

Social Dimensions of Education in the Era of the Internet of Things (IoT) and during COVID-19 Pandemic

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Abstract

Internet of things (IoT) brings disruption to services in society including education. New platforms in educational services made possible by the internet of things have changed the way of teaching and learning activities. The question was how schools provide services to their stakeholders. This disruption was accelerated with the onset of the COVID-19 pandemic. This article aims to identify the social dimensions of education and their characteristics caused by the disruption of IoT technology and COVID-19. It examines social dimensions from the point of view of social intelligence, which comprises of three dimensions, namely social sensitivity, social insight, and social communication. In doing so, this study used a qualitative method based on a survey that involved respondents and their experience of learning through the IoT platforms. The results of this study indicate that social sensitivity and social communication were the most problematic social dimensions in learning and teaching activities through the IoT platforms. On the other hand, social insight was a very good dimension experienced by students in learning and teaching activities through IoT and during the COVID-19 pandemic.

Key Words

Social sensitivity, social insight, social communication, internet of things, COVID-19

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Introduction

Internet of things (IoT) is a term that refers to the ability of devices to connect and exchange data (Parjuangan, Setyawan and Sofiyan 2019). The simplest term for IoT is internet-enabled devices (Wortmann 2015). Internet connection is not just an exchange of data between two connected devices but also a function of completing a job or a process so that it can be done consistently and in real-time, and the production increases. Being consistent means that the service that implements IoT will not serve a particular service request selectively, but refers to the fulfilment of access and request queues. Being in real-time means that the services delivered through the IoT network output from the process have the same time where the service is processed and where the service is received. The increase in the number of production occurs, due to consistent processing capabilities and no wasting time for each production, because the connected devices run consistently. In addition, another thing that contributes to the popularity of IoT technology is its ability to provide services and be served by the network. Lastly, the combination of IoT with various other fields of science further adds to the increasing use of IoT in various sectors such as merging IoT with artificial intelligence (Yarlagadda 2018), IoT and Blockchain (Fernández-caramés dan Member 2018) where many of our daily objects will be interconnected and will interact with their environment in order to collect information and automate certain tasks. Such a vision requires, among other things, seamless authentication, data privacy, security, robustness against attacks, easy deployment, and self-maintenance. Such features can be brought by blockchain, a technology born with a cryptocurrency called Bitcoin. In this paper, a thorough review on how to adapt blockchain to the specific needs of IoT in order to develop Blockchain-based IoT (BIoT, IoT and Big Data (Ochoa, Fortino and Di 2017) and IoT with GIS (*Geographic Information System*) (Nourjou and Hashemipour 2017).

Various fields have experienced IoT disruption such as finance, sales, transportation services, supply chain, health, agriculture, and education. Disruption certainly changes various aspects including changing the existing business processes in that field. As seen in the payment system, a transaction occurs by scanning the barcode using a smartphone device in which an application that has been integrated with an electronic wallet account has been installed. Every change in business processes will change the role of everyone involved.

This also happens to education. One of the business processes in the field of education is reporting student learning outcomes to students,

parents, and related parties. The reporting system used today has information technology-based software that has a function in terms of reporting student learning outcomes (Parjuangan and Aditiya 2020). Another thing that is currently being disrupted is the learning process in education. Teaching and learning activities have been disrupted since 1990, starting from the Computer-Based Training (CBT) era where the e-learning system was included in CD-Room that could be accessed by students. However, in 1997 a new technology was born, namely the Learning Management System (LMS). LMS is a web-based learning platform through websites in which teaching and learning activities are carried out such as registration of participants, explanation of the concept of teaching materials, marking of student attendance, distribution of teaching materials to students, and implementation of exams and assessments (Agustina, Riska, Santosa, and Paulus 2016). Currently, it is integrated into mobile applications, not only web-based. Furthermore, software that provides virtual classes has been created so users can meet face-to-face online. So, currently, all teaching and learning activities can be carried out through software, although on separate platforms.

