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Cloud-Based Collaborative Assessment Platform to Evaluate Service-Learning Group Projects in University Courses

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ABSTRACT

In response to the digital era, various online assessments have been implemented and are used in several domains, including educational institutions. Cloud services facilitate real-time feedback, overcoming delays inherent in traditional assessment methods. However, some online assessment platforms are hard to follow as there are several stages and steps in the evaluation process. It is a further hindrance when considering several types of assessor roles in the evaluation process. The maturity of online assessment demands that different contributors be integrated into the evaluation process. It required careful consideration of a marking distribution plan. This paper specifies the design and development of an online assessment platform for multiple contributors that utilizes the capabilities of Cloud computing. A key feature of the platform is offering multi-assessors in the evaluation workflows. The choice of Cloud computing is that the assessors can assess from anywhere, provided that they are registered contributors. The online assessment platform of this study demonstrates the reasonable multi-assessor's application of Cloud computing. The model of marking distribution is also practical for assessing the class project of service-learning (SL) activities. The multi-role assessors significantly enhance the overall assessment process with transparent evaluation and by utilizing the Cloud service, the assessment process is further enhanced.

1. Introduction

With the in-depth and widespread application of information technology in management, the implementation of evaluation systems has gradually matured technically, completely changing the way educators evaluate themselves. Notable among these technological innovations are the development of comprehensive course assessment through digital platforms. The incorporation of Cloud computing into educational technologies has significantly transformed the landscape of learning and assessment methodologies. Cloud computing offers scalable, on-demand access to computing resources, facilitating the development of more dynamic, accessible and efficient

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educational platforms [1]. Utilizing Cloud computing reflects a broader trend in educational technology, aiming to enhance the quality and accessibility of learning assessments while reducing complexities [2].

In terms of assessment methodologies, Cloud computing enables a more nuanced approach to evaluating student performance. Traditional assessments often rely on one-size-fits-all testing mechanisms that may not accurately reflect individual learning progress or challenges. However, as noted by Dai *et al.,* [3], Cloud-based assessment tools can offer personalized learning experiences and adaptive testing, which aligns with the learners' abilities and knowledge levels. This personalized approach not only improves the assessment's relevance and fairness but also enhances student engagement and motivation.

An experiential learning approach can be assessed by getting the students involved and solving real-life problems. With the growth of the ICT era, an assessment strategy can be realized by integrating several perspectives from different assessors through a digital portal and real-time processing as discussed in Alkrimi *et al.,* [4]. However, it creates obstacles when it comes to the issue of assessment components and separations. It is challenging to develop a marking scheme and rubric when the assessors come from different experiences. The issue of what criteria to use and how many points to distribute among assessors is required to be studied. With that motivation, this project's goal is to develop a multi-roles assessment model with Cloud computing for evaluating student engagement in service-learning (SL) projects

The assessment model employs several numbers of assessors that consists of instructor, peer and industry/community representative. The SL project materials and evidence will be evaluated by the assessors based on the prescribed rubric and according to the assessor's role. The score that can be viewed collectively is conclusive since it comes from several perspectives. Using a Cloud-based collaborative assessment platform, the assessors can work remotely to evaluate how well students participated in service-learning projects.

2. Literature Review

In the educational sphere, the dynamics of student assessment and the ethos of cooperative learning emerge as pivotal elements shaping pedagogical practices. In the domain of integrated assessment platform, the significance of expert review systems and tailored scoring mechanisms cannot be overstated. User-centred design and data integration principles significantly contributes to the effectiveness of the collaborative assessment in delivering reliable assessment data.

2.1 Cooperative Assessment

To ensure the objectivity and fairness of evaluations, the multi-role contributors' model must be well designed. It must adhere to stringent professional standards in education. It is supported by the analysis of peer review standards in academic publishing conducted by Husain *et al.,* [5]. The efficacy of peer assessment is well-documented, with studies by Ng and Yu [6] illustrating how such evaluative practices foster deeper cognitive engagement among students, thereby enhancing their analytical and presentational competencies. Furthermore, the work of Huynh and Nguyen [7] underscores the motivational benefits of peer assessment, highlighting its role in bolstering students' autonomy and engagement with learning tasks. The depth of an expert's practical experience and academic background is crucial for the credibility of project evaluations, as highlighted by Braman [8].

Moreover, the intricacy of scoring mechanisms plays a pivotal role in accurately reflecting the nuances of different projects. Madan and Gnanendran [9] advocate for the adaptation of scoring

mechanisms to the unique demands of varied educational projects, suggesting a bespoke approach to criteria and weight allocations. This customization is crucial for fields like design, where Park and Lee [10] examine the value of creativity and conceptual thinking and engineering projects, where Honoré-Livermore *et al.,* [11], Neyem *et al.,* [12] and Fossum *et al.,* [13] stress the practicality and necessity of engineering projects. Therefore, in order to maintain the scientific and rational foundation of the evaluation process, the establishment of a scoring system requires a thorough understanding of the goals, requirements and characteristics of the project. Liu, Wang and Xiao [14] and Podymova *et al.,* [15] have confirmed this need in their investigation of scientific scoring systems in educational projects.

Equally critical is the role of cooperative learning in developing essential social and academic skills. According to Yang *et al.,* [16], cooperative learning methodologies significantly contribute to the cultivation of teamwork and communication abilities, enabling students to effectively navigate the complexities of collaborative projects. Amran *et al.,* [17] support this idea by demonstrating the beneficial effects of cooperative learning on students' capacity for problem-solving and flexibility when applying theoretical knowledge to real-world situations. Furthermore, Chowdhury ‘s research [18] explores the iterative process of improving one's cognitive and skill sets through cooperative learning, highlighting the transformational power of ongoing peer engagement and discussion.

2.2 Data Processing

Student data is huge and the processing of big data is also a key research area for many researchers. He [19] mentioned that the academic affairs system generates a large amount of data information every day and also needs to invest some manpower, material resources and manpower for mining, analysis and decision-making. The use of big data technology in college student management can better improve the authenticity and reliability of student management data. Similarly, the authors in Jahangir *et al.,* [20] designed the education administrative attendance management system to serve the college's educational attendance work. They use layered thinking for architectural design. Fuadi *et al.,* [21] revealed that the sample size in the study was 340 respondents. It is conducted using sampling techniques with a simple random sampling type based on the approximately 15, 000 students on the Entrepreneur campus. Data were collected using an online questionnaire tool and then analysed using descriptive analysis techniques. Note that the university governance practices have changed their operations into a digital platform, especially for educational management information systems for quality services. This has also directly involved the use of an academic scoring system online.

