JPPIPA 11(7) (2025)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

Enhancing Student Participation through a Validated Cooperative Flipped Classroom Framework in Technology Education

Jusmita Weriza[1*], Irfan Ananda Ismail[2], Henny Yustisia[3], Zulkifli[3], Lise Asnur[3]

[1] Universitas Ekasakti Padang, West Sumatra, Indonesia.
[2] Sekolah Pascasarjana Pendidikan IPA Universitas Negeri Padang, West Sumatra, Indonesia.
[3] Universitas Negeri Padang, West Sumatra, Indonesia.

Received: May 22, 2025
Revised: June 28, 2025
Accepted: July 25, 2025
Published: July 31, 2025

Corresponding Author:
Jusmita Weriza
jusmitaweriza@gmail.com

DOI: 10.29303/jppipa.v11i7.11445

Abstract: Abstract: This study addresses the challenges of limited student participation and ineffective group learning in Information Systems Analysis & Design education. The objective was to develop, validate, and test a seven-syntax flipped classroom model integrated with cooperative learning. The study employed Borg and Gall's R&D methodology with 60 students in experimental and control groups at Universitas Ekasakti. Data were analyzed using descriptive statistics for validity and practicality, and independent t-tests for effectiveness. The results demonstrated exceptional model validity (≥88%), high practicality from instructors (≥85%) and students (≥86%), and significant effectiveness. The experimental group showed superior cognitive (85.2 vs. 75.1), affective (collaboration and responsibility), and psychomotor outcomes (88.5 vs. 78.2) compared to the control group. In conclusion, the validated seven-syntax model successfully improves student participation and learning outcomes by balancing asynchronous learning with synchronous collaboration, providing a valuable framework for technology education.

Keywords: Blended learning; Cooperative learning; Flipped classroom; Information systems education; Science and technology education; SDLC; UML

Introduction

The educational landscape for technical vocational programs has undergone significant transformation in response to Industry 4.0 requirements and pandemic-era restrictions, necessitating innovative pedagogical approaches that emphasize both technical knowledge and collaborative capabilities (Dougherty et al., 2020; Giani et al., 2019; Gottfried et al., 2018; Nathan et al., 2017; Sudira, 2017; Verawardina et al., 2019; Verloigne et al., 2016; Villalba et al., 2018). Traditional educational methods in higher vocational contexts often fail to foster active student participation, particularly in complex technical subjects like Information Systems Analysis & Design that require both theoretical understanding and practical application (Irwanto, 2019). The disconnect between conventional classroom instruction and workplace requirements has created an urgent need for educational models that simulate professional environments while leveraging digital technologies (Heyer et al., 2017; Martinengo et al., 2019; Murzo et al., 2021; Petrovych et al., 2021; Pinto et al., 2020; Volodymyrovych et al., 2021; Wang et al., 2017).

Recent educational research has highlighted the potential of flipped classroom approaches in enhancing student engagement and learning outcomes (Bishop et al., 2013; Erbil, 2020; Estrada et al., 2019; Insani et al., 2022; A. Ismail, 2022; Maolidah et al., 2017; Munir et al., 2018; Şengel, 2016). Simultaneously, cooperative learning methodologies have demonstrated significant efficacy in developing the collaborative capabilities essential for technology professionals (Canelas et al., 2017; Erbil, 2020; Foldnes, 2016; Gillies, 2007; Gillies et al., 2003; Munir et al., 2018; Rau et al., 2017; Robert, 2016;

How to Cite:
Weriza, J., Ismail, I. A., Yustisia, H., Zulkifli, & Asnur, L. Enhancing Student Participation through a Validated Cooperative Flipped Classroom Framework in Technology Education. *Jurnal Penelitian Pendidikan IPA*, *11*(7), 134-141. https://doi.org/10.29303/jppipa.v11i7.11445

Shattuck et al., 2016; Stoltzfus et al., 2016). However, few studies have systematically integrated these complementary approaches within a coherent framework specifically designed for technical science and technology education (Villalba et al., 2018).

The COVID-19 pandemic further accelerated the necessity for flexible learning models that effectively combine online and face-to-face instruction (Horn et al., 2012; Huang et al., 2022; Zhang et al., 2020). This research addresses these convergent challenges by developing and validating a seven-syntax flipped classroom model with integrated cooperative learning approaches for Information Systems Analysis & Design education, providing a structured framework that balances individual preparation, collaborative problem-solving, and practical application (Lee et al., 2017; Suartama et al., 2019)

Method

This study employed a Research and Development (R&D) methodology. The research was systematically structured to develop, validate, and test the proposed instructional innovation.

Time and Place of Research

The research was conducted at the Computer Management and Informatics Program, Faculty of Economics, Universitas Ekasakti Padang. The participants were 60 third-semester students enrolled in the Information Systems Analysis & Design course, who were equally distributed between the experimental and control groups.

