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Redstone Jammin': Conversational Analysis from a Collaborative Music-Making Activity in Minecraft

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Abstract

This paper describes an intervention in which the immersive environment of *Minecraft* was used for collaborative learning in creating musical pieces with the use of a metaphor of introductory physics circuitry. This study explored the affordances of *Minecraft*, of how learning within a collaborative group can happen differently, with each participant having diverse backgrounds both in music and in *Minecraft* and how they may use this to their advantage. Laurillard's (1999, 2002) Conversational Framework was used as a basis in exploring and examining the social discourse between the participants to reflect how the distinct types of effective communication between the "expert" and the "novice" will conflate when both roles are not restricted to a sole individual, and analyses the behavior of the participants when the role of the expert, novice, or both simultaneously, are adopted in the music-making process.

1. Introduction

Minecraft is a video game in which players explore randomly-generated worlds that have a variety of environments (from jungles to deserts to icy tundras) as well as extensive underground areas. Players can build their own structures by placing blocks together in a Lego-like fashion. These blocks consist of different materials such as sand, rock, wood, or Redstone — blocks that can transmit power. By using Redstone and other electronic parts (such as switches), players can create their own circuits and even powered machines. Players can play by themselves in their own world, or play online with others, either by opening their world to friends, joining a friend's world or joining dedicated multiplayer servers with up to hundreds of players. *Minecraft* was released in 2011 and remains very popular, with over 100 million online players in May 2020. (Chiang, 2020). It is also the most-viewed game on YouTube. *Minecraft* is available on a wide range of platforms, from a computer (Windows, Mac, and Linux), mobile (iOS and Android), consoles (Xbox, Playstation, Nintendo Switch), Raspberry Pi, and VR (Oculus Rift). The game costs approximately US\$30 on computers and consoles and under US\$10 on mobile platforms. (There is also a limited trial version available for computers, and the Raspberry Pi version is free.)

Minecraft is commonly associated with being an open-world “sandbox” exploration game for users to play (Pellet, 2014), explore their world, and defend themselves to survive in the game. From Nebel et al.'s (2016) review on *Minecraft*, it was noted that *Minecraft* could indeed be a useful tool in education. This was so as it has a simplistic nature in terms of modifications both to the game overworld and in-game coding. This then allows the ease of use and operation of this platform as both professionals and novices can adopt and can manipulate any in-game material easily. In the *Minecraft Java Edition*, the game also has a wide assortment of music-producing materials that could be operated using Redstone circuitry. With that, one of the few considerations needed for the participants was the need to introduce such a concept to them before they begin their music-making process. Therefore, *Minecraft* was chosen to be a suitable platform as it has both the capabilities and the freedom for participants to explore and play.

2. Aims / Objectives

This intervention was aimed to research more on Laurillard's (1999, 2002) Conversational Framework and its practicality in application to a targeted group of the same age, to explore how the conflation of both teaching and learning will occur in the game overworld. Laurillard's (1999, 2002) Conversational Framework states that four components are needed for an effective learning space to occur, and that would respectively be how the teacher needs to have a theoretical representation of the idea and/or concept that they wish to teach to the novice, as well as an experiential environment for the novice to explore themselves. The novice will then have the conceptual representation presented back to the teacher, as well as setting a goal-oriented and driven behavior when they explore the learning environment.

In this paper, the analysis largely focuses on how the “novices” (that is, participants without any background knowledge) can step up and guide others in areas that they are more proficient in, since a collaborative task is given to them. Such could include the influence of their musical backgrounds in aiding them to determine the cadence, which is the harmonic progression (Neuwirth & Birge, 2015) of the notes that they have created. They could, perhaps, assume the role of an “expert” in terms of guiding and rectifying any musical errors they could come across, or possibly inadvertently created. Vice versa, the participant(s) who had prior experience with *Minecraft* could also, possibly, lead the participant group in basic operatives in crafting, utilizing and identifying objects in the game world.

