

# K-DAD a Platform for Cooperative Learning in Primary Schools

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**Abstract:** In Cooperative Learning (CL), students work together in small groups to achieve shared learning goals. Several studies have proved that CL promotes active learning, social skills development, inclusion, and well-being in the classroom. Technology can support CL-based interventions, providing different tools to increase learners' participation and communication. However, few studies investigated the use of technology-based CL in lower schools. We present a new digital platform, *K-DAD*, to support CL strategies in Italian primary and lower secondary schools. To develop *K-DAD*, we used the learning management system Moodle, customizing appearance, interactions, and content architecture to provide a child-friendly e-learning environment. In the platform, several CL activities and tasks were structured to promote environmental awareness as well as diversity, equity, and inclusion. A prototype has been developed and further experimental investigations are needed to estimate the usability and effectiveness of the *K-DAD* platform.

## 1 INTRODUCTION

Cooperative Learning (CL) is an educational strategy in which small groups of students cooperate to accomplish shared learning goals to enhance their and each other's learning (Johnson and Johnson, 1990). Although there are different techniques of CL, all are characterized by five core properties: 1) *positive interdependence*: success or failure of the group depends on each group member; 2) *individual accountability*: each group member is responsible for achieving the final goal; 3) *promotive interaction*: encourage positive collaboration and mutual support; 4) *social skills*: communication, decision making, problem-solving, and handling of conflicts; 5) and *group processing*: monitoring and assessing of group processes (Gillies, 2016). The extant literature demonstrates that CL improves individual academic outcomes (Yeh and Fu, 2014; Yusuf et al., 2019), supports social (Veldman et al., 2020), emotional (Fernandez-Perez and Martin-Rojas, 2022; Han and Son, 2020), and critical thinking skills (Erdogan, 2019) development, facilitates the involvement of the students (Tran, 2019), and promotes inclusion and well-being in the classroom (Klang et al., 2020;

Van Ryzin and Roseth, 2019; Völlinger and Supanc, 2020).

Johnson and Johnson (2014) discussed the primary role of digital technologies in supporting CL strategies, especially in communication and cooperative learning activities. The combined use of properly designed technologies and CL promotes student-centered learning in which the learners are actively part of their learning process, whereas the instructor acts as a facilitator (Silalahi and Hutauruk, 2020; Bodsworth and Goodyear, 2017). According to Wang and Wu (2022), digital technologies change the traditional learning environment into a CL environment by providing new tools to increase learners' participation. Furthermore, they may support teachers in creating groups in a more structured way (Jacobs and Ivone, 2020) as well as easily monitor and assess the contributions and actions of each group member (Nam, 2014).

Several studies (Silalahi and Hutauruk, 2020; Aghajani and Adloo, 2018; Wang and Wu, 2022; Sarif and Maknun, 2022) investigated the efficacy and effectiveness of implementing online CL interventions. This specific aspect became especially important during the COVID-19 pandemic. Møgelvang et al. (2023) studied the effects of a digital CL intervention in a cohort of undergraduate Norwegian students. The CL-based intervention was organized so

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that the students' groups met twice a week for five weeks in Zoom meetings. The results pointed out significant increments in the psychological measures of sense of belonging and perceived generic skills. In another study (Sugino, 2021), the impact of online CL on students' participation using the system of virtual classroom Google Workspace for Education was explored. In particular, chat, pools, and video-meeting were used to organize group interactions and discussions. Overall, high levels of participation and cooperation were measured.

In addition to online CL, several studies (Bosch et al., 2019, 2020; Sukmawati et al., 2020; Bosch and Laubscher, 2019; Yang et al., 2021; Yapici, 2016) have shown how CL can be applied in a blended learning environment to improve learning outcomes. For instance, Yapici (2016) assessed the effectiveness of blended CL in teaching biology. In this study, different cooperative activities (quizzes, glossaries, and drag-and-drop activities), in a Moodle-based learning management system (LMS) were developed. The findings suggest that blended CL increases the students' classroom community and academic achievements.