Research Method

This study followed Borg et al. (1983) ten-phase R&D model. The testing phase utilized a quasi-experimental design, suitable for investigating educational interventions in natural settings (Gopalan et al., 2020; I. A. Ismail et al., 2022), comparing an experimental group (using the developed model) with a control group (using traditional instruction).

Research Stages and Instruments

The research process included several key stages. First, a needs assessment was conducted through interviews, observations, and document analysis (Anggunan et al., 2022). Second, a conceptual framework was built from literature on flipped classrooms (Bishop et al., 2013), cooperative learning (Gillies et al., 2003), and blended learning (Horn et al., 2012). Third, the seven-syntax instructional model and its supporting materials were developed, which included instructor guides, student manuals, modules, and an e-learning platform. The instruments used for data collection were: (1) Validation Sheets: For expert validation using a Focus Group Discussion (FGD). (2) Practicality Questionnaires: For instructors and students, employing Likert scales. (3) Cognitive Tests: Pre-test and post-test to measure knowledge acquisition. (4) Observation Protocols: To assess the affective domain (e.g., collaboration). (5) Standardized Rubrics: To evaluate psychomotor outcomes in case study projects.

This foundation informed the development of the seven-syntax instructional model and its supporting materials, including instructor guides, student manuals, learning modules, and the e-learning platform. The development of the instructional design aligns with established models for blended and flipped learning environments (Lee et al., 2017; Suartama et al., 2019).

Validation employed a multi-method approach including Focus Group Discussion (FGD) with five educational technology experts who evaluated the model's theoretical coherence and practical applicability (Love et al., 2016; Rutkowski et al., 2016). Validation efforts focused on assessing content appropriateness, linguistic clarity, presentation quality, and graphical design (Andersen et al., 2021; DeMonbrun et al., 2017; Klepsch et al., 2017; Ng et al., 2024; Pellegrino, 2016; Setiawan, 2017). Practicality testing involved both instructors and students assessing the model's implementation feasibility across multiple dimensions like ease of use, resource availability, contextual appropriateness, and time efficiency (DeMonbrun et al., 2017; Hew et al., 2016; Setiawan, 2017). The effectiveness evaluation employed a quasi-experimental design comparing the experimental group (using the developed model) with the control group (using traditional instruction) through pre-tests and post-tests measuring cognitive (Andersen et al., 2021; Festiyed et al., 2025; Klepsch et al., 2017), affective (Aguilera et al., 2020; Kazemi et al., 2020; Truax et al., 2018), and psychomotor outcomes (Hernon et al., 2023; Heyer et al., 2017; Muirhead et al., 2021).

Data collection instruments included validated questionnaires employing Likert scales for model validation and practicality assessment (DeMonbrun et al., 2017; Setiawan, 2017), cognitive tests for knowledge acquisition measurement (Andersen et al., 2021; Klepsch et al., 2017), observation protocols for affective domain assessment (Kazemi et al., 2020; Truax et al., 2018), and a standardized rubric for evaluating case study projects (Chevalier et al., 2020). Data analysis combined descriptive statistics for validation and practicality measures with inferential statistics (independent t-tests) for effectiveness determination (Gopalan et al., 2020), after confirming normality and homogeneity assumptions (González-Valero et al., 2019; Gopalan et al., 2020).

Data Analysis

Data were analyzed using a combination of methods. Validation and practicality data were analyzed using descriptive statistics (percentages). Effectiveness data were analyzed using inferential statistics, specifically independent t-tests, to compare the post-test scores between the experimental and control groups after confirming data normality and homogeneity (González-Valero et al., 2019; Gopalan et al., 2020).

Result and Discussion

Model Validity

The validation results demonstrate the model's exceptional content and construct validity across all components. The flipped classroom model with cooperative approach received validation scores of 92% for content appropriateness, 95% for linguistic clarity, 90% for presentation quality, and 88% for graphical design (Andersen et al., 2021; Klepsch et al., 2017; Ng et al., 2024; Pellegrino, 2016; Setiawan, 2017). Supporting materials achieved similarly high validation scores, with the instructor's guide, student manual, course textbook, and e-learning platform all receiving expert ratings above 87% across evaluation dimensions (DeMonbrun et al., 2017; Hew et al., 2016). These high validity scores indicate the model is theoretically sound and appropriately designed for the target subject and context (Pellegrino, 2016).