3. Methodology / Materials

The intervention was set in two different settings. The first setting occurred between two high school students who were not acquainted with each other and was used as a form of beta testing (named participants α and β) to measure the suitability of this intervention. The second setting occurred between five friends (named participant A, B, C, D, and E). The participants were aged between sixteen and seventeen years old, and their identified genders were three males and two females. Participants' choice was convenience sampling, as these students from a local high school volunteered to spend an afternoon shadowing the authors at work as part of their school's career guidance program. The results in this paper were taken from the second setting, in which participants accessed the environment from their own laptops while gathered in a single room. They were thus able to talk to each other face-to-face while accessing the environment, and anonymized extracts of their utterances are shared in a subsequent section of the present paper.

In order to introduce the concept of music-making in *Minecraft*, the environment was set up with tutorial zones, which were purposefully scaffolded in terms of increasing difficulty for the participants to explore. This served to ensure that participants have a standardized form of understanding with respect to the game, such that inaccuracies about their presumed background knowledge about the game can be reduced. The tutorial segment was bounded by three different zones, which were compulsory for all participants to undergo. Figure 1 depicts a portion of one such zone.



Figure 1: Musical note blocks in relation to Redstone circuitry

Table 1: A simple background profiling was done to better determine the participants' level of engagements and prior experiences

Questions	Participants						
	α	β	A	B	C	D	E
Any music background?	Y	N	N	N	Y	Y	Y
Any prior experience to <i>Minecraft</i> ?	Y	N	Y	N	N	Y	N
Do you play computer games?	Y	Y	Y	N	N	N	N

Legend: N for No, Y for Yes

4. The Theoretical Framework

As elaborated upon earlier, Laurillard's (1999, 2002) Conversational Framework states that the need of four components for an effective learning space to occur, and that would respectively be how the teacher needs to have both a theoretical representation of the idea, and/or concept that they wish to teach to the novice, as well as an experiential environment for the novice to explore themselves. In this intervention specifically, both the experiential environment and the goal-oriented behavior are set to be a constant, given that the tutorial zones had been pre-constructed by the operator for the participants to explore themselves. The objectives (which was the goal of the task) were also instructed to the novices at the beginning of the task, which was to create a one-minute music piece. Participants were not given any penalties should they fail to complete it.

In the framework, Laurillard (1999, 2002) had similarly stated that the effective learning outcome would take place over a series of four phases (Bostock, 1996), namely discursive, adaptive, interactive, and reflective. These phases are not arranged sequentially, but rather in a cycle through which each phase flows back and forth naturally to the next during the participants' conversation and concludes when the task is completed. However, it should be noted that the participants were in the interactive phase throughout the entire duration of the intervention, as they were able to explore the pre-constructed tutorial world freely. Laurillard describes this phase as occurring when the novice interacts with the constructed environment and attempts to build or craft something with the conceptions that they have learned. They were able to construct any objects with the materials without any form of restriction. The task given similarly had no bounds and hence, did not have a specific "expert" present. It was up to the participants' discretion to teach and learn from those that had, or did not have, a prior background knowledge in *Minecraft*. Participants were also allowed to raise questions should they had any doubts.

5. Results: The Social Discourse

Laurillard's (1999, 2002) framework was largely seen to be true as the participants engaged in the music-making activity whilst learning more about how the pre-constructed tutorial environment had its relation to their real world, and this was so through the resemblance present in both the objects presented to them in *Minecraft* and in practical electronics circuitry. As the participants engaged in the

activity, questions prompted were answered by other participants, and intervention from external parties was kept to a minimum.