2.3 Collaborative Assessment Design

The architecture of course assessment must offer accurate collection and analysis of educational data. It includes the system interaction between users. In multi collaborators assessment platform, the interface design become another critical issue. Studies by Patel and Kumar [22] emphasize the importance of intuitive form design, focusing on user experience principles to facilitate ease of use and engagement. Moreover, the adaptability of form designs, as examined by Lee and Thompson [6], allows for a more personalized assessment process, accommodating diverse needs and learning outcomes.

One strategy for enabling hands-on learning is to give students tasks and responsibilities. To embed innovation in teaching and learning (T & L), some assessment strategies involving industrial engagement and community service have been implemented in [23-25]. In this project, we focus on

service-learning activities for assessing students' capacity outside of class sessions. Service-learning is an experiential learning strategy where students learn course content and additional relevant skills through completing service with a community partner. It essentially serves to build social responsibility and civic skills while enhancing students' knowledge and experience. For example, the activities include supporting families and neighbourhoods to clean up residential areas and guiding teachers in the use of online learning tools. In response to the need to instil holistic and diverse values among students, the service-learning activity needed to be valued not just by the lecturer but also by the entity where the service is conducted. The author Gerstenblatt [26] mentioned that a well-designed community service activity must involve and benefit both participants, i.e., students and communities. Diversity in designing community service activities will be able to value the students' capacity and skills due to the multidimensional and different objectives of the community [27]. Hence, their expectations from the service activities can be part of the assessment rubric.

Collaborative assessment is not a new approach used in T&L activities and it has been employed in several assessment strategies for innovative learning based on [28-31]. Recent work by Ridwan *et al.,* [32] conducted assessment tests that involved several entities, including self, peers and teachers in vocational education. The assessment rubric considers three main aspects: planning, monitoring and evaluation. Their rubric assessment model was tested by 35 students and was able to meet project-based learning outcomes. But the assessor is limited to entities within the institution. Meanwhile, in Figueiró *et al.,* [33] proposed the evaluation as a complementary layer by conducting qualitative research based on a systematic literature review and semi-structured interviews with experts in the fields of higher and management education. Their study contributes to the field by presenting a multi-analytical model that can guide institutions to integrate management education related to planning and action. In Zascerinska *et al.,* [34] they highlighted that the multi-perspective phenomenon has been beneficial to educational systems when it includes both external and internal perspectives. Zhou [35] proposed a mixed-methods (MM) tool to ensure effective assessment and quality course delivery. Their course-based service-learning model is integrated with real-world experience to evaluate competency development. The tool served as self-assessment for professionals, an educational tool in higher education, or training for organizations that intended to conduct evaluations. Even though integrated assessment is utilized, it does not focus on producing grades for the learners.

3. Development Environment

This section elaborates on the environment setting for the integrated assessment systems platform. It consists of a detailed introduction to the application of front-end and back-end tools and technology stacks in the process of developing the platform. Figure 1 below shows the system architecture diagram with the various components and tools used, from the front-end user interface to the database. The back end is responsible for processing the request sent by the front end, data processing and logic implementation. Back-end development can choose different programming languages and frameworks (such as Java, Python, Node.js, etc.), handle database operations and logic according to requirements and return the processing results to the front end through an API.

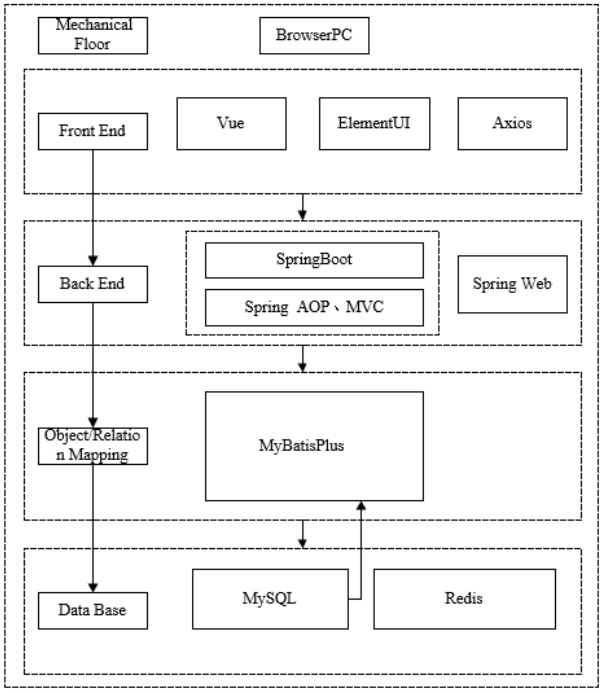

Fig. 1. System architecture

3.1 Develop the Use of Front-end and Back-end Tools

The front-end and back-end development models are separated based on their operational roles in the system. The front-end is responsible for user interface and interactive logic, while the back end is responsible for data processing and logic. The main feature of this model is that the front and back end are independently developed and communicate through an API. The front-end and the back end communicate by defining a set of unified API interfaces; the front-end develops according to the interface documents and the back-end provides corresponding API interfaces according to the interface documents. In this way, front-end and back-end development can be executed in parallel. Moreover, the front and rear ends are independent and the technology selection and expansion can be flexibly carried out.

The front-end development tool uses Visual Studio (VS) Code, a cross-platform source code editor for writing modern web and Cloud applications. Its comprehensive language support for Vue, Spring Boot and SQL. Database management that goes from the Vue.js interface to the Spring supports server functionality. VS Code enables code editing, running and debugging in a single, customizable interface. The ability to connect to remote systems further aligns with the modern development practices of Cloud-based applications and services, making it an efficient development tool.

The back-end development tool uses IntelliJ IDEA. IntelliJ IDEA is a very powerful development tool and is a great choice for working on complex websites because it works well with Java and web languages. It can handle databases too. It helps to write code faster and more accurately. It also has special add-ons for the tools that this project uses, like Vue.js and Spring Boot, which helps faster integration between front-end and back-end models in building the website.

3.2 System Development Model

In our work, the front-end model is developed by using HTML, CSS, JavaScript, React, Angular and Vue.js. It is responsible for realizing the user interface and interacting with users. Listed are the application used in developing the front-end model for our platform.

i. JDK17: JDK 17 is a version of Java Development Kit, which contains various tools and libraries for developing, compiling and running Java applications. JDK 17 is the latest version in a series of versions after JDK 8, which introduces some new functions, improvements and optimizations. The development of the integrated assessment platform involves many modules such as user management, course management and grade management. There are various functions provided by JDK 17 is used and the Figure 2 below shows JDK17 platform settings.