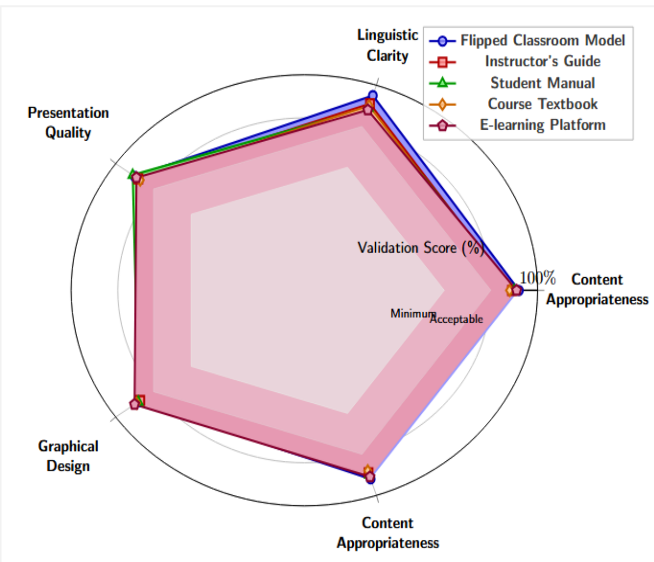

Figure 1. Validation results

Model Practicality

Practicality assessment revealed high usability ratings from both instructors and students. Instructors rated the model at 88% for ease of use, 85% for resource availability, 87% for contextual appropriateness, and 86% for time efficiency (DeMonbrun et al., 2017; Hew et al., 2016). Similarly, students provided positive evaluations with 89% for ease of use, 86% for resource availability, 88% for contextual appropriateness, and 87% for time efficiency (DeMonbrun et al., 2017; Hew et al., 2016), confirming the model's implementability in real educational settings (Huang et al., 2022; Suartama et al., 2019). The high practicality scores suggest that the model can be readily adopted and utilized by educators and learners in vocational technology programs.

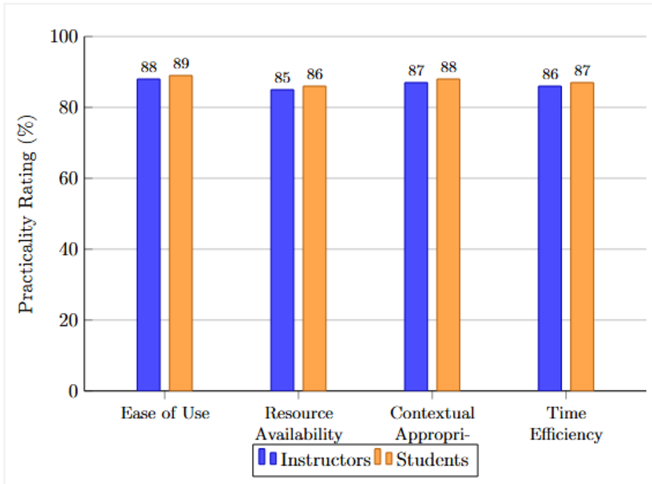

Figure 2. Practicality rating

Model Effectiveness

The effectiveness evaluation demonstrated statistically significant improvements in learning outcomes. The experimental group using the seven-syntax model achieved substantially higher post-test scores (M=85.2) compared to the control group using conventional instruction (M=75.1), with homogeneity (Levene's test, p=0.726) and normality (Kolmogorov-Smirnov, p0.200) assumptions confirmed (Gopalan et al., 2020). An independent samples t-test revealed this difference was statistically significant (t(58)=4.567, p0.001), representing a substantial educational impact (Gopalan et al., 2020; I. A. Ismail et al., 2022). This finding aligns with previous research indicating the effectiveness of combined flipped classroom and cooperative learning approaches (Erbil, 2020; Foldnes, 2016; Munir et al., 2018). Additionally, the experimental group exhibited superior performance in project-based assessments (M=88.5 vs. M=78.2) and demonstrated more positive affective outcomes in cooperation, responsibility, and participation dimensions (Aguilera et al., 2020; Estrada et al., 2019; González-Valero et al., 2019; Kazemi et al., 2020; Truax et al., 2018). The improvement in affective domains highlights the success of the integrated cooperative learning element.

