

AI-Based Student Participation and Engagement Analytics Tool for Enhancing Classroom Learning & Engagement

1. Sidra Nazish, 2. Izharul Haq

1. MBA Global Business Administration, University of Gloucestershire, United Kingdom

sidra.nazish14383@gmail.com

2. College of Sciences and Human Studies (CSHS), Mohammad Bin Fahd University, Al

Khobar Dammam, Saudi Arabia

Ihaq@pmu.edu.sa

Abstract

Participation and engagement are essential to positive learning outcomes and while participation is important, it is difficult for instructors to assess participation at the individual level in a classroom. The traditional methods are primarily based on manual tracking and data recording, which require significant time and effort. These procedures are subjective and difficult to follow consistently from the beginning of the semester to its end. This article introduces a student presentation and engagement analytics solution based on artificial intelligence that captures, analyses, and properly visualizes interaction data in real time in the students' classroom. The proposed system allows students to engage in classroom activities by participating in the activities through mobile devices responses to questions and assignment submission, while automatically capturing their responses. A gamification reward system is used to encourage the students to actively participate in the classroom and to motivate them. AI offers live insights to teachers and learners about learning activities, participation and engagement. The proposed approach will make

the traditional classroom into an interactive learning environment that provides timely feedback, support individualized learning and increased student participation, through data driven practices.

Keywords: Artificial Intelligence, Student Engagement, Classroom Analytics, Gamification, Learning Management Systems, Mobile Learning, Educational Technology

1. Introduction

It is very difficult for teachers to keep track of and assess each student's engagement, participation and learning intensity during the semester, especially in the typical classroom setting. While teachers can take the time to write down names and IDs of who participated and what was contributed to the discussion, this is time-consuming, can create an additional workload for teachers, and can be inconsistent and prone to human error. Also, with traditional approaches, it becomes increasingly more difficult to be accurate and to continually document participation and engagement of each student, particularly with class sizes larger than 20 (**Siemens & Baker, 2012**). A real-time data capture system of students' participation that is comprehensive and reliable is a significant obstacle to the study of students' learning behaviours. The lack of quantitative data regarding participation frequency of students, how students respond to questions, obvious signs of participation or disinterestedness, and how participation patterns evolve and change over time are common issues faced by teachers (**González-Pérez et al., 2025**). This research paper presents a new AI-powered student participation and engagement analytics tool to address these issues. The proposed system will allow the students to be active in the classroom activities, engage in Q&A sessions, collaborate in groups or individually on tasks, and write assignments for the professor. Real-time data will be automatically synced, and each student's participation will be analysed by artificial intelligence techniques with this system.

The proposed approach will be based on a gamification approach that will boost and motivate active learning. In this system, students receive points and are recognised for their participation. This gamification mechanism can help increase students' engagement while supporting their focus and deepening their understanding during learning (**Dahri et al., 2025**). It creates something more than a class participation exercise; it is a learning activity that can be enhanced by technology to motivate students to actively participate as active learners, not passive learners.

One of the key benefits of the system that is being proposed is that it would be able to give live feedback and analysis for both student and instructor. Through the use of immediate feedback, teachers have the ability to gain insights into how engaged students are, participation trends in their classrooms, and individual student performances, while students have instant feedback regarding their own contributions and progress **(Ifenthaler & Yau, 2020)**. In traditional classroom settings, less confident or less active participants are encouraged to engage in the classroom by the instructor. The proposed AI based solution automatically recognizes participation and engagement levels, thereby enabling inclusive engagement **(González-Pérez et al., 2025)**. This system is designed to provide a more interactive, data-informed and student-centred learning platform where each student has the opportunity to be engaged, "on-board" and actively involved in classroom activities.

2. Traditional Ways of Engaging and Participating in the Classroom

Traditional class participation and engagement strategies are dependent on instructor led, manual approaches, including personal observation, record-keeping, manual attendance logs, verbal questioning and answering, hand raising techniques, quizzes and participation logs. These methods are widely adopted for decades and are subjectively, time consuming and not scalable in big classrooms. These systems typically miss the broad range of student engagement, do not monitor quieter students and do not track or analyse students' engagement automatically. Consequently, these traditional approaches have low levels of accuracy and are not suitable to make decisions based on data in contemporary educational contexts **(Nazish & Haq, 2026)**.