Now, this disruption is getting more massive with the outbreak of the Covid-19 pandemic that started at the end of 2019, creating unexpected changes in the way how services are delivered including education services. All education services are forced to find solutions to deliver services to their stakeholders. New technologies are massively used to carry out teaching and learning activities such as Zoom, Google Meet, and Webex. This technology is used to carry out the implementation of learning like learning in class. Currently, it has been more than a year that learning is carried out through virtual classes. Many stories of joy and sorrow are reported in this field of learning activities through these platforms. Some teachers are happy when their classes run smoothly, and all of their students have no problems in joining virtual classes. However, other teachers or educators have difficulty in explaining their learning materials to their students (Syafutra and Rachmat 2007). The arising problems are not only related to how to make students understand but also to various obstacles in providing independent learning to students and forming high order thinking skills (HOTS) of learning patterns.

One of the demands of the current curriculum is that students are expected to have 21st-century skills in communication, collaboration (cooperation), critical thinking, problem-solving, creativity and innovation. All these aspects of 21st-century skills, in the development process, experience various challenges with learning platforms that implement IoT

technology. For example, at the moment students' critical thinking skills are only developed with assignments, whereas assignments are certainly influenced by various influences such as the opportunity to get assignments from various sources as well as help from related stakeholders. This is similar to problem-solving skills, in which problems are often used as assignments to students, even though these assignments provide students with opportunities to be not honest in solving these problems. So, teachers and lecturers cannot develop the ability of students in the field of problem-solving to the maximum. Most of them give students online exam methods in the form of online quizzes. Working together and communicating are the most difficult skills to develop as they cannot be done in virtual classes in the form of assignments (Septiana and Nila 2019).

Thus, 21st-century skills cannot be done completely with virtual classrooms. The limitations of the IoT learning platform are thought to be unable to accommodate the development of 21st-century skills, especially in the communication and collaboration aspects. This article describes the forms of social intelligence of students who participate in teaching and learning activities through IoT-based learning platforms. It especially describes the inequality of aspects of social intelligence in students. It also aims to give a recommendation for policymakers in the field of education in finding solutions for the development of the social intelligence of students.

The method used for this research is qualitative. The stages in conducting this research were data collection, data analysis, and conclusion. The population and sample for this study were teachers and students who meet the criteria as follows: (a) Teachers selected were those who conducted teaching and learning activities using an IoT-based learning platform. The IoT platforms in question are the learning management system (LMS), Edmodo, Google Meet, Google Classroom, Google Form, Zoom, social media, and chat communication media platforms; (b) students selected were those who participated in teaching and learning activities through an IoT-based learning platform. The IoT platforms in question are the learning management system (LMS), Edmodo, Google Meet, Google Classroom, Google Form, Zoom, social media, and chat communication media platforms; and (c) Students selected were those from SMA or equivalent schools, and higher education institutions. The sampling technique used was purposive sampling.

Data collection techniques used in this study were interviews, observation, and documentation. The interview is a communication and interaction process carried out by at least two people in a natural setting, in which the direction of the conversation refers to the goals that have been set

and carried out based on mutual trust as the main foundation in the process of interpreting the contents of the conversation. The type of interview used in this study was a structured interview. Each respondent was asked the same questions. Another method of data collection was the observation by utilizing the human senses to see, hear, and feel. This observation was carried out on online KBM activities in virtual classes. The last data collection method used was documentation. Documentation is carried out in finding data on various forms of notes, transcripts, books, newspapers, meeting minutes, agendas, and others (Sidiq, Choiri and Mujahidin 2019). Documentation was done in books or notes of a teacher/educator.

The data analysis technique carried out in this qualitative research involves stages as follows. First, data reduction. This was done by summarizing the results of interviews, selecting the main things, focusing on matters relating to the variables and indicators. Data that did not meet the criteria and indicators were ignored. Second, data presentation. This was the stage of displaying data so that they could be understood easily in the form of tables, graphs, or summaries. The purpose of presenting this data was to organize the data so that they were well structured and had a pattern or grouped based on their similarities and differences. Lastly, drawing conclusions and verification. This step was carried out after presenting, presenting, and analysing the data. So the data were studied comprehensively to conclude the data presented.

Social Intelligence

In his book, Goleman (2006) tells a story to describe the social intelligence of two students. A student could not cooperate with others because he knew that he was intelligent and creative so that this made him arrogant and nobody could cooperate with him. He only reached the interview stage in employee recruitment so he failed to get jobs. But, another student, who was average in terms of academics, got job offers in various companies. This story shows that there is in need for 21st-century skills, namely the ability to work together and communicate, and this is related to social intelligence. Social intelligence is a person's ability to position themselves in an environment according to their scalability and competence. One must have these reliable skills to communicate and work with others.