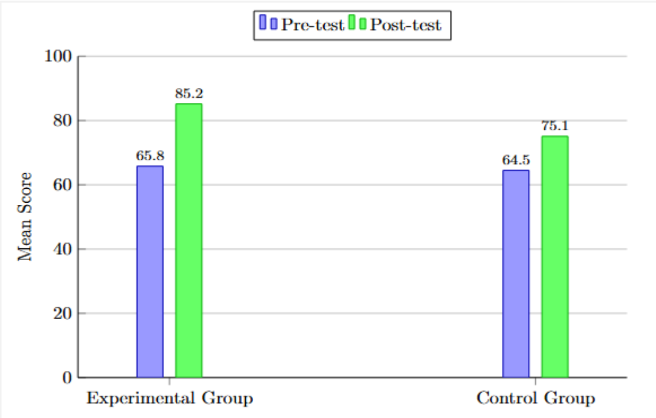

Figure 3. Experimental and control group

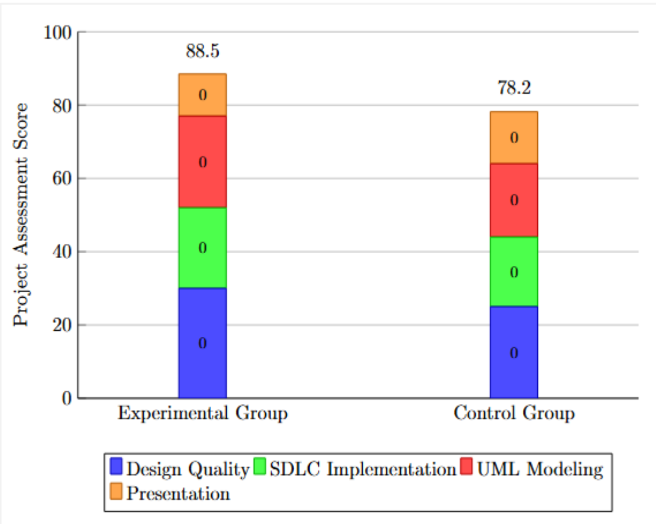

Figure 4. Project assessment score

The Seven-Syntax Flipped Classroom and Cooperative Learning Model

The seven-syntax model that emerged from this research provides a structured framework for balancing asynchronous online learning with synchronous collaborative activities: 1) Information: Instructors provide comprehensive orientation regarding learning objectives, materials, and assessment systems while students access digital learning resources prior to face-to-face sessions (Lee et al., 2017; Suartama et al., 2019). 2) Understanding & Developing Materials: Students independently comprehend learning materials through online resources, develop their understanding by researching additional relevant sources (Murzo et al., 2021; Pinto et al., 2020), and complete online pre-tests to measure initial comprehension (Bishop et al., 2013). 3) Discussion of Development Results: Students engage in group discussions about independently studied materials, share ideas and understanding with teammates (Canelas et al., 2017; Foldnes, 2016; Gillies, 2007; Gillies et al., 2003), and clarify uncertainties with instructor guidance. 4) Generating New Designs: Student teams analyze case studies and develop new information system designs using SDLC methodology and UML modeling tools (Anđić et al., 2023; Chevalier et al., 2020), presenting their preliminary designs for class feedback. 5) Implementation: Teams implement their information system designs as prototypes or simple applications (Huang et al., 2022; Rahman et al., 2021), test their functionality (Heyer et al., 2017), and make iterative improvements based on testing results (Sarkany et al., 2017). 6) Evaluation Instructors assess student learning outcomes across cognitive, affective, and psychomotor domains through tests and case study evaluations (Hernon et al., 2023; Ng et al., 2024; Pellegrino, 2016), while students engage in self-assessment and peer evaluation (Love et al., 2016; Rutkowski et al., 2016). 7) Recognition: Instructors provide recognition to students or teams demonstrating outstanding achievement or significant improvement, reinforcing motivation and positive learning behaviors (Truax et al., 2018).

This model successfully addresses the challenges of limited student participation by encouraging pre-class preparation and in-class collaborative activities (Erbil, 2020; Estrada et al., 2019; Munir et al., 2018). The cooperative learning integration provides structured approaches to group work, addressing previous inefficiencies in collective learning experiences (Foldnes, 2016; Gillies, 2007; Gillies et al., 2003; Rau et al., 2017). The blended learning implementation balances online flexibility with face-to-face interaction, creating a comprehensive learning environment that aligns with vocational technology education needs in the digital transformation era (González-Valero et al., 2019; Horn et al., 2012; Huang et al., 2022; Kuleto et al., 2022; Suartama et al., 2019; Sudira, 2017; Verawardina et al., 2019).

Conclusion

This research has successfully developed and validated a seven-syntax flipped classroom model with cooperative learning integration for Information Systems Analysis & Design education. The model demonstrates exceptional validity, high practicality, and significant effectiveness in improving student learning outcomes across cognitive, affective, and psychomotor domains. This innovative pedagogical approach provides a structured framework that effectively combines online and face-to-face instruction, particularly valuable for technology education during and beyond pandemic conditions. The model's implementation significantly enhances student participation and collaborative learning capabilities while developing the technical skills required for information systems analysis and design. Its effectiveness in balancing individual preparation with team-based problem-solving addresses a critical need in vocational technology education, preparing students for workplace environments that demand both technical expertise and collaborative capabilities. Future research should explore the model's applicability across diverse technical subjects, institutional contexts, and longer implementation timeframes. Additionally, investigations into the development of specific critical thinking, creativity, and collaborative skills through this model would provide valuable insights for technology education advancement

Acknowledgments
The authors express sincere gratitude to the educational technology experts who participated in the Focus Group Discussion for their valuable feedback on improving the model. Special appreciation to the administration of Universitas Ekasakti Padang for facilitating the research implementation, and to the students who actively participated in this study.