Nevertheless, the educational, social, and technological aspects need to be planned and defined clearly for achieving effectiveness in a technology-based CL intervention (Wang and Wu, 2022). For what concerns the educational and social aspects, several guidelines (Johnson et al., 1994; Johnson and Johnson, 1990; Gillies, 2016) were developed to help instructors to implement and organize CL activities and promote positive interactions and communication. Yet, a smaller number of studies (among them, notably Nilakusmawati et al., 2021; Bodnenko et al., 2020; Zhou and Lewis, 2021) provide detailed indications of technological tools suitable for CL. Therefore, there is high heterogeneity in computer applications employed (e.g., web-based applications, LMSs, social networks, apps, and games) (Jacobs and Ivone, 2020; Silalahi and Hutaaruk, 2020). In addition, most studies in technology-based CL have involved university or high school students; yet, the usability, design, and content management of many applications are not well-suited for teachers and pupils in primary and lower secondary schools (Bodsworth and Goodyear, 2017).

Based on this background, this paper presents a new platform, *K-DAD*, meant to support and facilitate CL in primary and lower secondary schools. *K-DAD* is specifically designed to enhance cooperation among pupils, promote social skills development, engage pupils in educational activities, and facilitate learning of specific didactic content. The educational

objectives of *K-DAD* are to improve knowledge and awareness of environmental and inclusion issues. To achieve these goals, we have developed several activities, such as educational games, wikis, glossaries, and concept maps, that are aligned with CL strategies. Moodle 4.0 was used as LMS to develop the first release of the platform. The remaining part of the paper is organized as follows: Section 2 provides an overview of the platform, illustrating the design phases; Section 3 discusses research questions, hypotheses, and future directions.

## 2 METHODOLOGY

The design involved a multidisciplinary expert team to evaluate how to implement several CL-based digital activities in the platform, assess users' requirements as well as technological aspects. The team adopted a cyclic process for the design and development phases, organizing periodic meetings to discuss, review and program each advance.

Following previous studies (Yapici, 2016; Sulisworo et al., 2016; Nilakusmawati et al., 2021), we adopted as a technological solution the LMS Moodle, version 4.0. Moodle is one of the most popular open-source LMS to support e-learning, assist traditional face-to-face learning, and implement specific teaching-learning strategies (Gamage et al., 2022). It also supports the creation, sharing, and management of educational content, the interaction among pupils and between the teacher and the pupils, monitoring and assessment of pupils by the teacher, and especially the development of personalized e-learning environments (Ziraba et al., 2020).

### 2.1 The *K-DAD* Platform

The *K-DAD* platform is a CL-based platform targeting Italian pupils of primary (fourth and fifth grade) and lower secondary school (sixth and seventh grade). The *K-DAD*'s goals are to enhance pupils' social and soft skills training, and promote inclusion in the classroom via technology-based CL.

To design the platform, we analyzed macro- and micro-interactions of users within the basic theme of Moodle to ameliorate usability issues and other issues to make *K-DAD* more attractive for pupils in primary and secondary schools. In line with previous studies (Hasan, 2019; Suárez et al., 2022; Mkpojiogu et al., 2018), the analysis emphasized the necessity to modify and customize several user interface elements, such as the graphical style, interactions, and content architecture.