2.1. Direct Classroom Observation

Observation of student participation is one of the most frequently used methods of determining student participation. This approach involves teachers watching students' oral participation, interest, attention, and responses to class, and has not been hampered by automated technologies **(Prince, 2004)**. There is much reliance on the judgement of the teacher, making the evaluation of students fall short of consistency and may be biased. It also uses additional classroom time, especially in large classes where the teacher does not have the time to monitor the performance of each student. Furthermore, this approach does not offer an objective record and real-time analytics in order to monitor and engage students in the long term **(Siemens & Baker, 2012)**.

2.2. Manual Record-Keeping

With the traditional system of record keeping, busy teachers must fill out paper notebooks, spreadsheets, or paper forms during the term to record attendance and contributions to class discussions (**Prince, 2004**). The traditional way adds to teacher workload, and is very susceptible to human error such as double logging, incorrect data entry, and missing records. Besides, this is impractical in large classrooms, and has serious limitations in having any data visualization capability, automated analysis, or long-term tracking of student participation patterns (**Dawson et al., 2009**). Instructors may find it difficult to keep track of students' participation in large classes when they have several student participations. In most cases, the attendance marks are not calculated with the support of accurate data and this leads to either the reduction of the student's grade or its over increase (**Haq et al., 2020**).

Paper attendance records require students to fill an attendance book or for teachers to call students one by one to enter attendance. All these are a waste of precious teaching time and conducive to malpractices like proxy attendance. Paper records are prone to loss, damage and take longer and involve more time to store and analyse (**Stausberg et al., 2003**).

2.3. Verbal Questioning

Verbal questioning is a traditional teaching method in which teachers ask questions during lecture and assess student participation through their answers. A limited number of pupils are able to take part in each session and quieter or less confident pupils may not be seen when they do participate. However, assessment outcomes can also be affected by the bias of the instructor and there can be issues in systematically recording and analysing participation data over time. It is a traditional method that teachers have been using for a long time, "verbal questioning," where teachers will ask questions to the students and evaluate the students' involvement through their answers in lectures.

2.4. Hand Raising

Another method to get students to ask questions or offer answers when they are in the classroom is to encourage them to raise their hands and using it as an indicator of participation. The approach works well for some students but does not appreciate the involvement of the introverted student. Little attention is paid to students who are listening but not raising their hands. Furthermore, the hand raising method will not give real data or insight into engagement patterns.

2.5. Paper Based Quizzes

Students' understanding is often assessed through paper based quizzes which are used to indirectly determine their engagement in the classroom. The paper-based quizzes can be used to assess academic achievement and not classroom participation. Marking, allocating and distributing of quizzes is a time consuming process for teachers. Feedback is largely delayed – this takes time to prepare and needs intervention to enhance pupils' engagement **(Nicol & Macfarlane Dick, 2006)**.

2.6. Participation Logs

Learner's participation logs are kept by educators to document students' inputs to class presentations and discussions, and to other activities that take place in the classroom over the course of the term **(Siemens & Baker, 2012)**. In large classrooms it becomes impractical to keep students engaged. The student record data is subjective and incomplete because its reliability depends entirely on the educator's consistency and their memory. Moreover, participation logs aren't automated, monitored in real time, or analysed for the information that today's learning environment can provide **(Dawson et al., 2009)**.

The envisaged AI-based mobile analytics tool for student engagement and participation will enhance classroom learning by enabling students to engage through their mobile devices and helping teachers monitor and evaluate student engagement in real time. It is a system that automatically captures students' contributions, answers to questions, quiz participation, assessment submission and classroom activities through artificial intelligence and learning analytics. The system is able to gather large amounts of data, which are precisely analysed by the system, recognise engagement trends and give helpful feedback to educators and learners. The mobile-based AI system offers benefits such as lowering the need for manual observation, enabling continuous monitoring, actively and passively engaging learners through interaction, and fostering a more personalized, data-oriented, and enriching learning environment in the classroom **(Smith et al., 2022)**.