Author Contributions
Conceptualization, J.W. and I.A.I; methodology, J.W.; software, H.Y.; validation, J.W., I.A.I, H.Y., Z., and L.A.; formal analysis, J.W.; investigation, J.W.; resources, J.W.; data curation, J.W.; writing-original draft preparation, J.W.; writing-review and editing, I.A.I, H.Y., Z., and L.A.; visualization, J.W.; supervision, I.A.I; project administration, J.W. All authors have read and agreed to the published version of the manuscript.

Funding
This research received no external funding.

Conflicts of Interest
The authors declare no conflict of interest.

References

Aguilera, D., Perales-Palacio, F. J., Ayala, M. D. M., & Sánchez-Aguilera, J. D. Á. (2020). What Effects Do Didactic Interventions Have on Students' Attitudes Towards Science? A Meta-Analysis. *Research in Science Education*, *50*(2), 573–597. https://doi.org/10.1007/s11165-018-9702-9

Andersen, M. S., Ravaja, N., Parmar, D., & Krageloh, C. (2021). The validation and further development of a multidimensional cognitive load scale for virtual environments. *Journal of Computer Assisted Learning*, *37*(1), 183–196. https://doi.org/10.1111/jcal.12478

Anđić, B., Ulbrich, E., Dana-Picard, T., Cvjetićanin, S., Petrović, F., Lavicza, Z., & Maričić, M. (2023). A Phenomenography Study of STEM Teachers' Conceptions of Using Three-Dimensional Modeling and Printing (3DMP) in Teaching. *Journal of Science Education and Technology*, *32*(1), 45–60. https://doi.org/10.1007/s10956-022-10005-0

Anggunan, B., Andrianisa, I., Nurhayani, N., & Andriansyah, A. (2022). Kebutuhan Media Interaktif Virtual Reality 360o untuk Menunjang Implementasi Project-Based Learning di SMK Kompetensi Keahlian Akuntansi dan Keuangan Lembaga. *Jurnal Inovasi Teknologi Dan Pendidikan*, *1*(2), 69–80.

Bishop, J. L., & Verleger, M. A. (2013). The flipped classroom: A survey of the research. *ASEE National Conference Proceedings*, *30*(9), 1–18. Retrieved from https://peer.asee.org/the-flipped-classroom-a-survey-of-the-research

Borg, W. R., & Gall, M. D. (1983). *Educational Research: An Introduction* (4th ed.). Longman.

Canelas, D. A., Arcaute, K., Butler, S. W., & Plett, S. D. (2017). Cooperative learning in organic chemistry increases student assessment of learning gains in key transferable skills. *Chemistry Education Research and Practice*, *18*(3), 441–456. https://doi.org/10.1039/c7rp00014f

Chevalier, M., Ahlgren, S., Basilico, M., Michaelson, P., Riley, A., Wagh, A., & Walker, M. (2020). Fostering computational thinking through educational robotics: a model for creative computational problem solving. *International Journal of STEM Education*, *7*(1), 1–13. https://doi.org/10.1186/s40594-020-00238-z

DeMonbrun, M., Finelli, C. J., Prince, M., Borrego, M., Crockett, C., Ford, J., Guzman, R. P., Hovard, R., Lowery, B., McFarland, A., Nagel, R., O'Neal, C., Pawley, A., Plumlee, D., Reeping, D., Rickey, D., & Smith, B. (2017). Creating an Instrument to Measure Student Response to Instructional Practices. *Journal of Engineering Education*, *106*(2), 273–298. https://doi.org/10.1002/jee.20162

Dougherty, S. M., Lovenheim, M. F., Ma, L., & Owens, A. (2020). Can growth in the availability of STEM technical education improve equality in participation?: evidence from Massachusetts. *Journal of Vocational Education & Training*, *72*(1), 47–70. https://doi.org/10.1080/13636820.2019.1578818

Erbil, D. G. (2020). A Review of Flipped Classroom and Cooperative Learning Method Within the Context of Vygotsky Theory. *Frontiers in Psychology*, *11*, 1157. https://doi.org/10.3389/fpsyg.2020.01157

Estrada, Á. C. M., & Galindo, J. S. P. (2019). Flipped classroom to improve university student centered learning and academic performance. *Social Sciences*, *8*(11), 315. https://doi.org/10.3390/socsci8110315

Festiyed, F., Ismail, I. A., Lufri, L., Mawardi, M., &

Insani, M. (2025). Culturally Responsive Science Education Through Ethnoscience: A Meta-Analysis of Impact on Junior High School Students. *Multidisciplinary Reviews*. https://doi.org/10.31893/multirev.2026004

Foldnes, N. (2016). The flipped classroom and cooperative learning: Evidence from a randomised experiment. *Active Learning in Higher Education*, *17*(1), 39–49. https://doi.org/10.1177/1469787415616726

Giani, M. S., Parrish, K., & Donaldson, M. N. (2019). Does Vocational Still Imply Tracking? Examining the Evolution of Career and Technical Education Curricular Policy in Texas. *Educational Policy*, *33*(7), 1002–1046. https://doi.org/10.1177/0895904817745375

Gillies, R. M. (2007). *Cooperative learning: Integrating theory and practice*. Sage Publications.

