



IoT Collaborative Peer Assessment Model for Education in Rural Areas

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Abstract. In rural educational settings, access to quality education and resources may be limited. Internet of Things (IoT) technology enables learning with a Learning Management System (LMS) offline while integrated with LMS Cloud. Integrating IoT technology with collaborative peer assessment presents a promising solution for improving the learning experience in these areas. This journal explores the development and implementation of an IoT Collaborative Peer Assessment (CPA) model aimed at enhancing educational outcomes in rural settings. The model leverages IoT devices to facilitate real-time feedback and collaborative learning, addressing challenges such as limited access to quality education resources and isolated learning environments. This study evaluates the effectiveness of the IoT CPA model through pilot programs, assessing improvements in student engagement, peer interaction, and academic performance.

Keywords: Education, IoT, Rural Areas

1 Introduction

Based on a survey by the Indonesian Internet Service Providers Association (APJII, 2024) [1] the internet penetration rate in 2024 will reach 79.5% of the total national population. However, the distribution of internet penetration in Indonesia is still not evenly distributed. This inequality is especially visible in people living in disadvantaged, frontier and outermost areas (3T), where access to cell phone signals or the internet is still very limited. This condition creates major challenges for the education sector in these areas.

In the 3T region, limited access to quality education is a quite serious problem. Lack of infrastructure, limited human resources such as qualified teachers, and minimal access to up-to-date teaching materials are the main obstacles in improving the quality of education. Students in these areas often lag behind their peers in urban areas who have better access to educational facilities and technology.

Internet of Things (IoT) technology provides new hope in overcoming educational challenges in the 3T region. By utilizing IoT, learning can be done through a Learning Management System (LMS) which operates offline and is integrated with LMS Cloud. This allows students and teachers to access the latest learning content, take assessments,

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and participate in collaborative learning activities even without continuous internet access [2][3].

In this way, Collaborative Learning can be used in classroom learning. Collaborative Learning is a learning method in which students work together in small groups to achieve common goals, share ideas, and solve problems [4]. According to Wijaya & Basuki (2020) the Collaborative Learning approach allows students to engage in peer feedback and learn from each other [5]. In addition, state that the goal of the collaborative learning model is to increase student learning by including the 4Cs (critical thinking, communication, collaboration, and creativity), which in turn increase student problem-solving skills and creative thinking abilities [6]. This method has various advantages that can improve students' learning experiences, including increasing understanding and retention of material, developing social and communication skills, and encouraging student involvement and active participation [7]. The assessment system that can be applied in the Collaborative Learning method is Collaborative Peer Assessment (CPA). The CPA method is an assessment in which students evaluate each other's work or performance in a collaborative environment [8][9]. CPA has various advantages that can improve student learning experiences and learning outcomes, and can reduce teacher workload in assessing student work [10][11].

The integration of IoT technology with the Collaborative Peer Assessment (CPA) model offers an innovative solution to improve the student learning experience in the 3T region [12][13]. This CPA model allows students to assess each other and provide feedback in real-time via IoT devices, such as tablets and smart whiteboards [14][15]. This not only increases student engagement in the learning process but also encourages more active interaction and collaboration between students [16][17].

2 METHOD

This study employs a mixed-methods research design, integrating both quantitative and qualitative approaches to evaluate the effectiveness of IoT Collaborative Peer Assessment. The design includes pre- and post-intervention assessments, classroom observations, student and teacher interviews, and surveys to gather comprehensive data on student learning outcomes and engagement.

3 Results And Discussion

The technology elements needed to put the IoT collaborative peer assessment concept into practice are covered in this section. It covers the hardware (such as sensors and Internet of Things devices), software (such as data analysis platforms and peer assessment tools), and networking infrastructure required to enable smooth student interaction and cooperation.