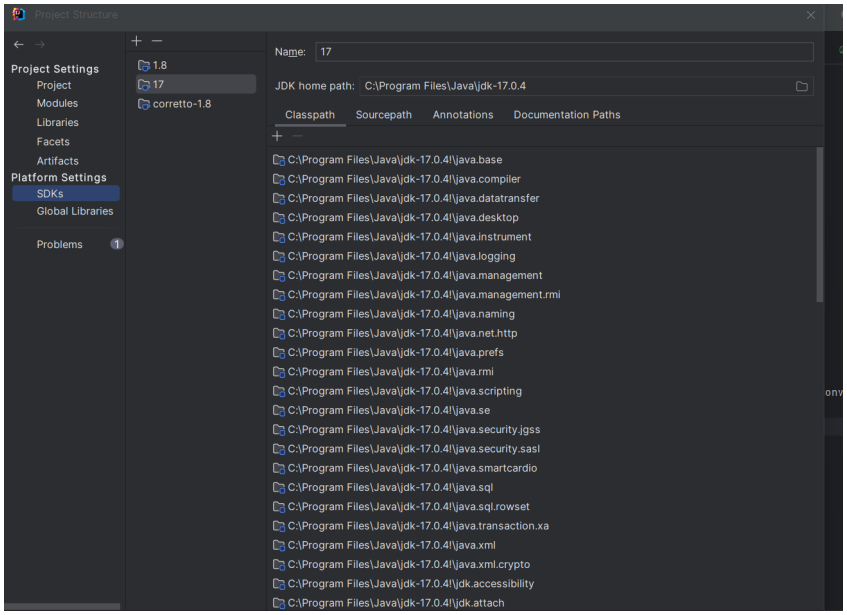

Fig. 2. JDK17 settings

ii. Springboot Framework: Spring Boot aims to simplify the configuration and deployment processes of Spring applications. Importantly, with its automation and default configuration, it offers streamlined configuration that convention is superior to configuration. The Spring Boot provides an API for handling the requirements. On our platform, the parent dependency at back-end is using spring-boot-starter-parent-web. The Figure 3 shows the poml.xml of the Spring Boot project.

```
<parent>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-parent</artifactId>
    <version>1.5.13.RELEASE</version>
</parent>

<dependencies>

    <dependency>
        <groupId>org.springframework.boot</groupId>
        <artifactId>spring-boot-starter-web</artifactId>
    </dependency>
```

Fig. 3. Web project built based on the spring boot framework

iii. Vue Framework: Vue.js is a modern JavaScript framework for building user interfaces. It adopts a component-based development mode, which makes the front-end development more modular, reusable and easy to maintain. In the integrated assessment platform, Vue

is used to build the front-end user interface and interactive logic page application. Meanwhile, SpringBoot is used to build the back-end application logic and server-side applications. The Figure 4 depicts the version using Vue.

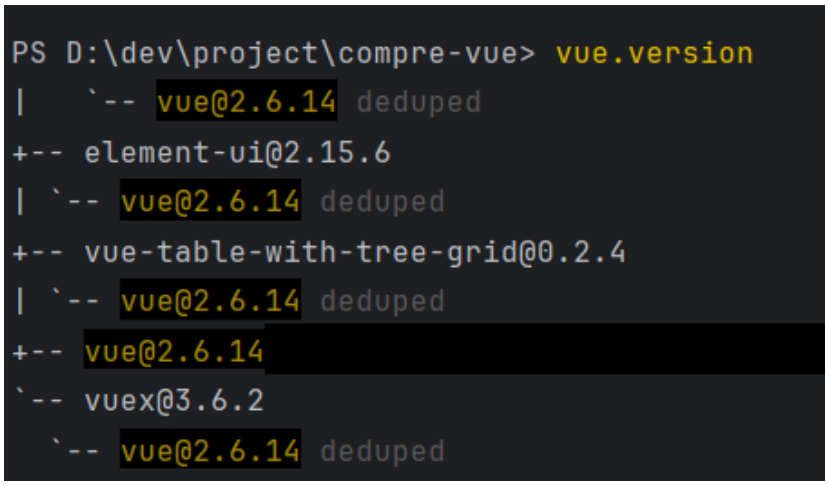

Fig. 4. Vue version

iv. MySQL Database: MySQL is an open-source relational database management system (RDBMS), which is widely used in data storage and management of various applications. In the development of our platform, MySQL plays as database design aims to design multiple related tables to store different data. In prior, the database is relied on the Entity-Relationship Diagram (ERD) that given in Figure 5. For our assessment integrated modules, the database means to relate relationships between entities i.e., courses, students, lecturers and external contributors.

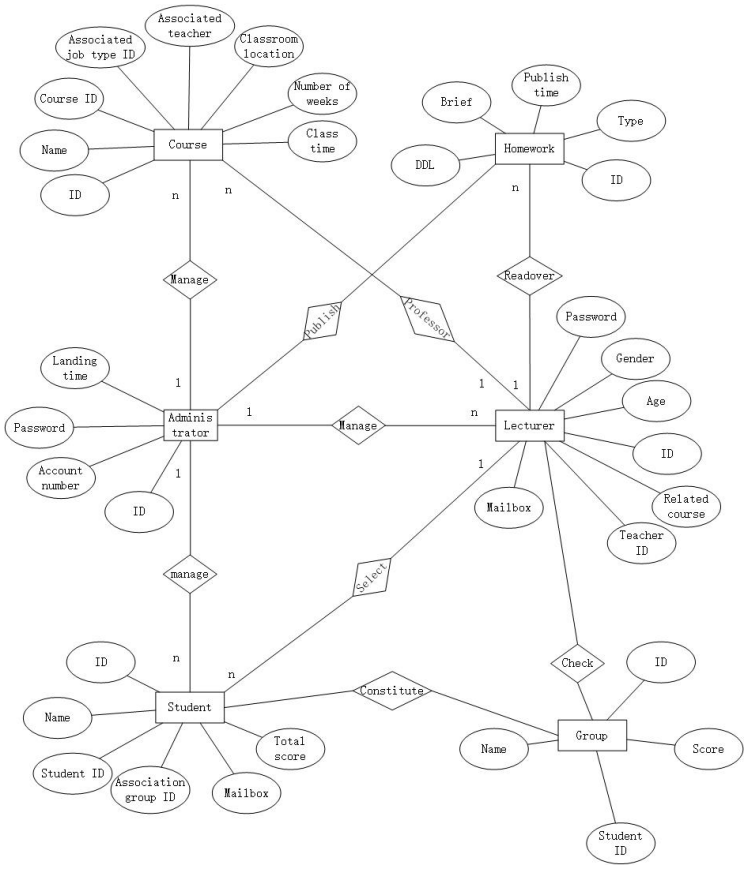

Fig. 5. E-R diagram of system

v. Axios Request: Axios is an HTTP request library based on Promise, which can send asynchronous HTTP requests in browser and Node.js environment. It enables interaction with the back-end API, handle asynchronous requests, exception handling, interceptors and other operations, to ensure front-end and back-end data transaction. In the development of our platform, Axios used for data interaction with back-end API. We used Axios to initiate GET request to obtain student list and use POST request to submit student information. The following is an example code for sending a GET request using Axios:

```
import axios from 'axios';
//Initiate a GET request
axios.get('/api/students')
.then(response => {
//Process the returned data
console.log(response.data);
})
.catch(error => {
//Handling error
console.error(error);
})
```

vi. Tomcat Server: Tomcat is an open-source Java Servlet container. It implements Java Servlet and JavaServer Pages (JSP) specifications for running Java Web applications on the server. As a servlet container and a platform supported by JSP, it can handle user requests, dynamically generate pages and provide static file access through static resource services.