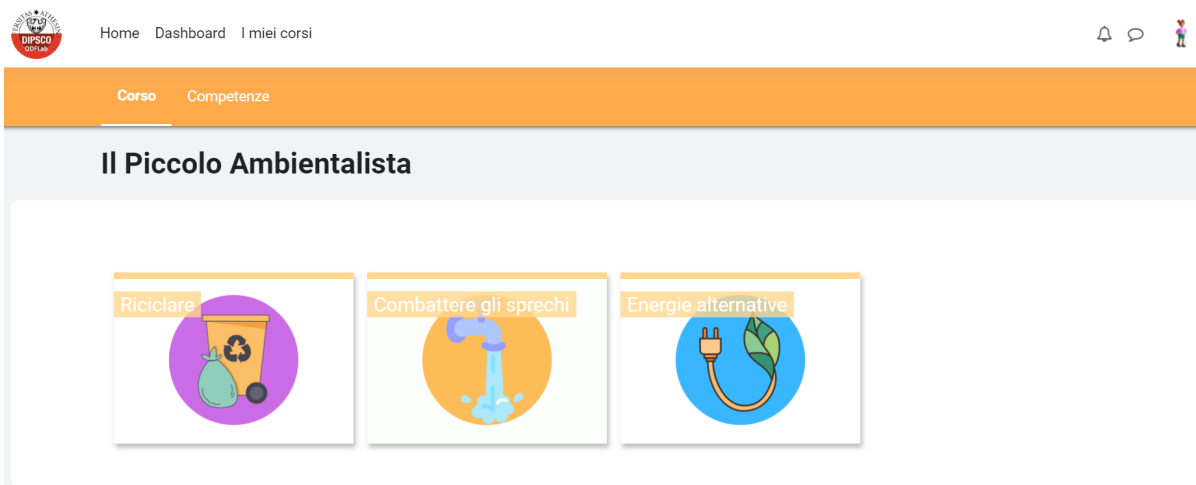


Figure 1: Screenshot of the first section of K-DAD: Little Environmentalist. This section involves activities aimed to become environmentally responsible. In particular, the activities were organized into three main sub-sections: Recycle, Avoid Waste, and Alternative Energy.

Concerning the appearance, we assessed several themes provided by Moodle and eventually customized a specific modern theme (CONNECTIME LTDA, 2022) by using an appealing palette of colors, icons, and illustrations. Furthermore, as suggested by Lyu et al. (2022), we used colors to visually support the navigation of the users through pages of the platform, attract users' attention, and express information (e.g., each section has different colors). In addition, users can change text size and color background based on their visual needs.

Following the advice of Mkpojiogu et al. (2018), we structured and simplified the navigation inside the platform: i) creating direct links between the home page and the platform sections; ii) introducing a navigation menu for returning to the previous page; iii) redirecting to a new page to show subsections; iv) designed minimal and clear menu. Moreover, we inserted a virtual tour to guide the user at the first access to the platform and created video tutorials and instructions, available inside *K-DAD*. Additionally, we customized the Italian language pack available by default in Moodle to adopt a style more suited for kids.

We designed the content architecture using card blocks to cluster sections and subsections and avoided providing too much information on a single page (Figure 1). Providing clear instructional design is aimed to help pupils focus on the content to be learned (Nilakusmawati et al., 2021).

### 2.1.1 CL Activities

Up to now, *K-DAD* is organized into two main sections aimed at promoting environmental knowledge and awareness (*Il Piccolo Ambientalista*, the little en-

vironmentalist) as well as diversity, equity, and inclusion (*Diversamente uguali*, we are different and equal). Following Veldman et al. (2020), we organized the tasks starting with a story introducing a social problem related to the selected topics. After this introduction, pupils are involved in several activities and tasks that include:

- concept maps;
- boards to express and organize opinions and ideas;
- cooperative educational games such as platform games (as shown in Figure 2), drag-and-drop games, crosswords, quizzes, play-roles, and puzzle games;
- glossaries;
- collaborative writing (wikis);
- synchronous (e.g., chat) and asynchronous (e.g., forum) communication tools.

These activities have been structured to be carried out in small groups and each group member has a specific role. At the end of each activity, both the group as a whole and each individual member receive feedback and reward based on their outcomes.

For example, upon completing the *Il Piccolo Ambientalista* section, pupils are awarded a certificate that accredits their competencies and level of environmental responsibility. The activities were embedded in the platform and implemented using both default activities of Moodle, specific plugins, or external tools, especially for educational games.

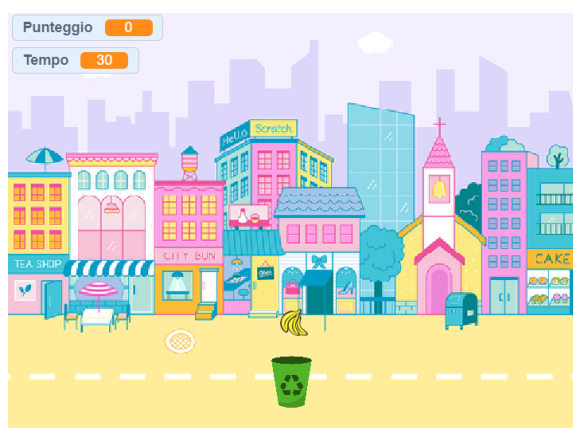


Figure 2: Screenshot of an educational game, developed in the platform *K-DAD*. The game provides that the player puts waste in the right bin.