3. Key Features of the AI-Based Student Participation and Engagement Analytics Tool

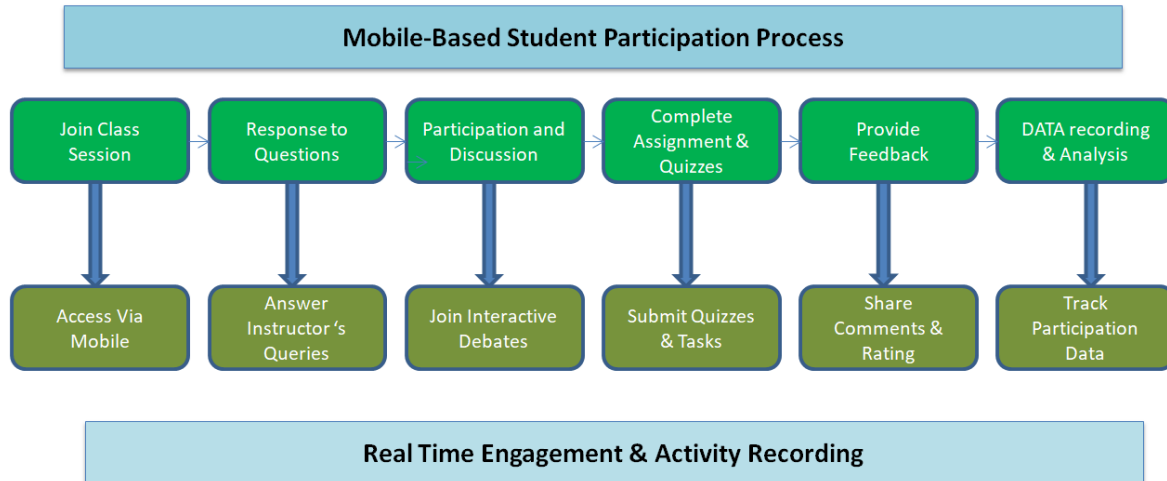


Figure 01: Flow Chart of Mobile-Based Student Participation

3.1. Mobile-Based Student Participation

The proposed system promotes a participatory approach in the learning activities from the students in the classroom by using smartphones. Mobile application performs a significant and interactive role as it offers a platform to students to answer the question posed by the instructor, discuss, attempt quizzes, submit assignments and give feedback. It also enables students to remain active as part of a group in learning activities. In contrast, in the non-mobile phone participation classroom, limited opportunities exist for student participation and contribution while mobile phone participation provides opportunities for all students to participate with the learning activities. The mobile platform can be used for ongoing data collection through data logging of students' learning activities, frequency of participation, response patterns, and task completion and durations. This method allows for the use of a learning space that is inclusive for all learners, both active and passive, to be engaged in learning in the classroom and through a digital learning platform (Naseer et al., 2026).

3.2. Collect Real-Time Participation Data

This systematic approach enables teachers to gather and document information on each student throughout the class without having to manually track data. This data may involve student answers to questions, quiz attempts, scenario based discussions, assignment submissions, attendance and interactions. Collecting the data in real time eliminates the time consuming, subjective and cumbersome nature of traditional manual observation methods and these methods would be difficult to sustain for an extended school semester. The system automatically records the data of classroom interactions that allows for accurate and continuous participation records. Moreover, it can be a tool for analysing and understanding students learning behaviour and engagement (Castillo-Hernández et al., 2022).

3.3. AI based Engagement Analytics

The system's main purpose is to be an AI-driven analytical engine which analyses student activity data and rates students' engagement. Participation metrics such as interactions, response levels and timing, quiz scores, assignment completion time and classroom engagement are analysed by AI algorithms. The AI model detects patterns in student behaviour and generates student engagement levels (high, medium and low). This information can be used to guide the designing of pedagogical strategies and to implement them in the classroom with desirable outcomes. In addition, the analysis process also facilitates the detection of changes in participation patterns over time and indicates which students need extra academic help.

3.4. Customer Tagging System

The proposed system has an automated engagement scoring system to help objectively evaluate the engagement level and participation of each student in the classroom. A predefined score is given for each learning activity based on the impact it has on the overall learning process. Student's engagement with activities including answering questions, attending class discussions, completing quizzes and assignments are logged systematically and included in the overall engagement score. Furthermore, the scoring system gives students levels of engagement and feedback on their performance, and motivates students to participate in class activities.



Figure 2: Flow of Automated Engagement Scoring System

3.5. Live Chat Support

The AI analytics module analyses the overall engagement based on various participation metrics, such as the number of interactions, task completion timelines and learning activities. The results of the engagement allow an objective, consistent assessment of each student's participation in class, which helps the instructor to track how much students are participating, and provide a comparison to the participation of students who might need extra support in their academic learning. Furthermore, students can receive feedback from the results throughout.