Social intelligence is interpersonal intelligence in creating relationships, building relationships and maintaining relationships with other people so that both parties benefit from the relationship (Bakti and Putra 2012). Kihlstrom and Cantor (2019) who quoted Thorndike and

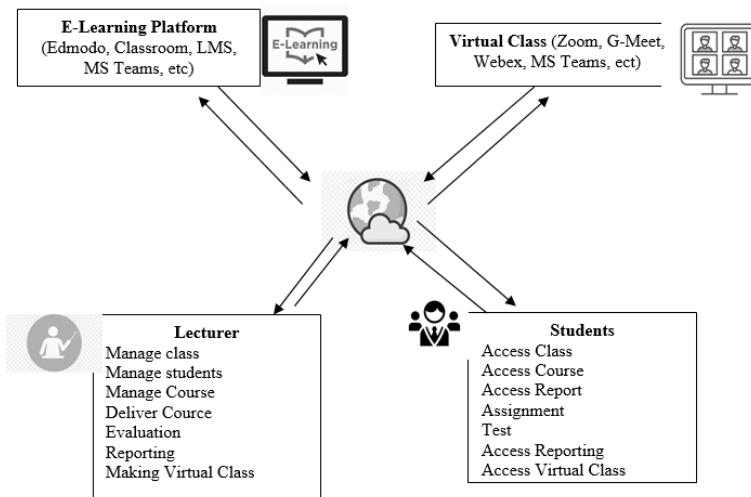
Edward (1920) say that “by social intelligence is meant the ability to understand and manage men and woman, boys and girl – to act wisely in human relations”. Likewise, Moss and Hunt 1927 defines that social intelligence as the “ability to get along with others”. Referring to these definitions, social intelligence is a person’s ability to interact with others and make these interactions valuable and useful for those who interact with each other. Social intelligence has several indicators to pin on a person, namely: (a) ability to identify social situations; (b) ability to remember names and faces; (c) ability to observe human behavior; (d) ability to identify mental states when other people speak; (e) ability to identify mental states from facial expressions; (f) ability to know social information; and (g) ability to understand humor and convey humor. Of all the indicators, it is narrowed down into several parts, namely: (1) someone sensitive to the social environment; (2) someone has social insight; and (3) someone who is able to communicate socially. So that these three indicators can be measured in humans to understand and identify a person’s level of social intelligence.

Referring to the current education curriculum at the primary, secondary, and higher education levels, students have a target specification of intelligence called 21st-century skills. The skills in question are the ability to work together, problem-solving skills, being creative and innovative, and the ability to communicate. However, disruption to teaching and learning activities is thought to interfere with the development of this ability for students. Therefore, this assumption needs to be proven, and how much social intelligence is disrupted because of learning activities that use IoT-based learning platforms and the occurrence of the covid-19 pandemic.

Characteristic of Learning Activities through IoT-Based Learning Platforms

The ability of the device to exchange data with other devices provides opportunities for humans to exchange data (documents, voice, and video). The capabilities referred to are not only for devices similar to the spreader device, but also for different devices in terms of type, size, and specifications. Data exchange certainly cannot be done without instruction. These instructions are embedded in the hardware and interface. Hardware functions to store and generate instructions conveyed by instructions from the interface on it. Structurally, the IoT-based learning platform has several components as shown in Figure 1.

Figure 1
IoT-Based Learning Platform Architecture



The IoT learning platform architecture has several components, including teachers/lecturers who carry out several activities, namely managing classes, students, courses, distributing courses, creating virtual classes, evaluating, and reporting on teaching and learning activities. The next component of the IoT-based learning platform is the participant/student, the functions that can be performed as students on the IoT learning platform are accessing classes, courses, and reports, doing assignments, and taking exams. The next component is the e-learning component, which functions to accommodate the activities of two groups of users, namely teachers/educators and students/participants. This component is in the form of hardware and software, a server computing device that can run a learning platform. The virtual class component is used by teachers/educators in conducting learning through virtual classes. The main component of all of them is the internet by which every device is connected to the internet network, which passes all data in teaching and learning activities.

