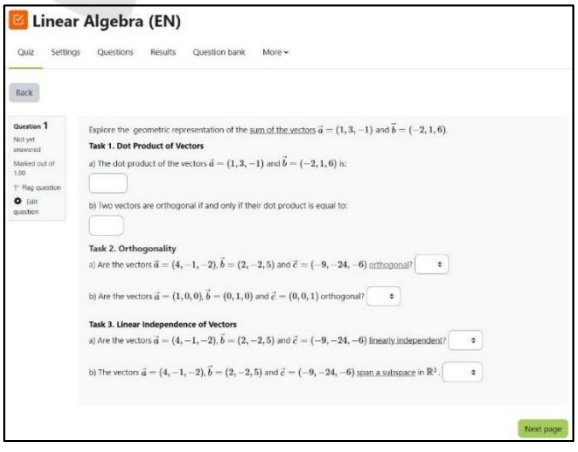

Figure 5: LMS-Moodle-Cloze-Task about Linear Algebra Concepts: Dot Product of Vectors, Orthogonality and Linear Independence of Vectors.

converting scans of already written formulas into the LaTeX syntax. Such transformation that emerging technologies propose may empower instructors and contribute to increasing the sustainability of OER. Finally, modernizing mathematics curricula that will allow sought flexibility and personal adjustments according to context and settings through cooperative development by different stakeholders may contribute to easier scale and sustainability.

5 SHARE-ABILITY OF THE RESOURCES PUBLICLY

The third criterion for *OER-Enabled Pedagogy* according to Wiley & Hilton Iii (2018), as given in Section 2, is the possibility for sharing resources with others. The aim of the share-ability is that the created resources become reusable in new contexts and settings or become a source of renewal and upgrade. The suggested curricular OER in this paper are available in English and German, which can facilitate easier dissemination. They are visible via the link: https://moodle.htw-berlin.de/course/view.php?id=38124 using the password: MatheWin24. Exporting and importing them into other Moodle courses is possible by the use of the Moodle-XML-format or in another non-Moodle application in the XHTML-format. Both file formats allow exporting and importing of all questions in the question bank and its categories.

6 OPEN-LICENCING

A come back to the criteria for *OER-Enabled Pedagogy* (Wiley & Hilton Iii, 2018), leads to the last, but not least one, licencing.

Instructors and learners who "donate" their artefacts to OER are considered to be authors and copyright holders. If they wish, they may licence the products that they have created under a specific CC License. To secure the quality of open resources, a Creative-Commons (CC) Licence can be used.

7 CONCLUSIONS

Based on *four theoretically defined criteria for OER-Enabled Pedagogy* (Wiley & Hilton Iii, 2018), this paper considers multiple purposes for developing, implementing and sharing LMS-Quiz-Activities beyond summative assessment. Although *limitations* refer to the current regulated accessibility for university-external users of the resources, four prospects can be outlined. Firstly, *(1) an added value of the proposed OER* is seen in their potential to foster improvement of skills such as *self-regulated learning, collaboration,* and *creativity,* in addition to *subject-related competences in mathematics* (discussed in Section 3). Secondly, a possible *(2) implementation of the created OER* in the light of these added values is envisioned and exemplified through a Moodle-Quiz-Multiple-True/False-Task about Algebraic Structures and two Moodle-Quiz-Embedded-Answers (Cloze)-Tasks about Linear Algebra (Sub-section 4.1). *Revision, recreation and small scale of the OER,* is possible by the use of the widely spread compatible tools (Edit and Duplicate options in LMS-Moodle) and, moreover with the aid of advanced software and techniques, as described in Sub-section 4.2. Thirdly, the created *(3) OER are shared and made publicly available* through a direct link to the LMS-Moodle-Course (Section 5). Finally, the offered *OER can be licensed* (Section 6) which opens gates for further work.

ACKNOWLEDGMENTS

The work presented in this paper is part of the project Curriculum Innovation Hub at the HTW Berlin - University of Applied Sciences and financed by the "Stiftung Innovation in der Hochschullehre".

The Author thanks all anonymous reviewers for their valuable comments contributing to the improvement of the article.

REFERENCES

Bachiri, Y. A., & Mouncif, H. (2023). Artificial intelligence system in aid of pedagogical engineering for knowledge assessment on MOOC platforms: open EdX and moodle. *International Journal of Emerging Technologies in Learning (Online), 18*(5), pp. 144-160.

Damnik, G., Proske, A. & Körndle, H. (2017). Designing a constructive learning activity with interactive elements: the effects of perspective-shifting and the quality of source material, Interactive Learning Environments, 25:5, 634-649, DOI: 10.1080/10494820.2016.1172239.