### 3 DISCUSSION AND CONCLUSIONS

The aim of this paper is to introduce an Italian digital CL-based platform tailored for pupils of primary and lower secondary schools. Following previous studies (Sulisworo et al., 2016; Yapici, 2016; Nilakusmawati et al., 2021; Gamage et al., 2022), we have developed a Moodle-based platform to provide a flexible and customized e-learning environment. To prevent usability issues, we have designed a clear and structured user interface with child-friendly elements. To facilitate the CL tasks, we integrated several plugins and implemented different group activities. In particular, we developed two main sections as examples and provided indications to teachers for implementing and structuring other CL tasks into the platform.

CL offers an instructional paradigm to promote active learning, teamwork, critical thinking, and decision-making skills (Gillies, 2016). Specifically, pupils can experiment with a positive experience of interdependence in which they can co-construct new knowledge and learn by themselves and others (Johnson and Johnson, 1990). To foster this form of knowledge-sharing cooperation and collaboration, a key role is played by the organizational structure within the educational environment that ensures different actors cooperate on the same project and share information inside and outside their group (Johnson et al., 1994; Johler, 2022). Therefore, integrating CL into the learning platform offers the opportunity to create an organized space of communication, collaboration, sharing, organization, and monitoring to support both teachers and pupils (Sulisworo et al., 2016; Yapici, 2016; Huang et al., 2020).

Despite the potential benefits, there is a lack of research investigating the implementation of CL-based digital platforms in lower schools due to the need for a variety of resources, tools, specific equipment in classrooms, and a high level of involvement and training of teachers (Zhou and Lewis, 2021; Veldman et al., 2020). Previous research (Akram et al., 2021; Blikstad-Balas and Klette, 2020) demonstrated that the use of technological tools, especially interaction with pupils, can be challenging for teachers in different ways. For instance, teachers may not be experts in educational technologies and then not always identify the several opportunities that technologies offer in traditional learning settings (Johler, 2022; Cachia et al., 2021). In addition, using technology-based CL requires teachers to appropriately design CL tasks as well as to evaluate the suitability of the technological applications in order to produce effective learning and guarantee collaborative processes (Jacobs and Ivone, 2020; Iacono et al., 2021; Johler, 2022). Furthermore, many educational platforms requires specific guidance to be used proficiently and with satisfaction by children without adult guidance (Vlachogianni and Tselios, 2022; Floriano et al., 2022), leading teachers to favor specific technological applications such as games, mobile apps, or social networks for implementing cooperative strategies.

The driving idea beyond the *K-DAD* project is that open-source learning systems, designed specifically for school-aged children and structured based on CL's main elements, can improve the application of technology-based CL interventions in primary and secondary schools. In particular, the project aims to provide new frameworks to integrate digital learning platforms into traditional teaching to foster cooperation and inclusion in the classroom context.

Further studies need to be carried out in order to validate the effectiveness and efficacy of the *K-DAD* platform. As future study, we plan to conduct a task-oriented usability test with kids to assess the usability and user experience of the platform. Then, we will evaluate possible changes and adjustments to the platform prototype. After this first phase, we will complete the development of the platform and assess the impact of *K-DAD* in a whole-classroom setting. Specifically, the study will involve 80 primary and lower school Italian pupils who will use the *K-DAD* platform in their classrooms. Changes in the perceived level of inclusion, social skills development, peer engagement in learning activities, and educational outcomes among the pupils will be evaluated.