Referring to Figure 1, the characteristics of teaching and learning activities on an IoT-based learning platform are a complex environment. So the possibility of various disturbances when learning using the IoT learning platform is very high. Currently, the most disturbing factor is

the network factor. When teachers/educators have made classes, managed courses, and distributed courses, students/participants cannot access them or *vice versa*. Another nuisance was the power supply. Since all devices must have a power source, it is best if this power source is always available throughout the teaching and learning process. To overcome these technical obstacles, teachers/educators and students/participants used different communication channels such as Whatsapp, Telegram, and telephone. Another obstacle was the psychological condition of the participants who will experience disturbances to carry out learning. This happened to both teachers/educators and students/participants.

Another characteristic in teaching and learning activities is the communication line that is not always reliable in conveying a condition. For example, when the course material has been distributed through the e-learning platform, participants need some explanations to explore the course material that is distributed. But when communicating with teachers/educators, they do not get a response or get a different response. This was an understandable thing in learning using the IoT platform. Likewise, when a virtual class is opened, when students/participants join, some of the characteristics of the incident are that the voice of the teachers/educators is not heard well and the opposite is true. Likewise, course slides sometimes cannot be the main reference for students in understanding the course material that is being delivered.

This characteristic demands that students must be in the best condition every time they participate in teaching and learning activities. So the difference in the material of learning conditions triggers the ability of students/participants to absorb the course material delivered. Another thing, for some people this condition causes stress, because of the complexity of the course material that is assigned or tested. On the other hand, certain students/students even consider it a normal problem and seem to allow the consequences of the various obstacles they experience. These characteristics cause a variety of social intelligence among students/participants.¹ Therefore, it is necessary to conduct an in-depth study of the impact of social intelligence on the characteristics of teaching and learning activities using the IoT platform.

COVID-19 Pandemic

The COVID-19 pandemic has started at the end of 2019. Until today, efforts are made to deal with it so that it can be suppressed. As of today, the COVID-19 pandemic has not ended. The handling methods recommended

¹ Another alternative that is done by teachers/educators is to switch to communication apps such as WhatsApp and Telegram. But some students/participants have the potential not to experience teaching and learning activities like in class (Ajibaho 2021).

in many countries are to maintain physical distancing, wear masks, wash hands, stay away from crowds and eat healthy food. All this has created changes in all fields. The pandemic has changed the way people communicate, shop, study, worship, and even visit families. The impact of the COVID-19 virus on all corners of the earth has been so terrible. As a result of COVID-19, teaching and learning activities have also undergone forced changes, in which teachers, institutions, students are not ready to face the COVID-19-style learning pattern. It is not certain when this change will end because the regulations are still rolling to find the best method of tackling the spread of COVID-19.

Teaching and learning activities that have changed are the activities of delivering teaching materials and learning activities in the classroom. During the pre-COVID-19 pandemic, teaching and learning activities were held face-to-face directly in the classroom, with classroom equipment and procedures that supported learning conditions. Meanwhile, during the pandemic, classes move to virtual ones, where teachers and students use various video streaming platforms. All course materials are distributed to students through various online platforms. Some educational institutions have learning tools developed on a web-based basis, which are called LMS. Other institutions use communication platforms such as WhatsApp or Telegram. However, it can be ascertained that until today, there is no single teaching and learning activity that only uses one platform. All of them do a combination of platforms such as a communication platform with a video streaming platform and LMS with a video streaming platform. Some also use three platforms by using the LMS platform to distribute course materials, take attendance, collect assignments and administer exams. The communication platform is used to hold discussions and disseminate information related to classes. Video streaming is used to conduct online meetings to present course materials. For the prevention of covid, this method may be good, but for teaching and learning activities this method has many problems such as infrastructure, device availability, access, and users mindset. So the education sector is the most impacted by COVID-19. The impact on the education sector is different from other sectors. The impact on other sectors can be directly felt and seen, but if the one on the education sector will be only seen in the next few years.

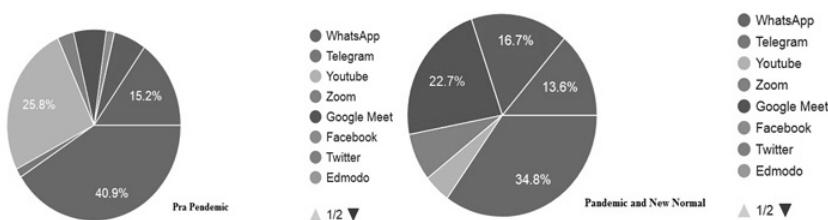
One of the characteristics of teaching and learning activities during the COVID-19 pandemic is the increasing communication lines to students/participants. This communication pattern has an impact on students, namely on their communication skills. Another characteristic of teaching and learning activities during the COVID-19 pandemic is the changing pattern of developing communication and collaboration skills.