Gillies, R. M., & Ashman, A. F. (2003). *Co-operative learning: The social and intellectual outcomes of learning in groups*. Routledge.

González-Valero, G., Fuentes, S., González-Jiménez, D., García-Santos, F., Gómez-Salgado, J., & Ruiz-Fernández, M. D. (2019). Use of meditation and cognitive behavioral therapies for the treatment of stress, depression and anxiety in students. A systematic review and meta-analysis. *International Journal of Environmental Research and Public Health*, *16*(22), 4394. https://doi.org/10.3390/ijerph16224394

Gopalan, M., Rosinger, K., & Tanner-Smith, E. (2020). Use of Quasi-Experimental Research Designs in Education Research: Growth, Promise, and Challenges. *Review of Research in Education*, *44*(1), 218–243. https://doi.org/10.3102/0091732X20903302

Gottfried, M. A., Sotelo, R., & Plasman, J. S. (2018). From Secondary to Postsecondary: Charting an Engineering Career and Technical Education Pathway. *Journal of Engineering Education*, *107*(4), 531–555. https://doi.org/10.1002/jee.20236

Hernon, O., Smith, G. D., Cody, D., Cunningham, D., Feeney, S., McCarthy, V., O'Connell, S., & Mulcahy, H. (2023). The use of educational technology in teaching and assessing clinical psychomotor skills in nursing and midwifery education: A state-of-the-art literature review. *Journal of Professional Nursing*, *45*, 35–50. https://doi.org/10.1016/j.profnurs.2023.01.005

Hew, T., Wah, Y. B., Don, Y., & Ping, T. P. (2016). Predicting instructional effectiveness of cloud-based virtual learning environment. *Industrial Management & Data Systems*, *116*(8), 1557–1584. https://doi.org/10.1108/IMDS-11-2015-0475

Heyer, K., Kunz, P. J., Lütz, F., Müller, F., Peschke, M., Stenger, R., & Wichelhaus, J. (2017). Compression therapy cross-sectional observational survey about knowledge and practical treatment of specialised and non-specialised nurses and therapists. *International Wound Journal*, *14*(6), 1148–1153. https://doi.org/10.1111/iwj.12773

Horn, M. B., & Staker, H. clayto. (2012). *Classifying K-12 Blended Learning*. Mountain View, CA: Innosight Institute.

Huang, H., Shi, F., Wu, M., Guo, Y., Chang, M., Tan, C., Jiang, R., & Huang, Y. (2022). Technological solutions for promoting employees' knowledge levels and practical skills: An SVVR-based blended learning approach for professional training. *Computers & Education*, *189*, 104593. https://doi.org/10.1016/j.compedu.2022.104593

Insani, M., Mawardi, M., & Ismail, I. A. (2022). The system of flipped classroom based on guided inquiry learning on redox reactions and electrochemistry using Moodle. *International Journal of Academic Pedagogical Research*, *6*(5), 53–56. Retrieved from http://ijeais.org/wp-content/uploads/2022/5/abs/IJAPR220510.html

Irwanto, I. (2019). Kesiapan program studi pendidikan vokasional teknik elektro dalam melaksanakan praktik industri. *Taman Vokasi*, *7*(2), 96–105. http://dx.doi.org/10.30738/jtv.v7i2.6297

Ismail, A. (2022). *Sistem Pembelajaran Flipped Classroom Berbasis Inkuiri Terbimbing Menggunakan Learning Management System Moodie pada Materi Termokimia untuk Siswa SMA Kelas XI*. Universitas Negeri Padang Repository.

Ismail, I. A., Pernadi, N. L., & Febriyanti, A. (2022). How to Grab and Determine the Size of The Sample For Research. *International Journal of Academic and Applied Research (IJAAR)*, *6*(9), 88–92. Retrieved from https://repository.unp.ac.id/id/eprint/41155/

Kazemi, A., Heidari, S., Hesampour, S., Rahbar, A., & Kazemian, Z. (2020). Dynamic assessment in English classrooms: Fostering learners' reading comprehension and motivation. *Cogent Psychology*, *7*(1), 1788912. https://doi.org/10.1080/23311908.2020.1788912