In addition, Tomcat also provides database connection and management tools, which to configure and manage the web-based system. The Figure 6 below shows the version of Tomcat used in our project.

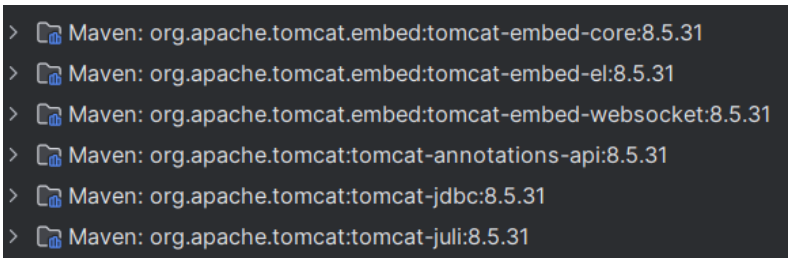

Fig. 6. Tomcat server

4. Development Environment

This section discussed the assessment design and implementation in catering to the multiple assessors and their diverse roles. It consists of the assessment process in detail**.**

4.1 Evaluation Design

The flowchart in Figure 7 outlines the process from the beginning with user login and subsequent verification of account existence. Upon successful login, the user selects their role, which branches into lecturers, students and partners. The lecturers become superior assessors because the majority of course assessment tasks will be under their responsibility. The student in our scope acts as a peer assessor where there are course tasks that are also required to be assessed by their friends. Meanwhile, the partners, either from industry or community representatives, will evaluate the course SL project. Mainly, the representative comes from where the project is held.

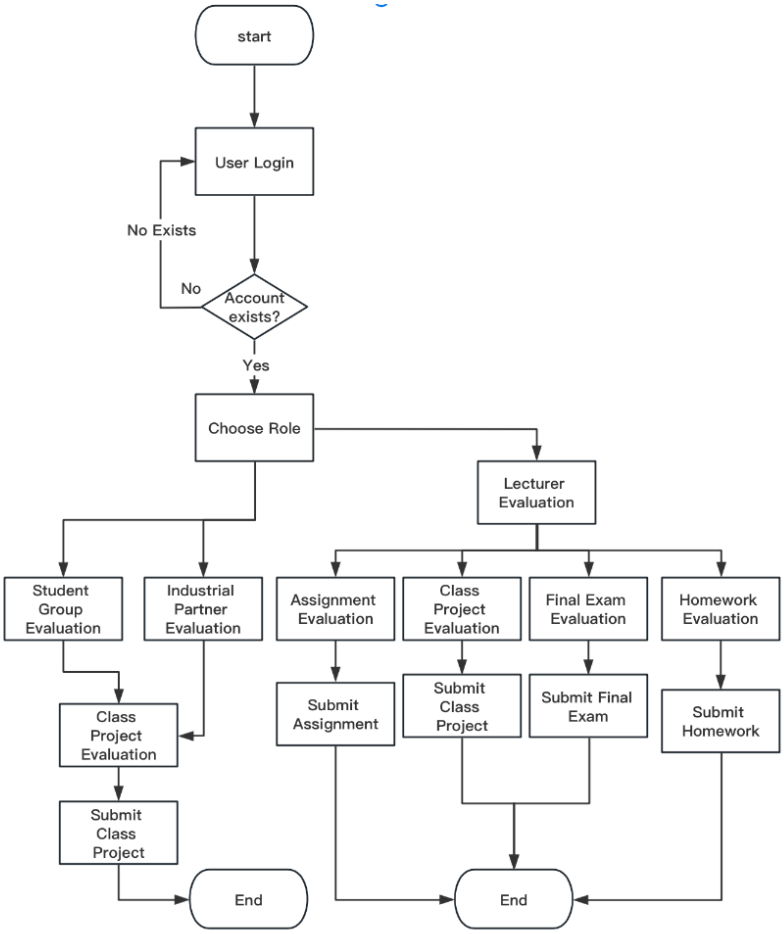

Fig. 7. Evaluation flow process

Basically, students are assessed based on four types of assessment are assignment, homework, final exam and class project. Each of the tasks is being assessed differently according to its criteria. For example, the assignment can be assessed using a rubric, while the final exam requires a mark. For the rubric design, we formed it based on the type of assessment, either Assignment, Homework or Project. Each type of assessment has a different rubric for identification. Note that the Final Exam does not involve peer and partners in the assessment. Meanwhile, for the other assessments, it depends on the lecturers to call for peers and/or partners representatives to assess their students or not. It means there is a possibility that the student materials are also evaluated by others besides the lecturers. For Final Exam evaluation, the lecturers can directly enter scores. The total score of all types of assessments becomes the final score for the student.

The Figure 8 shows the design for type of assessment Assignment. The rubric is used as follows:

i. Complete according to requirements
ii. Understanding concepts
iii. Implementation quality
iv. Timeliness.

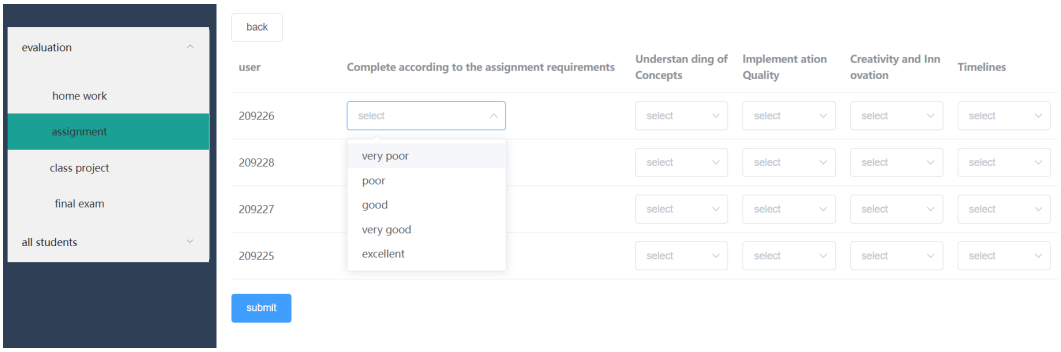

Fig. 8. Assessment evaluation

The Figure 9 shows the design for type of assessment Homework. The rubric used as follows:

i. Content accuracy.
ii. A clear grasp of the underlying principles.
iii. Work organization.
iv. Clear process at deriving the solutions.
v. Submissions.