All indicators of communication and cooperation skill development are assignments. In addition, due to teaching and learning activities from home, the development of critical and creative thinking skills in solving problems cannot be controlled directly by teachers/educators. Another issue is the teaching and learning environment that is not always conditioned for the learning activities. Students who want to complete assignments have to find the right time in quiet times or at night. This condition has impacted the students' health. There are other issues in teaching and learning activities during the COVID-19 pandemic, including the incompleteness of teacher/educator explanations in virtual classes due to interference from various sources. As a result, the course material is not holistically and comprehensively conveyed.

Social Dimensions of Teaching and Learning Activities Through the IoT Platform

Demographically, the respondents in this study are aged from 16 to 59 years with 21.5% male and 78.5% female. The learning platform used by respondents in the pre-pandemic, pandemic, and post-pandemic periods are shown in Figure 2.

Figure 2
The use of IoT-based learning platforms and their supporting communications



Dimension of Sensitivity

The form of the social dimension that will be described in this article is social intelligence. Social intelligence has three indicators, namely sensitivity to the environment, social insight, and communication and cooperation (Mamangkey *et al.* 2018). An indicator of sensitivity is a

person's ability to understand a person's mental state when interacting (Suplig 2017). The IoT-based learning platform is only able to present one's atmosphere to others in three forms of visualization, namely visual texts, sound, and video. So, the things that can be identified from teaching and learning activities through IoT-based learning platforms are voices and faces. Meanwhile, for the delivery of material through text/sensitivity messages, it can be seen from the various forms of emoticons embedded and the use of fonts (uppercase or lowercase).

The mental state of a person observed in this study was anger, sadness, enthusiasm, confusion, and pleasure. The cues that can be used by respondents who understood a person's mental state when interacting are facial (41,5 %), sound (24,4%), gestures (4,9%), eye contact (2,4%), and others (26.95%). Other criteria, referring to respondents' answers, including being enthusiastic about a topic of conversation or on an issue (4,9%), emoticons and text messages (12.25%), and the answer to the assignment (9.8%). The number of respondents who understood a person's mental state through the aforementioned cues that occur in IoT-based learning platforms was 60,29%. This gesture was understood by several respondents after it happened more than twice that someone gave a response through facial cues, voice, gesture, eye contact, and replies to messages in the form of texts and emoticons. The number of respondents who understood a person's mental state in teaching and learning activities through the IoT platform after giving a signal was more than twice (76.47%). About 51 % of respondents admitted that knowing enthusiastic persons is easier than angry or confused ones. So that after suppressing the response to the signal, it can only be known that someone is angry or confused. However, there is 11.76% of respondents experienced that a person's mental state cues are shown by turning off the camera on the IoT learning platform for this type of video streaming. This is known after respondents took several types of approaches, including inviting them to talk through communication platforms and telephones. Likewise for communication platforms, where during a discussion other cues were signs that describe a person's mental state, namely by giving emoticons without texts, and not responding to the topic being discussed. This was identified when someone did not respond to the topic being discussed related to several mental states of a person such as "dislike" the topic and "confused" about the topic and experiencing "disruption of the learning environment" when there are other activities. Regarding the messages that are only emoticons without texts, respondents understood that someone was gesturing to "care" about the topic being discussed.

Video streaming platforms and communication platforms are IoT-based learning platforms that are considered the easiest to accommodate respondents by giving and detecting signals of the mental state of the interlocutor or other participants in online meetings or learning activities. There was 77.94% of respondents shared their experiences that they knew someone was angry, sad, happy, or enthusiastic when conducting online meetings in virtual classes through the Zoom platform and Google Meet. Meanwhile, through communication platforms, only 47% of respondents understood easily the mental state of others.