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## REFERENCES

- Aghajani, M. and Adloo, M. (2018). The effect of online cooperative learning on students' writing skills and attitudes through telegram application. *International Journal of Instruction*, 11:433–448.
- Akram, H., Yingxiu, Y., Al-Adwan, A. S., and Alkhalifah, A. (2021). Technology integration in higher education during covid-19: An assessment of online teaching competencies through technological pedagogical content knowledge model. *Frontiers in psychology*, 12.
- Blikstad-Balas, M. and Klette, K. (2020). Still a long way to go: Narrow and transmissive use of technology in the classroom. *Nordic Journal of Digital Literacy*, 15(1):55–68.
- Bodnenko, D. M., Kuchakovska, H. A., Proshkin, V. V., and Lytvyn, O. S. (2020). Using a virtual digital board to organize student's cooperative learning. *CEUR Workshop Proceedings*.
- Bodsworth, H. and Goodyear, V. A. (2017). Barriers and facilitators to using digital technologies in the cooperative learning model in physical education. *Physical Education and Sport Pedagogy*, 22(6):563–579.
- Bosch, C. and Laubscher, D. J. (2019). Cooperative learning as a strategy for self-directed learning in blended-distance learning environments: A systematic literature review. *Student support toward self-directed learning in open and distributed environments*, pages 1–25.
- Bosch, C., Mentz, E., and Reitsma, G. (2020). Cooperative learning as a blended learning strategy: A conceptual overview. *Emerging Techniques and Applications for Blended Learning in K-20 Classrooms*, pages 65–87.
- Bosch, C., Mentz, E., and Reitsma, G. M. (2019). Integrating cooperative learning into the combined blended learning design model: Implications for students' intrinsic motivation. *International Journal of Mobile and Blended Learning (IJMBL)*, 11(1):58–73.
- Cachia, R., Chaudron, S., Di Gioia, R., Velicu, A., Vuorikari, R., et al. (2021). Emergency remote schooling during covid-19, a closer look at european families.
- CONNECT.ME LTDA (2022). [https://moodle.org/plugins/theme\\_moove](https://moodle.org/plugins/theme_moove). Online; accessed 15 January 2023.
- Erdogan, F. (2019). Effect of cooperative learning supported by reflective thinking activities on students' critical thinking skills. *Eurasian journal of educational research*, 19(80):89–112.
- Fernandez-Perez, V. and Martin-Rojas, R. (2022). Emotional competencies as drivers of management students' academic performance: The moderating effects of cooperative learning. *The International Journal of Management Education*, 20(1):100600.
- Floriano, H. M., Jino, M., and de Franco Rosa, F. (2022). A study on usability assessment of educational systems. In *ITNG 2022 19th International Conference on Information Technology-New Generations*, pages 129–134. Springer.
- Gamage, S. H., Ayres, J. R., and Behrend, M. B. (2022). A systematic review on trends in using moodle for teaching and learning. *International Journal of STEM Education*, 9(1):1–24.
- Gillies, R. M. (2016). Cooperative learning: Review of research and practice. *Australian Journal of Teacher Education (Online)*, 41(3):39–54.
- Han, S.-I. and Son, H. (2020). Effects of cooperative learning on the improvement of interpersonal competence among students in classroom environments. *International Online Journal of Education and Teaching*, 7(1):17–28.
- Hasan, L. (2019). The usefulness and usability of moodle lms as employed by zarqa university in jordan. *JISTEM-Journal of Information Systems and Technology Management*, 16.
- Huang, P.-S., Chiu, P.-S., Huang, Y.-M., Zhong, H.-X., and Lai, C.-F. (2020). Cooperative mobile learning for the investigation of natural science courses in elementary schools. *Sustainability*, 12(16):6606.
- Iacono, U. D., Amorese, T., Cuciniello, M., and Mannillo, C. V. (2021). User-friendly interfaces for vygotskian computer-based learning activities. In *Proc. 12th International Conference on Society and Information Technologies*, pages 57–62.
- Jacobs, G. M. and Ivone, F. M. (2020). Infusing cooperative learning in distance education. *TESL-EJ*, 24(1):n1.
- Johler, M. M. S. (2022). Collaboration and communication in blended learning environments. *Frontiers in Education*, 7.
- Johnson, D. W. et al. (1994). *Cooperative learning in the classroom*. ERIC.
- Johnson, D. W. and Johnson, R. T. (1990). Cooperative learning. *Perspectives on small group learning: Theory and practice*, pages 68–79.
- Johnson, D. W. and Johnson, R. T. (2014). Using technology to revolutionize cooperative learning: an opinion. *Frontiers in psychology*, 5:1156.
- Klang, N., Olsson, I., Wilder, J., Lindqvist, G., Fohlin, N., and Nilholm, C. (2020). A cooperative learning intervention to promote social inclusion in heterogeneous classrooms. *Frontiers in Psychology*, 11:586489.
- Lyu, F., Xi, R., and Liu, Y. (2022). Color design in application interfaces for children. *Color Research & Application*, 47(2):507–517.
- Mkpojiogu, E. O., Hussain, A., and Hassan, F. (2018). A systematic review of usability quality attributes for the evaluation of mobile learning applications for children. In *AIP Conference Proceedings*, volume 2016, page 020092. AIP Publishing LLC.
- Møgelvang, A., Vandvik, V., Ellingsen, S., Strømme, C., and Cotner, S. (2023). Cooperative learning goes online: teaching and learning intervention in a digital