Fig. 9. Homework evaluation

The Figure 10 shows the design for type of assessment Project. The rubric used as follows:

i. The project documentation should include a well-defined statement of the problem, project objectives and scope of the network design or implementation.
ii. The technical aspects of design or implementation
iii. Demonstration of functionality and performance
iv. Clarity and effectiveness of project presentations and communication
v. Creativity and innovation.

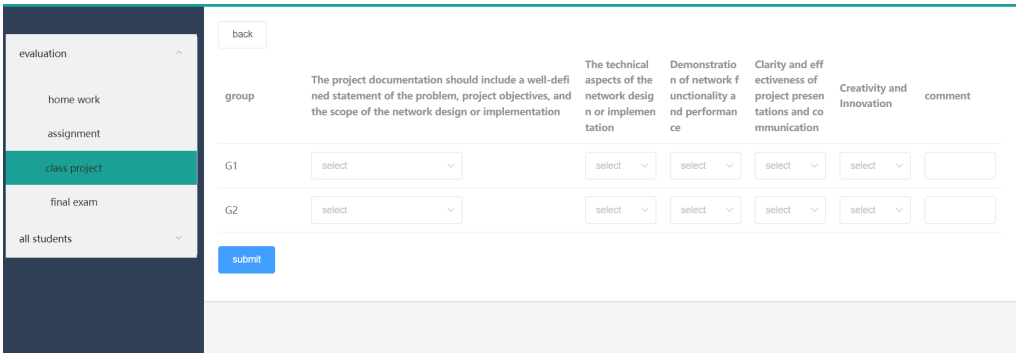

Fig. 10. Project evaluation

4.2 Grading Process

Explicitly, every rubric has a score with it to form the mark value. Because we are dealing with several contributors in the assessment process, we make it easier by simply clicking the drop-down menu. It involved five levels evaluation are very poor, poor, good, very good and excellent. For generating the numerical data in the total score, we assigned a value in each level evaluation. It assigned one value for each string value ("very poor", "poor", " good", "very good", "excellent"), a corresponding numerical value (0, 5, 10, 15, 20). This conversion facilitates the use of precise, numeric representations for qualitative data, which can then be used for further processing. The code snippet is given in Figure 11.

```
BigDecimal oneScore = new BigDecimal("0");
if ("very poor".equals(d.getOne())){
   oneScore = new BigDecimal(0);
}else if ("poor".equals(d.getOne())){
   oneScore = new BigDecimal(5);
}else if ("good".equals(d.getOne())){
   oneScore = new BigDecimal(10);
}else if ("very good".equals(d.getOne())){
   oneScore = new BigDecimal(15);
}else if ("excellent".equals(d.getOne())){
   oneScore = new BigDecimal(20);
}
```

Fig. 11. Grade calculation grades algorithm

5. Implementation for Users' Roles

This section describe role for every assessment contributor. The platform has successfully work in Cloud computing and some user interfaces are also presents.

5.1 Lecturer Role

Lecturers log in to integrated assessment platform through their dedicated account and password. Such information is assigned by the system administrator earlier. Then they evaluate students through four types of assessments are Assignment, Homework, Final Exam and Class Project. Different types correspond to different scoring rubrics. The Figure 12 to Figure 14 below shows the several interface for lecture's role.