Technological Infrastructure

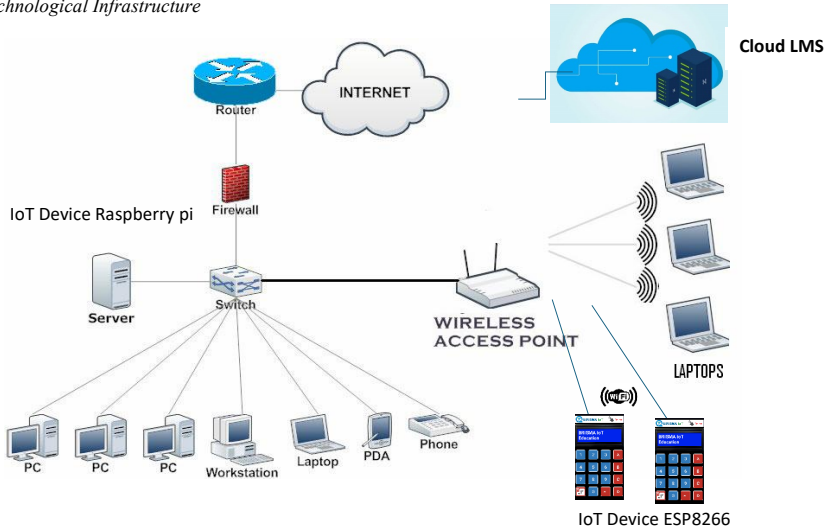


Figure 1. LMS Network Topology

According to the topology image above, there is a local LMS in the form of an IoT Raspberry Pi device, which will be accessed by a variety of devices, including PCs, laptops, and IoT gadgets, which serve as LMS clients. A LAN cable or WiFi can be used to connect to the network. If there is an internet connection, the API will synchronize any changes made to the Local LMS data with the Cloud LMS server. The data changes, however, will be kept in the API data pool and synchronized later when there is an internet connection if the local network is not connected to the internet.

User Interface Learning Management System

There are 2 types of IoT Collaborative Peer Assessment application displays, namely the website version display and the IoT devices version display. The following is a display of the website version.

H. Haris, S.Kom, M.Kom
Dibuat - Mar 5th

Tugas Kelompok 01

Tugas Kelompok ke-1

Maks. per Kelompok: 3 orang
55201120232024200010102

File Tugas

Mulai Tampil 05 Mar 2024 07:10:00

Akhir Submit 27 Apr 2024 23:59:00

Sisa Waktu Waktu Submit sudah berakhir

Kelompok Mahasiswa Kelompok Mhs Export Nilai Edit

Hapus Semua Anggota Kelompok Tambah Kelompok

Kelompok 1 Judul: Tambah Anggota

No	NIM	Nama	Nilai	Aksi

Kelompok 2 Judul: Tambah Anggota

No	NIM	Nama	Nilai	Aksi
1	41522010019	GEDE JOVAN TIYO ADITYA		🗑️ 📄

Figure 2. Collaborative Assignment

In the initial stage the teacher will make a Collaborative Assignment. Then proceed with the formation of student groups automatically. Students can upload assignments in the form of a YouTube video link or file attachment.

Status Submit Tugas

Upload Video Youtube Play Video Youtube

Status Submit	Belum Submit
Akhir Submit	03 Jun 2024 23:59:00
Sisa Waktu	1 hari 56 menit 49 detik
Waktu Upload	
File Upload	Upload Drag & Drop Files

Figure 3. Upload File Assignment

Upload Video Kolaborasi

Home Lis

Form Video Kolaborasi

Urutan Tampil Play

URL Video Youtube

Keterangan Video

Simpan Reset

Figure 4. Entry Youtube URL Assignment Form

The next step is for the teacher to fill out the Peer Assessment Form.

Edit Peer-Assessment 1B6152CA PEMROGRAMAN SMART WEB - Selasa, 05 Mar 2024 13:15 - 15:45 M-511

Home

Form Edit Peer Assessment

Pilih Tugas Kolaborasi

Mulai Tampil

Akhir Tampil

Simpan Reset

Figure 5. Peer Assessment Form

To open an assessment by fellow students, click the Presentation Start button for the group that will present the results of their group work.

Kelompok Mahasiswa

Kelompok 2				Judul:
Presentasi Stop List Nilai List Pertanyaan				
No	NIM	Nama	Nilai	Aksi
1	41522010019	GEDE JOVAN TIYO ADITYA		+ ↓
2	41522010038	PUTRI WULAN RAMADHAN(Lapor BAP, ijazah)		+ ↓
3	41522010107	SITI NUR AMALIAH SAFITRI		+
Kelompok 4				Judul: Bab 2 XML
Presentasi Start List Nilai List Pertanyaan				
No	NIM	Nama	Nilai	Aksi
1	41522010083	MIMI LAVENIA SINAGA(Lapor BAP-ijazah)		+ ↓
2	41522010094	SULFIA		+ ↓
3	41523010028	EVI WAHYUNI PULUNGAN		+ ↓
Kelompok 5				Judul: SRS WEBSITE TOP UP ALL GAME
Presentasi Start List Nilai List Pertanyaan				
No	NIM	Nama	Nilai	Aksi
1	41521010123	MUHAMMAD FARIS KURNIAWAN		+
2	41521010168	MUHAMMAD TSABIT MUTHI		+

Figure 6. Presentation Start Form

For students who are not part of a group that is presenting their group assignment, they can provide assessments either via the LMS website or via an IoT device.