3.6. Harnessing the potential of gamification to motivate students to learn

It adopts gamification approaches in class activities to help students to be more engaged and motivated in their daily tasks. Students are rewarded with points/achievement scores, participation based recognition and engagement contributions. Gamification transforms learning in the classroom from a "doing" to a "doing with pleasure" moment. Students are encouraged to do learning tasks, be involved in discussion, continuous engagement and answer questions. This approach encourages students to be active instead of passive and absorb the information (Ashfaq et al., 2024).

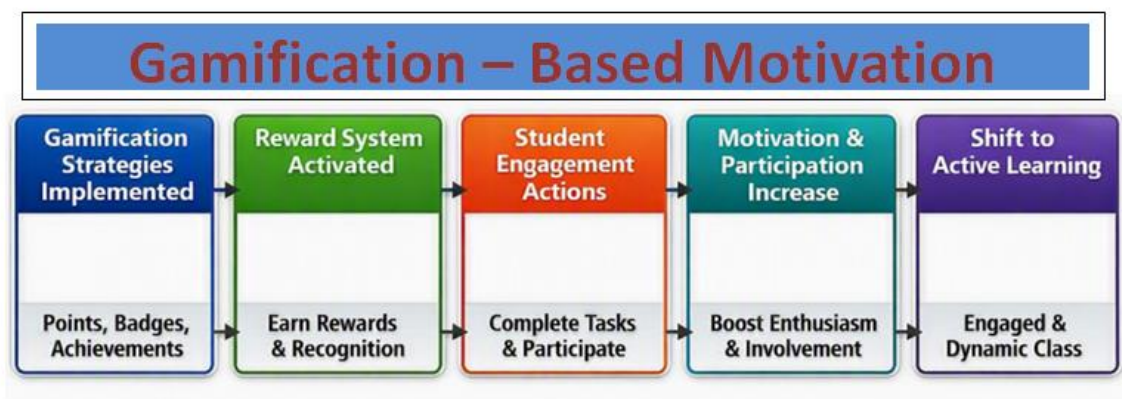


Figure 3: Gamification-Based Motivation Flow Chart

4. Real-Time Analytics Dashboard and Feedback

The AI-based mobile system offers a captivating dashboard, enabling real-time classroom engagement and participation monitoring for teachers and students. The teacher dashboard provides visual analytics with scores, models of performance in the classroom, engagement, participation trends, student activity, and more. This can be used to pinpoint students who are strongly engaged, to identify students who are not participating and adjust instruction and or teaching methods. Meanwhile, the system offers students instant feedback on progress, engagement and contribution. This constant remediation process leads to self-reflection and better learning behaviour (Kashif et al., 2026).

5. Personalized Learning Support and Intervention

One of the most important features of the AI based system is the capability to offer personalized support according to the user's engagement patterns. The approach can be used to evaluate student behaviour and determine students who are unlikely to participate, be disengaged or unable to finish learning tasks. The system gives teachers important data and information about student learning which enables them to design the right interventions (individual feedback, extra guidance, identified learning resources, etc. and strategies to involve and encourage). This will ensure that students who are not often caught up in conventional classes will receive academic guidance at the appropriate time.

6. Data Driven Classroom Management

The system converts classroom participation information into meaningful educational information for teachers to make decisions based on data. Teachers can use AI generated reports and analytics to evaluate classroom interactions and enhance their teaching methods beyond personal analytical observations. Additionally, data gathered can inform teachers about participation trends and assess the success of pedagogical methods to facilitate more dynamic learning experiences. It facilitates a student-centred, personalized, and technology-driven learning environment, thanks to its ability to incorporate AI, mobile technology, and learning analytics.

7. Overall System Contribution

The AI-based mobile student participation and engagement analytics tool combines mobile learning, AI, learning analytics and gamification to solve the problem of relying on conventional approaches for monitoring classrooms. Through this system, students can be continually tracked for participation and receive helpful feedback as well as engage analysis at the moment, which motivates students to participate and helps teachers assess students and take evidence-based decisions to improve the learning in the classroom (**Smith et al., 2022**).

8. Discussion

The proposed student participation and engagement analytics tool based on AI are discussed in terms of the core limitations of the participation assessment methods used such as manual observation, paper-based records and instructor maintained logs, which are time consuming and difficult to assess student participation in real time. The framework combines the insights of AI, mobile technology, learning analytics, and gamification to offer a scalable and objective means of ongoing monitoring of student engagement. One of the big systems' functions is to automatically gather real time participation information such as attendance, quiz answers, interaction in the classroom, and feedback on assignments, and other learning activities. Traditional approaches typically do not take other factors into account (**Smith et al., 2013**), while the proposed tool will continuously monitor and evaluate students' participation and engagement in the classroom. This enables instructors to make evidence based decisions and identify those students who require additional support (**Chen et al., 2025**).