Klepsch, M., Thurmaier, F., Hoppstock, M., Wieser, M., & Dresel, M. (2017). Development and validation of two instruments measuring intrinsic, extraneous, and germane cognitive load. *Frontiers in Psychology*, *8*, 1997. https://doi.org/10.3389/fpsyg.2017.01997

Kuleto, V., Stefanova, G., Kavoura, A., Radosavljević, Ž., Kuzmanović, M., Božić, G., Ilić, B., Perović, N., Dobrojevic, M., Nikolić, D., & Andria, K. (2022). The Potential of Blockchain Technology in Higher Education as Perceived by Students in Serbia, Romania, and Portugal. *Sustainability (Switzerland)*, *14*(2), 749. https://doi.org/10.3390/su14020749

Lee, J., & Choi, H. (2017). Development of an instructional design model for flipped learning in higher education. *Educational Technology Research and Development*, *65*(2), 427–453. https://doi.org/10.1007/s11423-016-9502-1

Love, J. N., Stojan, J. N., & Howell, L. E. (2016). A novel specialty-specific, collaborative faculty development opportunity in education research: Program evaluation at five years. *Academic Medicine*, *91*(4), 548–555. https://doi.org/10.1097/ACM.0000000000001070

Maolidah, I. S., Ruhimat, T., & Dewi, L. (2017). Efektivitas penerapan model pembelajaran flipped classroom pada peningkatan kemampuan berpikir kritis siswa. *Edutechnologia*, *1*(2), 160–170. Retrieved from https://ejournal.upi.edu/index.php/edutechnologia/article/view/9147

Martinengo, L., Ruzevicius, M., Girdwoyn, J., Koutsouri, E., Karagiannis, V., Charalambous, M., Gergely, D., Szabo, A., Mihaylov, S., Staikov, B., Yaneva, A., Pencheva, P., & Hadjipanayi, E. (2019). Digital education for the management of chronic wounds in health care professionals: Protocol for a systematic review by the digital health education collaboration. *JMIR Research Protocols*, *8*(3), e12488. https://doi.org/10.2196/12488

Muirhead, K., & McNally, K. (2021). Establishing the effectiveness of technology-enabled dementia education for health and social care practitioners: a systematic review. *Systematic Reviews*, *10*(1), 233. https://doi.org/10.1186/s13643-021-01781-8

Munir, M., Pratiwi, R., & Khusnah, H. (2018). Flipped classroom with cooperative learning as a cornerstone. *Education for Chemical Engineers*, *23*, 25–33. https://doi.org/10.1016/j.ece.2018.05.001

Murzo, Y., & Leshchynskyi, O. (2021). Use of Information Technologies in Developing Foreign Language Competence for Professional Interaction of Undergraduate and Postgraduate Students Specializing in Mineral Resources. *International Journal of Emerging Technologies in Learning*, *16*(3), 144–153. https://doi.org/10.3991/ijet.v16i03.17875

Nathan, M. J., Walkington, C., Petrosino, A., Horowitz, S., Alibali, M. W., Boncoddo, N., Brooks, M., Karwatowska-Prokopiena, A., Wolfgram, M., Srisurichan, R., Toman, D., Schenke, K., Williams, C., Purzer, & Puntambekar, S. (2017). Threading mathematics through symbols, sketches, software, silicon, and wood: Teachers produce and maintain cohesion to support STEM integration. *Journal of Educational Research*, *110*(3), 272–293. https://doi.org/10.1080/00220671.2017.1287046

Ng, D. T. K., Guo, L., & Ng, L. H. (2024). Design and validation of the AI literacy questionnaire: The affective, behavioural, cognitive and ethical approach. *British Journal of Educational Technology*, *55*(3), 1082–1104. https://doi.org/10.1111/bjet.13411

Pellegrino, J. W. (2016). A Framework for Conceptualizing and Evaluating the Validity of Instructionally Relevant Assessments. *Educational Psychologist*, *51*(1), 59–81. https://doi.org/10.1080/00461520.2016.1145550

Petrovych, O. B., & Popova, L. L. (2021). The usage of augmented reality technologies in professional training of future teachers of Ukrainian language and literature. *CEUR Workshop Proceedings*, *2898*, 315–333. Retrieved from https://ceur-ws.org/Vol-2898/paper17.pdf

Pinto, M., Fernández-Pascual, S. F., Gómez-Cambronero, L., Meneses, J., & Ruipérez, J. (2020). Digital technologies in support of students learning in higher education: Literature review. *Digital Education Review*, *37*, 343–360. https://doi.org/10.1344/der.2020.37.343-360

Rahman, M. M., & Hassan, Y. E. (2021). Impact of Practical Skills on Academic Performance: A Data-Driven Analysis. *IEEE Access*, *9*, 139975–139993. https://doi.org/10.1109/ACCESS.2021.3119145