Donevska-Todorova, A. (2018). Fostering students' competencies in linear algebra with digital resources. Challenges and strategies in teaching linear algebra, 261-276.

Engelbrecht, J., Borba, M. C., & Kaiser, G. (2023). Will we ever teach mathematics again in the way we used to

before the pandemic?. *ZDM–Mathematics Education*, *55*(1), 1-16.

Fernando, W. (2020). Moodle quizzes and their usability for formative assessment of academic writing. *Assessing Writing*, *46*, 100485. https://doi.org/10.1016/j.asw.2020.100485.

Hativa, N. (1988). Computer-Based Drill and Practice in Arithmetic: Widening the Gap between High- and Low-Achieving Students. *American Educational Research Journal*, *25*(3), 366–397. https://doi.org/10.2307/1163169

Hendrickson, A., & Guerquin-Kern, M. (2016). The moodle package: generating Moodle quizzes via LaTeX. *Recuperado de https://www. ctan. org/pkg/moodle Hendrickson, A*, 654-667.

Huang, R., Liu, D., Tlili, A., Knyazeva, S., Chang, T. W., Zhang, X., Burgos, D., Jemni, M., Zhang, M., Zhuang, R., & Holotescu, C. (2020). Guidance on Open Educational Practices during School Closures: Utilizing OER under COVID-19 Pandemic in line with UNESCO OER Recommendation. Beijing: Smart Learning Institute of Beijing Normal University.

Le, N.-T., Kojiri, T. and Pinkwart, N. (2014). Automatic question generation for educational applications–the state of art, in Advanced computational methods for knowledge engineering. Springer, pp. 325–338. https://doi.org/10.1007/978-3-319-06569-4_24

Lehtinen, E., Hannula-Sormunen, M., McMullen, J. et al. (2017). Cultivating mathematical skills: from drill-and-practice to deliberate practice. *ZDM Mathematics Education 49*, 625–636. https://doi.org/10.1007/s11858-017-0856-6

Mäkelä, A. M., Ali-Löytty, S., Humaloja, J. P., Joutsenlahti, J., Kauhanen, J., & Kaarakka, T. (2016). STACK assignments in university mathematics education. In *ANNUAL CONFERENCE OF THE EUROPEAN SOCIETY FOR ENGINEERING EDUCATION*. European Society for Engineering Education SEFI.

Naidu, S. (2023). From open access to open science—Open education in transition, *Distance Education, 44:*4, 599-603, DOI: 10.1080/01587919.2023.2278218

Trgalova, J., Donevska-Todorova, A., & Edson, A. J. (2023). Evaluation of Digital Resources: The "How" and "What for". In B. Pepin, G. Gueudet & J. Choppin (Eds.), *Handbook of Digital Resources in Mathematics Education* (pp. 1-28). Cham, Suisse: Springer. doi:https://doi.org/10.1007/978-3-030-95060-6_45-1

Pulido-Rodríguez, G., López-Bautista, R., & Gutiérrez-Rodríguez, I. (2021). Python, Stack and Moodle: Programming and production of thousands of math exam exercises with specific step-by-step feedback. In *ICERI2021 Proceedings* (pp. 3454-3462). IATED.

Riezebos, J., Renting, N., van Ooijen, R., & van der Vaart, A. J. (2023). Adverse effects of personalized automated feedback. In *9th International Conference on Higher Education Advances, HEAd 2023* (pp. 45-50). Universidad Politecnica de Valencia. http://dx.doi.org/10.4995/HEAd23.2023.16195

Sangwin, C. (2015, July). Computer aided assessment of mathematics using STACK. In *Selected regular lectures from the 12th international congress on mathematical education* (pp. 695-713). Cham: Springer International Publishing.

UNESCO (2019). Recommendations on Open Educational Resources (OER). Retrieved [on 18.03.2024] from: https://unesdoc.unesco.org/ark:/48223/pf0000373755/PDF/373755eng.pdf.multi.page=3

Wiley, D. (2013). What is open pedagogy? Retrieved from https://opencontent.org/blog/ archives/2975.

Wiley, D., & Hilton Iii, J. L. (2018). Defining OER-enabled pedagogy. *The International Review of Research in Open and Distributed Learning*, *19*(4).

Weller, Martin (2010). Big and Little OER. In *Open Ed 2010 Proceedings*. Barcelona: UOC, OU, BYU. [Accessed: 15/01/2024].

https://openaccess.uoc.edu/handle/10609/4851

Yuuichi, S., Toshihiro, K., Seisuke, Y., & Hiroshi, N. (2006, July). Web-based rapid authoring tool for LMS quiz creation. In *2006 7th International Conference on Information Technology Based Higher Education and Training* (pp. 617-620). IEEE.