Teachers said that this system facilitated work, particularly if it provided them with information on attendance and performance. These activities were automated, giving them more time to spend with students needing additional support (**Bin Bakheet et al., 2026**). The objective data and AI-based analytics and automated engagement scoring enhance transparency and consistency. With this proposed system, students will be able to get constructive feedback about their level of engagement and draw more awareness to their own engagement and awareness in classroom activities. Furthermore, gamification elements like points, badges, and rewards serve as positive reinforcement, fostering motivation. The mobile features enhance accessibility and inclusiveness, enabling students to take part digitally and remain engaged, no matter where, how confident or

how they communicate. This offers many advantages for blended and hybrid learning, where constant interactions and participation can be crucial **(Hadyaoui & Cheniti-Belcadhi, 2024)**.

But there are still several issues such as the need for a dependable technological infrastructure, internet connectivity, availability of devices and privacy concerns. Thus, the AI-based engagement scoring system is not intended to replace or supplant the professional judgement of the teacher, with some qualitative features that may not be effectively captured by an AI system. Further study is needed to measure the accuracy, ease of use, acceptance and learning outcomes of the proposed framework when implemented. In this case, the tools that will improve learning are those that will be able to engage in spoken or written discussion, understand non-verbal expression, and adapt learning. Together, the suggested system illustrates the potential of the integrating AI, mobile learning, analytics, and gamification to transfer classroom participation into a process driven by meaningful data and enhanced learning. **(Stausberg et al., 2023)**.

9. Conclusion

This article suggested an AI-based analytics platform for engagement and participation for students which goes beyond the traditional methods of assessing students in the classroom. The framework combines AI, mobile technology, gamification, and learning analytics to facilitate real-time data collection and give educators a comprehensive view of student engagement. This approach allows for more objectives and transparent participation monitoring, is more scalable, and cuts down on the workload for traditional participation monitoring. The teaching methodology will support teachers by providing them with actionable information about student learning behaviour, and it will offer the opportunity to evaluate participation in the class and intervene in time for students who require additional support. Moreover, by integrating the existing engagement scoring with gamification, active engagement is encouraged and an interactive learning can be maintained.

While there are potential advantages, there are also significant technological, privacy and ethical concerns for ensuring its successful implementation. The future research aims to evaluate the performance of the developed system, deploy it in real-world scenarios, and incorporate sophisticated AI capabilities such as computer vision, adaptive learning models, and natural language processing. The general idea of the AI system proposed is compelling in the overall

context of improving classroom participation through a digital, analytical and learner-centred process. It helps to enhance teaching effectiveness, improve education results, and facilitate individual learning in higher education.

References

- [1] Ashfaq, O., Sami, A., & Yousaf, H. (2024). Parent-teacher collaboration and its effect on student's achievement at pre-school level. *Pakistan Social Sciences Review*, 8(2), 386–399. [https://doi.org/10.35484/pssr.2024\(8-II\)32](https://doi.org/10.35484/pssr.2024(8-II)32)
- [2] Bin Bakheet, T., Alamri, H., & Alshaya, F. (2026). Developing deep learning in science through an adaptive AI-based STEM instructional program: Evidence from sixth-grade classrooms. *International Journal of STEM Education*. <https://doi.org/10.1186/s40594-026-00630-1>
- [3] Castillo-Hernández, F. J., Jiménez-Liso, M. R., & Couso, D. (2022). Can we do real inquiry online? Influence of real-time data collection on students' views of inquiry in an online, multi-site masters' degree on environmental education. *Journal of Computing in Higher Education*, 34(3), 608–632. <https://doi.org/10.1007/s12528-022-09312-7>
- [4] Chen, X., Xie, H., Qin, S. J., Wang, F. L., & Hou, Y. (2025). Artificial intelligence-supported student engagement research: Text mining and systematic analysis. *European Journal of Education*, 60(1), e70008. <https://doi.org/10.1111/ejed.70008>
- [5] Dahri, N. A., Yahaya, N., Al Rahmi, W. M., & Al Adwan, A. S. (2025). *The effect of AI gamification on students' engagement and academic achievement in Malaysia: SEM analysis perspectives*. *IEEE Access*, 13, 70791–70810. <https://doi.org/10.1109/ACCESS.2025.3560567>
- [6] Dawson, S., Bakharia, A., Lockyer, L., & Heathcote, E. (2009). *Using learning analytics to support student learning*. In *Proceedings of the 26th Annual ASCILITE Conference* (pp. 45–55). Auckland, New Zealand. <https://www.ascilite.org/conferences/auckland09/procs/dawson.pdf>
- [7] González-Pérez, L. I., García-Peñalvo, F. J., & Argüelles-Cruz, A. J. (2025). *Data-driven learning analytics and artificial intelligence in higher education: A systematic review*. *Revista Iberoamericana de Tecnologías del Aprendizaje*, 20, 440–451. <https://ieeexplore.ieee.org/document/11184165>
- [8] Hadyaoui, A., & Cheniti-Belcadhi, L. (2024, November). An ontology-driven framework for adaptive and transparent AI-assisted student assessment. In *International Conference on*