Rau, M. A., Weinstein, A., & Bader, A. (2017). Unpacking "active Learning": A combination of flipped classroom and collaboration support is more effective but collaboration support alone is not. *Journal of Chemical Education*, *94*(10), 1406–1414. https://doi.org/10.1021/acs.jchemed.7b00240

Robert, J. (2016). Coordinated Implementation and Evaluation of Flipped Classes and Peer-Led Team Learning in General Chemistry. *Journal of Chemical Education*, *93*(12), 1993–1998. https://doi.org/10.1021/acs.jchemed.6b00395

Rutkowski, D., & Svetina, D. (2016). Causal inferences with large scale assessment data: using a validity framework. *Large-Scale Assessments in Education*, *4*(1), 1. https://doi.org/10.1186/s40536-016-0019-1

Sarkany, D., & Kim, S. M. (2017). Providing Feedback: Practical Skills and Strategies. *Academic Radiology*, *24*(6), 740–746. https://doi.org/10.1016/j.acra.2016.11.023

Şengel, E. (2016). To FLIP or not to FLIP: Comparative case study in higher education in Turkey. *Computers in Human Behavior*, *64*, 547–555. https://doi.org/10.1016/j.chb.2016.07.034

Setiawan, B. (2017). The development of local wisdom-based natural science module to improve science literation of students. *Jurnal Pendidikan IPA*

Indonesia, *6*(1), 49–54. https://doi.org/10.15294/jpii.v6i1.9595

Shattuck, J., Marks, A., & Smith, R. S. (2016). A Parallel Controlled Study of the Effectiveness of a Partially Flipped Organic Chemistry Course on Student Performance, Perceptions, and Course Completion. *Journal of Chemical Education*, *93*(12), 1984–1992. https://doi.org/10.1021/acs.jchemed.6b00393

Stoltzfus, J. R., Hampton, S. R., & Thoms, B. M. (2016). Does the room matter? Active learning in traditional and enhanced lecture spaces. *CBE Life Sciences Education*, *15*(4), ar59. https://doi.org/10.1187/cbe.16-03-0126

Suartama, I. K., & Setyaningrum, E. W. (2019). Development of an instructional design model for mobile blended learning in higher education. *International Journal of Emerging Technologies in Learning*, *14*(16), 4–22. https://doi.org/10.3991/ijet.v14i16.10633

Sudira, P. (2017). *TVET abad XXI: Filosofi, teori, konsep dan strategi pembelajaran vokasional*. UNY Press.

Truax, M. L., & Womack, A. J. (2018). The Impact of Teacher Language and Growth Mindset Feedback on Writing Motivation. *Literacy Research and Instruction*, *57*(2), 135–157. https://doi.org/10.1080/19388071.2017.1340529

Verawardina, U., & Jama, J. (2019). Philosophy TVET di era disrupsi revolusi industri 4.0 di Indonesia. *Jurnal Filsafat Indonesia*, *1*(3), 104–111. https://doi.org/10.23887/jfi.v1i3.17156

Verloigne, M., De Bourdeaudhuij, I., Tanghe, A., Brug, J., Paw, M. J. M., De Cocker, K., Lacey, E., Haerens, L., Adachi-Mejia, A. M., Klasson, F. A., te Velde, S., Thorsen, T., Puderewski, M., van Stralen, M. M., Van Cauwenberghe, E., Maes, L., Marques-Vidal, P., Charreire, H., Oppert, J. M., & Bere, E. (2016). Mediating effects of self-efficacy, benefits and barriers on the association between peer and parental factors and physical activity among adolescent girls with a lower educational level. *PLoS ONE*, *11*(6), e0157216. https://doi.org/10.1371/journal.pone.0157216

Villalba, M. T., Fernandez, D. V, & Lopez, S. P. (2018). Factors with influence on the adoption of the flipped classroom model in technical and science and technology education. *Journal of Information Technology Education: Research*, *17*, 441–469. https://doi.org/10.28945/4121

Volodymyrovych, T. Y., & Savastynovych, M. V. (2021). Distance learning technologies in online and mixed learning in pre-professional education of medical lyceum students. *Journal of Advanced Pharmacy Education & Research*, *11*(4), 127–135. https://doi.org/10.51847/ZLy2idWa4f

Wang, J., Wang, S., Wang, J., Song, Z., Zhou, B., Ren, W., Yan, C., Li, Z., & Liu, S. (2017). The Construction of Enterprise Tacit Knowledge Sharing Stimulation System Oriented to Employee Individual. *Procedia Engineering*, *174*, 289–300. https://doi.org/10.1016/j.proeng.2017.01.139

Zhang, W., Wang, Y., Yang, L., & Wang, C. (2020). Suspending classes without stopping learning: China's education emergency management policy in the COVID-19 outbreak. *Journal of Risk and Financial Management*, *13*(3), 55. https://doi.org/10.3390/jrfm13030055