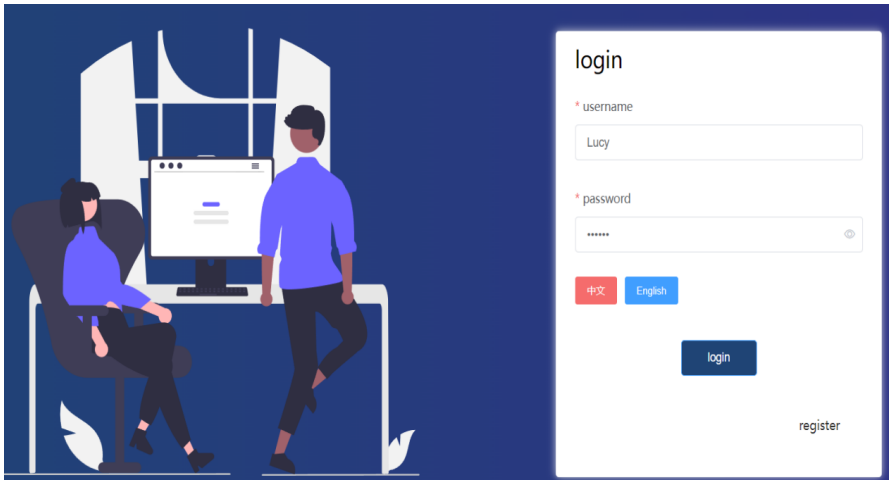

Fig. 12. Lecturer login page

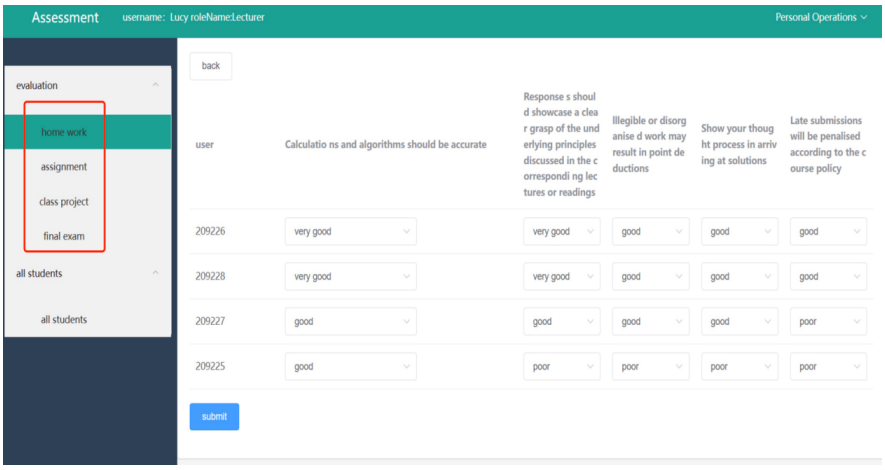

Fig. 13. Lecturer's assessment

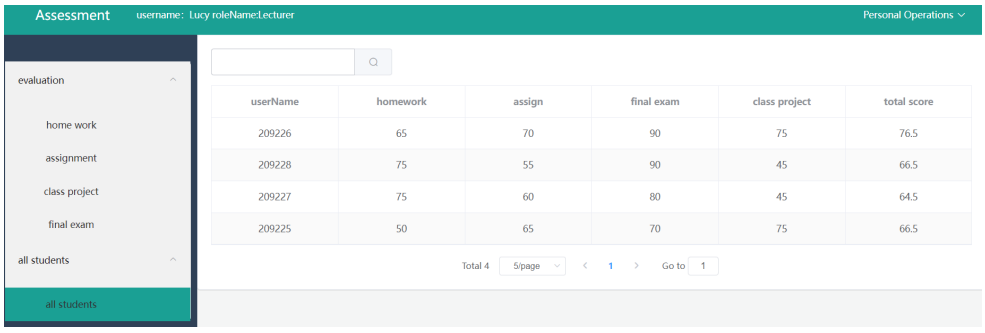

Fig. 14. Scoring page

5.2 Student Role

In this section, we focus on the project assessment. It involved project grouping, which consists of several processes: inviting the group members, viewing the group's score and making comments. Initially, the group is assigned manually. In the assessment platform, the group leader then added each group member to a project group (Figure 15).

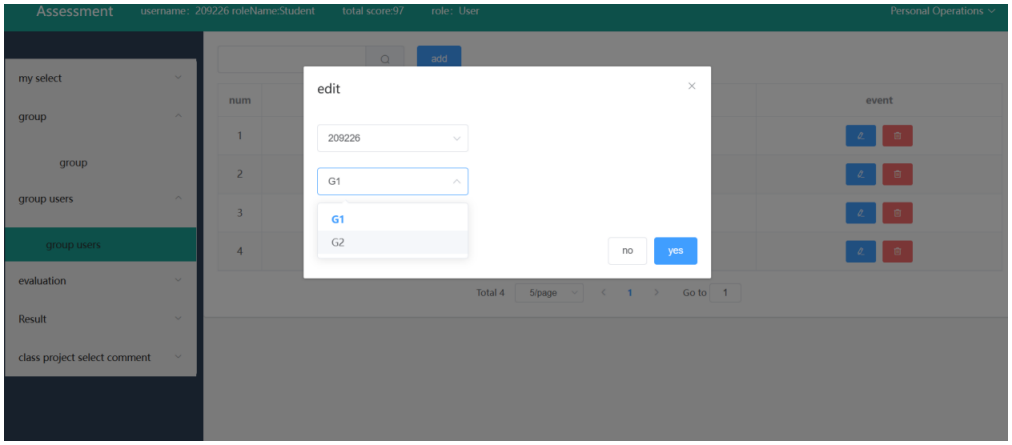

Fig. 15. Student selection groups

After the team is formed, the system should be able to display the team's information, such as their names and metric number (Figure 16). This facilitates communication and collaboration between team members. The group mutual evaluation algorithm stands as a powerful tool for enhancing team dynamics and individual accountability.

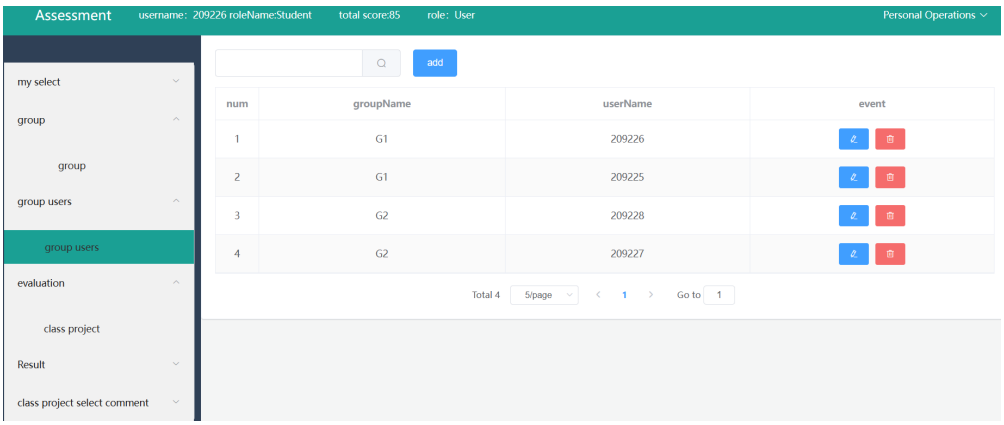

Fig. 16. Team information

In our integrated assessment platform, it also offers the peer (the student in the same group or from another group) the opportunity to assess their friend (a peer-to-peer scheme). By providing such a method, it not only promotes a deeper understanding of group interactions but also encourages personal growth and self-reflection. Once the assessment is done by the assessment's contributors, the students can view the project score and comments (Figure 17). The viewing function can be assessed by each student who has the username and password.

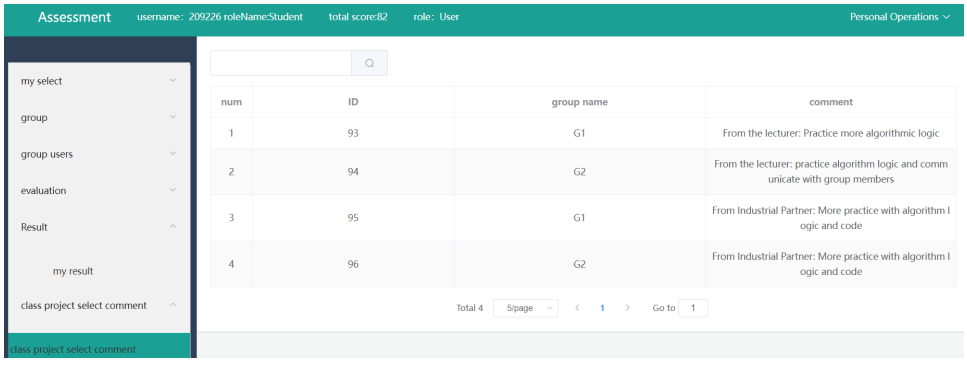

Fig. 17. Viewing class project comments

5.3 Partner Role

Partners can be industry and/or community representatives. We give them the privilege of assessing our students, so then the service-learning (SL) project has an impact on the students. Initially, the system administrator adds account identities to the invited partners. The representatives were then able to assess the platform (Figure 18 and Figure 19) to evaluate and comment on the groups involved in the SL project at their place. Through the implementation of the above functions, the lecturer can introduce a professional and objective evaluation perspective to improve the objectivity and comprehensiveness of team performance. This helps to stimulate students' enthusiasm and sense of responsibility for the project and it also provides students with opportunities to receive professional evaluation and promotes the improvement of their comprehensive ability and quality.