- Web Information Systems and Technologies* (pp. 246–267). Springer Nature Switzerland.
https://doi.org/10.1007/978-3-032-25534-1_11
- [9] Haq, I., Haq, R., & Ahmed, M. (2020). Using the ROFSET framework in tracking, measuring and analysing student participation and engagement in class. *INTCESS 2020 – 7th International Conference on Education and Social Sciences*.
<https://share.google/6VDMWN4rVyzWCa7eS>
- [10] Ifenthaler, D., & Yau, J. Y.-K. (2020). Utilising learning analytics to support study success in higher education: A systematic review. *Educational Technology Research and Development*, 68(4), 1961–1990. <https://doi.org/10.1007/s11423-020-09788-z>
- [11] Kashif, M., Shah, M. S., Fatima, A., Ahmad, S., & Maqbool, A. (2026). Parent–teacher collaboration and classroom engagement of autistic students in Punjab, Pakistan: An explanatory sequential mixed-methods study. *International Journal of Emerging Multidisciplinaries: Social Science*, 5(2). <https://doi.org/10.54938/ijemdss.2026.05.2.692>
- [12] Naseer, S., Khan, A., & Ahmad, N. (2026). Artificial intelligence-assisted art education foster student inclusion and engagement: Opportunities and challenges. *International Journal of Emerging Multidisciplinaries: Social Science*, 5(1).
<https://doi.org/10.54938/ijemdss.2026.05.1.735>
- [13] Nazish, S., & Haq, I. (2026). AI-enabled mobile attendance system for higher education: Enhancing accuracy, scalability, student engagement, and academic performance. *International Journal of Emerging Multidisciplinaries: Social Science*, 5(1), 139–156.
<https://doi.org/10.54938/ijemdss.2026.05.1.685>
- [14] Nicol, D., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in Higher Education*, 31(2), 199–218. <https://doi.org/10.1080/03075070600572090>
- [15] Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*, 93(3), 223–231. <https://doi.org/10.1002/j.2168-9830.2004.tb00809.x>
- [16] Siemens, G., & Baker, R. S. (2012). Learning analytics and educational data mining: Towards communication and collaboration. In *Proceedings of the 2nd International Conference on Learning Analytics and Knowledge (LAK '12)* (pp. 252–254). ACM.
<https://dl.acm.org/doi/10.1145/2330601.2330661>

- [17] Smith, M. K., Jones, F. H. M., Gilbert, S. L., & Wieman, C. E. (2013). The Classroom Observation Protocol for Undergraduate STEM (COPUS): A new instrument to characterize university STEM classroom practices. *CBE—Life Sciences Education*, 12(4), 618–627. <https://doi.org/10.1187/cbe.13-08-0154>
- [18] Smith, T. E., Holmes, S. R., Romero, M. E., & Sheridan, S. M. (2022). Evaluating the effects of family–school engagement interventions on parent–teacher relationships: A meta-analysis. *School Mental Health*, 14(2), 278–293. <https://doi.org/10.1007/s12310-022-09510-9>
- [19] Stausberg, J., Koch, D., Ingenerf, J., & Michaelis, J. (2003). Comparing paper-based with electronic patient records: Lessons learned during a study on diagnosis and procedure codes. *Journal of the American Medical Informatics Association*, 10(5), 470–477. <https://doi.org/10.1197/jamia.M1290>