Dimension of Social Insight

This dimension of social insight was identified from one's knowledge of social information. It was person's ability to find out social information that develops in the educational environment such as information on changes in the implementation of online classes, offline classes, and exams, friends who were in grievance, friends who got an accident, and other social information of the class members. This dimension was not only measured from their social knowledge, but also from one's response when they know social information. In this dimension, there was 91.17% of respondents said their experience. Few of the class members in their learning group were slow in receiving social information and responding to it. There were one or two people of their class members who had less responsive social insight. Usually, this was caused by several factors, including the use of communication tools simultaneously by family members as well as someone who had a high activity so that the hours of use of communication devices were high.

The second indicator in determining one's social insight was from their ability to accept humor. According to respondents, when information circulates in one's social environment, it often became a source of humor for some people in a group who like to do humor. But if someone did not understand the information included in humor, then the humor was not funny to him or her and made them confused. Someone who had good social insight knew minimal social information in his or her smallest environment. The respondent's experience in teaching and learning activities shows that sometimes a participant in a virtual class or discussion said humorous words or texts made up of information that was being discussed. There is 69.11% respondents admitted that social insight in their environment was easy to detect, seen from the response when the social information was discussed in a discussion group or sometimes became an example in

teaching and learning activities. However, this indicator was only seen from the information known or not, not from the depth of understanding of the information. Given the massive communication platform used today, all respondents said that information, even the real-time one, was very easy to obtain.

Dimension of Social Communication

This social communication was measured from several indicators, namely a person's ability to express opinions to others and respond to opinions from others. Teaching and learning activities carried out through the IoT communication-based learning platform were measured by the ability of a person to work together in solving problems through the platform used, such as the ability to do group assignments. Almost all respondents experienced miscommunication when they had assignments given through an IoT-based learning platform. Respondents usually overcame this by confirming each conversation with other communication platforms.

Regarding the indicator of "a person's ability to express opinions", 82.35% of respondents experienced difficulty in expressing opinions on the IoT learning platform. This is because of the form of response to express opinions. For example, the form "if someone wants to ask/express opinions, please click the raise hand icon": when someone clicked the icon of raise hand, he or she was not seen by teacher or educator. However, 95.58% of respondents often experienced inconsistencies in this communication. For example, if a guide said: "All questions can be submitted in the chat room", he or she allowed others to express opinions or ask directly through their microphone. Another problem was when several people wanted to ask questions or express opinions, technical problems like microphone troubles occurred. Almost all of the respondents experienced these obstacles.

As for the indicator of "cooperation ability" in teaching and learning activities through IoT-based learning platforms, it is recognized that 95.58% of respondents said that cooperation could not be done through virtual classes. Discussions had to be carried out in the form of assignments. Collaboration was made possible via Zoom Pro in which groups could be divided into separate rooms. As for other platforms, this was usually done separately from online meetings or virtual classes. Likewise, on the LMS and Edmodo platforms, collaboration indicators could not be carried out except in the form of assignments which were collected at a different time from the class implementation.

Conclusion

This article has shown that teaching and learning activities through the IoT learning platform were limited in forming social intelligence, especially efforts to develop social intelligence in the dimensions of sensitivity and communication. The causes of problems in teaching and learning activities include the problem of “understanding course material”, which was not comprehensively measurable by teachers/educators. Through virtual classes or communication platforms, the actual situation could not be identified by the participants of teaching and learning activities at IoT based learning platforms. The results of this study also show that learning through an IoT-based learning platform could not be developed to the maximum of the communication and collaboration skills of students/students due to the unavailability of facilities for collaborative problem-solving in the learning platform in use. The controlled communication was one of the obstacles in the development of the communication dimension so that students/participants did not ask questions or did not answer questions because of the factors of the devices they used. As a result, the students were unable to develop critical thinking and problem-solving skills because every effort was carried out without control (in the form of independent assignments). As for social insight, it was only a social dimension that was well developed in teaching and learning activities through IoT-based learning platforms. This was supported by the massive development of information dissemination platforms. But, this was not entirely as such due to the use of IoT-based learning platforms.

IoT-based learning platform technology should be a supporting learning tool, not the main one, as it created problems particularly in terms of developing social intelligence, which is one of the important achievements in learning in the era of the industrial revolution 4.0. The ability to communicate, collaborate, be creative and innovative, as well as critical thinking and problem-solving are skills that need to be developed in the 21st century. However, the use of IoT-based teaching and learning activities did not support all this. Therefore, face-to-face mode of learning and teaching should be taken within a strict health protocol. The longer students learn from home, the more young generations experience setbacks in terms of social intelligence.

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