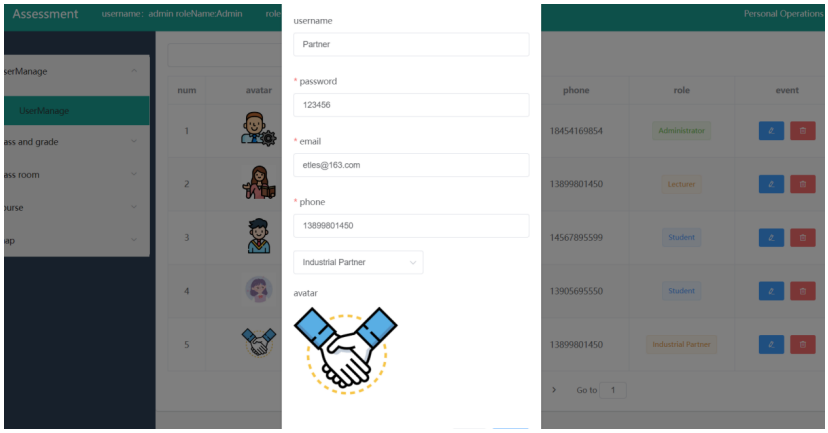

Fig. 18. Add account to partner

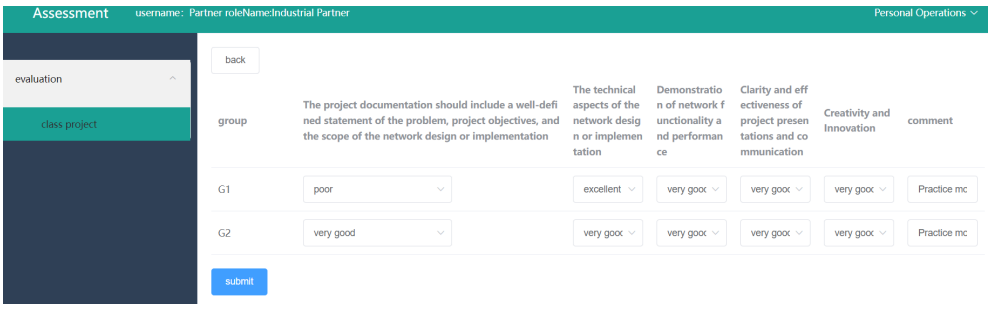

Fig. 19. Viewing score

4. Conclusions

In our work, the assessment platform utilized Cloud computing for integrating multiple roles of assessors. The integrated course assessment aims for effective evaluation process by considering multiple point of view in evaluating students' works. There are several types of assessors in the platform are students, educators (teachers, lecturer and tutors) and partners. The student can be from any educational institutions e.g., higher schools, universities, polytechnics etc. Meanwhile the partners in our work can be industrial partners, community representatives and/or outcasts that do not part in the educational institutions. They are invited by the system administrator to contribute to evaluation process. Diversity and cooperative assessment between academicians, community and other related representatives helps to ensure that students' involvement in service-learning projects is taken seriously and fosters a better understanding of the problems facing communities.

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References

[1] Baharuddin, Baharuddin, Dina Ampera, Hesti Febriasari, Muhammad Aulia Rahman Sembiring, and Abdul Hamid. "Implementation of cloud computing system in learning system development in engineering education study program." *International Journal of Education in Mathematics, Science and Technology* 9, no. 4 (2021): 728-740. https://doi.org/10.46328/ijemst.2114

[2] Menta, Amanda Jane C. "Adopting Technology Environment Organization Framework in Virtual Learning through Cloud Computing of Higher Education Institution." *International Journal of Computing Sciences Research* 6 (2022): 822-841. https://doi.org/10.25147/ijcsr.2017.001.1.75

[3] Dai, Jing, Xiaoqing Gu, and Jiawen Zhu. "Personalized recommendation in the adaptive learning system: The role of adaptive testing technology." *Journal of Educational Computing Research* 61, no. 3 (2023): 523-545. https://doi.org/10.1177/07356331221127303

[4] Alkrimi, Jameela Ali, Raja Salih Mohammed, Ameer Hamdi Hakeem Al-Ameedee, Safaa Hakeem Alkahfaji, Ban Alwash, and Rawan Al-Rubaye. "Measures of effectiveness for e learning of University students during the Covid-19 pandemic using the statistical model." *International Journal of Scientific Research in Network Security and Communication* 11, no. 3 (2023): 1-7.

[5] Husain, Omayma, Naomie Salim, Rose Alinda Alias, Samah Abdelsalam, and Alzubair Hassan. "Expert finding systems: A systematic review." *Applied Sciences* 9, no. 20 (2019): 4250. https://doi.org/10.3390/app9204250

[6] Ng, Wing Shui, and Guoxing Yu. "The impacts of dialogic interaction to engage students in peer assessment." *The Asia-Pacific Education Researcher* 32, no. 1 (2023): 53-64. https://doi.org/10.1007/s40299-021-00633-2

[7] Huynh, Thi Lan, and Uyen Nu Thuy Nguyen. "Peer assessment in a blended translation course: Students' perceptions, motivation and their self-perceived translational skill development." *International Journal of Applied Linguistics and English Literature* 8, no. 5 (2019): 52-60. https://doi.org/10.7575/aiac.ijalel.v.8n.5p.52

[8] Braman, Eileen. "Assessing the Credibility of Constitutional Experts." *Journal of Law and Courts* 11, no. 1 (2023): 86-103. https://doi.org/10.1017/jlc.2022.4

[9] Madan, Manohar, and Kingsley Gnanendran. "Course planning in educational programs: A project management approach." *Operations and Supply Chain Management: An International Journal* 13, no. 4 (2020): 349-358. https://doi.org/10.31387/oscm0430275

[10] Park, Woonghee, and Hyun-Kyung Lee. "Creative integration of design thinking and strategic thinking in a design education framework." *Creativity Studies* 14, no. 1 (2021): 160-174. https://doi.org/10.3846/cs.2021.13700

[11] Honoré-Livermore, Evelyn, Knut Robert Fossum, and Erik Veitch. "Academics' perception of systems engineering and applied research projects." *Systems Engineering* 25, no. 1 (2022): 19-34. https://doi.org/10.1002/sys.21599

[12] Neyem, Andres, Juan Diaz-Mosquera, and Jose I. Benedetto. "A Cloud-Based Mobile System to Improve Project Management Skills in Software Engineering Capstone Courses." *Mobile Information Systems* 2018, no. 1 (2018): 6371793. https://doi.org/10.1155/2018/6371793