Form Peer: 24000000148

File Tugas

Mulai Tampil 26 Mar 2024 14:56:00

Akhir Submit 27 Mar 2024 23:59:00

Sisa Waktu Waktu Submit sudah berakhir

[Upload](#)

Kelompok sedang Presentasi

Kelompok 2
Sedang Presentasi

Judul: [Penilaian](#)

No	NIM	Nama	Nilai
1	41522010019	GEDE JOVAN TIYO ADITYA	60
2	41522010038	PUTRI WULAN RAMADHAN(Lapor BAP, ijazah	60
3	41522010107	SITI NUR AMALIAH SAFITRI	60

Figure 7. Peer Assessment via website LMS

Form Penilaian Mahasiswa

[Tanya](#) [Back](#)

Kelompok 2:

GEDE JOVAN TIYO ADITYA
NIM: 41522010019

G

Peran dalam Kelompok

Partisipasi ★★★★★

Kolaborasi ★★★★★

Argumentasi ★★★★★

Berbagi Informasi ★★★★★

Sikap dan Perilaku

Komunikasi ★★★★★

Kedisiplinan ★★★★★

Komentar

PUTRI WULAN RAMADHAN(Lapor BAP, ijazah
NIM: 41522010038

NO PHOTO

Peran dalam Kelompok

Partisipasi ★★★★★

Kolaborasi ★★★★★

Argumentasi ★★★★★

Berbagi Informasi ★★★★★

Sikap dan Perilaku

Komunikasi ★★★★★

Kedisiplinan ★★★★★

Komentar

Figure 8. Peer Assessment Form

The following is an assessment rubric as a guide in giving grades to each group member who is presenting.

Table 1. Assessment Rubric

No	Rated aspect	Criteria	Star Score
1	Participation	Participates very often	5
		Participate often	4
		Participated several times	3
		Have participated	2
		Never participated	1
2	Collaboration	Participates very often	5
		Participate often	4
		Participated several times	3
		Have participated	2
		Never participated	1
3	Argumentation	Participates very often	5
		Participate often	4
		Participated several times	3
		Have participated	2
		Never participated	1
4	Sharing information	Participates very often	5
		Participate often	4
		Participated several times	3
		Have participated	2
		Never participated	1
5	Communication	Participates very often	5
		Participate often	4
		Participated several times	3
		Have participated	2
		Never participated	1
6	Discipline	Participates very often	5
		Participate often	4
		Participated several times	3
		Have participated	2
		Never participated	1

To provide assessments to colleagues via IoT devices such as the following.

Figure 9. Peer Assessment Mode on IoT Device



To use an IoT device as a peer assessment tool, you can select Mode 3 Peer-Assessment on the IoT device. After that, a 10-digit Peer Form Number obtained from the LMS Peer-Assessment Form will appear on the IoT device. If the Peer Form Number entered matches the one in the LMS, the name of the first person from the group who will be assessed by peers will appear.

Based on the provisions of Peer-Assessment, there are 6 assessment items given by peers to each group member who is on duty, namely in the form of assessments of Participation (N1), Collaboration (N2), Argumentation (N3), Information Sharing (N4), Communication (N5), and Discipline (N6). To give a value to Participation (N1), the user can press one of the options with the following conditions: A to give a value of 5 stars, B to give a value of 4 stars, C to give a value of 3 stars, D to give a value of 2 stars, or E to give a 1 star rating. Each value in the form of stars will be converted in the LMS application by multiplying the number of stars by the number 2, so that if the user gives an A value, then the LMS will be given an A value (5 stars) multiplied by 2 equals 10. If given a B value, then it means B (4 stars) multiplied by 2 equals 8, likewise if given a value of C, it means C (3 stars) multiplied by 2 equals 6. For the value D it means D (2 stars) multiplied by 2 equals 4, whereas for E value, then it means E (1 bit) times 2 is equal to 2.

If you have finished giving N1 to N6 to the first person in the group, CONTINUE [Enter]? will appear. If this appears, press the Enter button on the keypad on the IoT device, so the name of the second person from the group on duty will appear. After that, an assessment of N1 to N6 will appear for the second person. When all group members

have been given grades by their peers, to exit Mode 3 Peer-Assessment, you have to press the Touch button on the IoT device, followed by pressing the 0 button on the keypad on the IoT device, which means entering Mode 0 (Completed Activity).

4 Conclusion

By leveraging IoT technology in conjunction with the Collaborative Peer Assessment model, educational institutions in the 3T regions can address many of the barriers associated with limited access to resources and isolated learning environments. This integrated approach holds the potential to significantly improve educational outcomes and bridge the gap between students in remote areas and their urban counterparts. The combination of IoT and CPA creates a dynamic and interactive learning environment that fosters continuous engagement, collaboration, and feedback, thereby enhancing the overall quality of education in rural areas.

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