- environment impacts psychosocial outcomes in biology students. *International Journal of Educational Research*, 117:102114.
- Nam, C. (2014). The effects of trust and constructive controversy on student achievement and attitude in online cooperative learning environments. *Computers in Human Behavior*, 37:237–248.
- Nilakusmawati, D., Suprapti, N., Darmawan, I., and Raharja, M. (2021). Analysis of student interaction with learning objects on blended learning course applying cooperative learning together method on moodle learning management system. In *Journal of Physics: Conference Series*, volume 1722, page 012107. IOP Publishing.
- Sarif, M. J. and Maknun, J. (2022). The use of lms schoolology in cooperative learning to improve learning activeness of vocational high school students. In *4th International Conference on Innovation in Engineering and Vocational Education (ICIEVE 2021)*, pages 180–184. Atlantis Press.
- Silalahi, T. F. and Hutaaruk, A. F. (2020). The application of cooperative learning model during online learning in the pandemic period. *Budapest International Research and Critics Institute-Journal (BIRCI-Journal)*, 3(3):1683–1691.
- Suárez, C. A. H., Galan, C. A. P., and Osorio, H. M. (2022). Usability issues of e-learning systems: A case study for the moodle learning management system. *Journal of Language and Linguistic Studies*, 18(2).
- Sugino, C. (2021). Student perceptions of a synchronous online cooperative learning course in a japanese women’s university during the covid-19 pandemic. *Education Sciences*, 11(5):231.
- Sukmawati, R. A., Pramita, M., Purba, H. S., and Utami, B. (2020). The use of blended cooperative learning model in introduction to digital systems learning. *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, 2(2):75–81.
- Sulisworo, D., Agustin, S. P., and Sudarmiyati, E. (2016). Cooperative-blended learning using moodle as an open source learning platform. *International Journal of Technology Enhanced Learning*, 8(2):187–198.
- Tran, V. D. (2019). Does cooperative learning increase students’ motivation in learning?. *International Journal of Higher Education*, 8(5):12–20.
- Van Ryzin, M. J. and Roseth, C. J. (2019). Effects of cooperative learning on peer relations, empathy, and bullying in middle school. *Aggressive behavior*, 45(6):643–651.
- Veldman, M., Doolaard, S., Bosker, R., and Snijders, T. (2020). Young children working together. cooperative learning effects on group work of children in grade 1 of primary education. *Learning and instruction*, 67:101308.
- Vlachogianni, P. and Tselios, N. (2022). Perceived usability evaluation of educational technology using the system usability scale (sus): A systematic review. *Journal of Research on Technology in Education*, 54(3):392–409.
- Völlinger, V. A. and Supanc, M. (2020). Student teachers’ attitudes towards cooperative learning in inclusive education. *European Journal of Psychology of Education*, 35(3):727–749.
- Wang, Y.-P. and Wu, T.-J. (2022). Effects of online cooperative learning on students’ problem-solving ability and learning satisfaction. *Frontiers in Psychology*, 13.
- Yang, X., Zhou, X., and Hu, J. (2021). Students’ preferences for seating arrangements and their engagement in cooperative learning activities in college english blended learning classrooms in higher education. *Higher Education Research & Development*, pages 1–16.
- Yapici, İ. Ü. (2016). Effectiveness of blended cooperative learning environment in biology teaching: Classroom community sense, academic achievement and satisfaction. *Journal of Education and Training Studies*, 4(4):269–280.
- Yeh, S.-P. and Fu, H.-W. (2014). Effects of cooperative e-learning on learning outcomes. *Eurasia Journal of Mathematics, Science and Technology Education*, 10(6):531–536.
- Yusuf, Q., Jusoh, Z., and Yusuf, Y. Q. (2019). Cooperative learning strategies to enhance writing skills among second language learners. *International Journal of Instruction*, 12(1):1399–1412.
- Zhou, C. and Lewis, M. (2021). A mobile technology-based cooperative learning platform for undergraduate biology courses in common college classrooms. *Biochemistry and Molecular Biology Education*, 49(3):427–440.
- Ziraba, A., Akwene, G. C., Lwanga, S. C., et al. (2020). The adoption and use of moodle learning management system in higher institutions of learning: A systematic literature review. *American Journal of Online and Distance Learning*, 2(1):1–21.