[13] Fossum, Knut Robert, Evelyn Honoré-Livermore, Erik Veitch, Cecilia Haskins, and Erika K. Palmer. "Toward an integrated project complexity narrative–A case study of academic organizations." *Systems Engineering* 25, no. 5 (2022): 443-456. https://doi.org/10.1002/sys.21623

[14] Liu, Jinhua, Caiping Wang, and Xianchun Xiao. "Design and application of science and technology project management information system for educational institutes." *Mobile Information Systems* 2021, no. 1 (2021): 2074495. https://doi.org/10.1155/2021/2074495

[15] Podymova, Lyudmila, Marina Khmelkova, Maria Semyonova, Tatyana Golovyatenko, and Maria Poliakova. "Project Management as a Technology for Managing a Modern Educational Organization." In *SHS Web of Conferences*, vol. 79, p. 03006. EDP Sciences, 2020. https://doi.org/10.1051/shsconf/20207903006

[16] Yang, Cairu, Rongli Chen, Xiaozhong Chen, and Kuan-Han Lu. "The efficiency of cooperative learning in physical education on the learning of action skills and learning motivation." *Frontiers in psychology* 12 (2021): 717528. https://doi.org/10.3389/fpsyg.2021.717528

[17] Amran, Muhammad Syawal, Faridah Mydin Kutty, and Shahlan Surat. "Creative problem-solving (CPS) skills among university students." *Creative Education* 10, no. 12 (2019): 3049. https://doi.org/10.4236/ce.2019.1012229

[18] Chowdhury, Takad Ahmed. "Fostering learner autonomy through cooperative and collaborative learning." *Shanlax International Journal of Education* 10, no. 1 (2021): 89-95. https://doi.org/10.34293/education.v10i1.4347

[19] He, Guimei. "[Retracted] Construction of Teaching Management Platform for Universities Based on Big Data." *Advances in Multimedia* 2022, no. 1 (2022): 3468797. https://doi.org/10.1155/2022/3468797

[20] Moshayedi, Ata Jahangir, Atanu Shuvam Roy, Liefa Liao, Hong Lan, Mehdi Gheisari, Aaqif Abbasi, and Seyed Mojtaba Bamakan. "Automation attendance systems approaches: a practical review." *BOHR Int. J. Internet Things Artif. Intell. Mach. Learn* 1 (2021): 23-31. https://doi.org/10.54646/bijiam.005

[21] Fuadi, Djalal, Harsono Harsono, Muhammad Fahmi Johan Syah, Agus Susilo, Samsudin Suhaili, and Budi Wahyono. "Self-Governance: Internationalization management of distinctive higher education towards the world class university." *Indonesian Journal on Learning and Advanced Education (IJOLAE)* 3, no. 2 (2021): 96-113. https://doi.org/10.23917/ijolae.v3i2.11754

[22] Zhao, Hong, and Yajun Zhou. "Understanding the Mechanism of User Experience Role in Educational Livestreaming Platform." *Frontiers in Psychology* 13 (2022): 907929. https://doi.org/10.3389/fpsyg.2022.907929

[23] Eyler, Janet. "Reflection: Linking service and learning—Linking students and communities." *Journal of social issues* 58, no. 3 (2002): 517-534. https://doi.org/10.1111/1540-4560.00274

[24] Levkoe, Charles Z., and Holly Stack Cutler. "Brokering community-campus partnerships: An analytical framework." *Gateways: International Journal of Community Research and Engagement* 11, no. 1 (2018): 18-36. https://doi.org/10.5130/ijcre.v11i1.5527

[25] Matzembacher, Daniele Eckert, Mervi Raudsaar, Marcia Dutra de Barcellos, and Tõnis Mets. "Sustainable entrepreneurial process: From idea generation to impact measurement." *Sustainability* 11, no. 21 (2019): 5892. https://doi.org/10.3390/su11215892

[26] Gerstenblatt, Paula. "Collage portraits as a method of analysis in qualitative research." *International Journal of Qualitative Methods* 12, no. 1 (2013): 294-309. https://doi.org/10.1177/160940691301200114

[27] Pagatpatan Jr, Celso. "Teaching and learning community medicine during the pandemic and beyond: Interactivity as an essential process Commentary." *Philippine Journal of Health Research and Development* 24, no. 4 (2020): 1.

[28] Crisp, Geoffrey T. "Integrative assessment: Reframing assessment practice for current and future learning." *Assessment & Evaluation in Higher Education* 37, no. 1 (2012): 33-43. https://doi.org/10.1080/02602938.2010.494234

[29] Zhong, Baichang, Qiyun Wang, Jie Chen, and Yi Li. "An exploration of three-dimensional integrated assessment for computational thinking." *Journal of Educational Computing Research* 53, no. 4 (2016): 562-590. https://doi.org/10.1177/0735633115608444

[30] Harris, Judi, Neal Grandgenett, and Mark Hofer. "Testing a TPACK-based technology integration assessment rubric." In *Society for Information Technology & Teacher Education International Conference*, pp. 3833-3840. Association for the Advancement of Computing in Education (AACE), 2010.

[31] Besterfield-Sacre, Mary, Jessica Gerchak, Mary Rose Lyons, Larry J. Shuman, and Harvey Wolfe. "Scoring concept maps: An integrated rubric for assessing engineering education." *Journal of Engineering Education* 93, no. 2 (2004): 105-115. https://doi.org/10.1002/j.2168-9830.2004.tb00795.x

[32] Mahande, Ridwan Daud, Jasruddin Daud Malago, Nurul Mukhlisah Abdal, and Yasdin Yasdin. "Factors affecting students' performance in web-based learning during the COVID-19 pandemic." *Quality Assurance in Education* 30, no. 1 (2022): 150-165.

[33] Figueiró, Paola Schmitt, Daiane Mülling Neutzling, and Bruno Lessa. "Education for sustainability in higher education institutions: A multi-perspective proposal with a focus on management education." *Journal of Cleaner Production* 339 (2022): 130539. https://doi.org/10.1016/j.jclepro.2022.130539

[34] Zascerinska, Jelena, Anastasija Aleksejeva, Mihails Zascerinskis, and Irina Abjalkiene. "A Cross-Sectoral Approach to STEM Education: A Multi-Perspective Design." In *SOCIETY. INTEGRATION. EDUCATION. Proceedings of the International Scientific Conference*, vol. 1, pp. 846-856. 2022. https://doi.org/10.17770/sie2022vol1.6817

[35] Zhou, Yuchun. "Teaching mixed methods using active learning approaches." *Journal of Mixed Methods Research* 17, no. 4 (2023): 396-418. https://doi.org/10.1177/15586898221120566

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