- | | |
|----------|--|
| A | Ok. So basically redstone is electricity and that's what it is in Minecraft. Basically its just electricity. Think of it as a circuit. |
| A | This is basically a switch (turns the switch on and off repeatedly) |
| B | Switch? |
| A | Switch. |
| B | What did you do to the switch? |
| A | So basically when you switch it (on) right, there will be electricity flowing through it, or when you turn it off... |
| B | Err, this is the switch? |
| A | Erm no, this is not the switch, wait, where are you? |
| B | I actually don't know where I am. (laughs to herself) |

Extract 1. A transcription about the conversation between participants A and B about the presence of the “switch” in *Minecraft*.

In Extract 1, it was observed that participant A was the educator and was trying to articulate the concept of a “switch” in the Minecraft world to participant B, who was confused. This action happened after participant A understood the concepts in which they had to learn, which was the purpose of *Redstone* and how one can manipulate such materials to create electrical paths. This was parallel to Laurillard's (1999, 2002) first phase of a learning encounter, the discursive phase (Bostock, 1996). It was where the expert uses his/her expertise, in this instance, the role adopted by participant A, to teach a new concept to participant B, the novice. How Participant A has decided to explain would be to refer the overworld objects with its real-life counterpart to reduce its complexity, before listening to participant B's reiteration of the concept back to participant A, and clarifying any further misconceptions.

- | | |
|----------|---|
| D | Ok listen. Stop hitting that note block. You wait arh. |
| A | You have to change your repeater, face it differently. |
| B | Ok. I'm just like walking aimlessly in this thing leh... |
| D | Ok you just think of this redstone thing as wires! Then how we have to put battery to it right, so he explain how there is the battery, which is known as the redstone torch. |
| A | Yah. |
| B | How do (you) even put the battery? |
| D | The battery is based on the red brick, you look at where I am, the “epsilon”. |
| A | Right-click to put it on the brick. |
| B | Oh, yah, yah, yah. |

Extract 2. A transcription of the conversation between participants A, B, and D about *Redstones* and *Redstone Repeaters* in *Minecraft*

In Extract 2, however, it was observed that Participant B was still unclear about the concept and the applications of *Redstone* in the game. With that, participant D had similarly assumed the expert's role in reiterating the concepts to participant B. To teach participant B, Participant D had also taken participant A's approach in referencing and simplifying the objects in *Minecraft* to the objects in electrical circuitry. Through this action, it was observed that the participants had entered Laurillard's (1999, 2002) second phase of the learning encounter, the adaptive phase (Bostock, 1996), where the expert now modifies his/her way in presenting the concept, after understanding the novices' misconceptions such that the learning process can become clearer for both stakeholders. This was seen in Extract 2 as participant D noted that despite participant A's previous efforts in explaining (in Extract

1), participant B was still unclear and was confused between the functions of the different objects. Participant D decided that there was a need to paraphrase their choice of words, from how participant A mentions that *Redstone* “is electricity” (Extract 1) to how *Redstones* are now “wires” aiming at removing any misinterpretation by the novice (participant B).

The adaptive phase (Bostock, 1996) was observed to continue despite the completion of the tutorial zones, as participant A noted that both participants B and C were still unclear about the use of *Redstone* and *Redstone Repeaters* in Minecraft. As the “expert,” he had decided to reshape, combine, and further simplify the pre-constructed tutorial zones into a simple circuit seen in Figure 2.

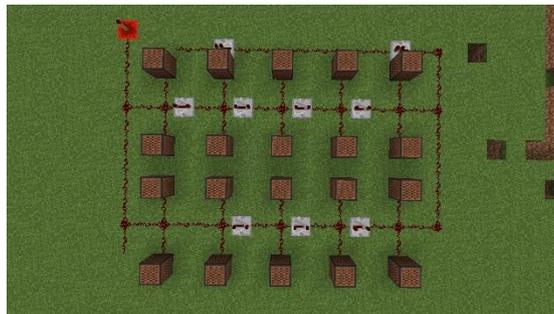


Figure 2: A further simplified tutorial crafted by participant A

As participant A had noted that participant D was highly disruptive in his presentation of ideas, participant A decided to have an individual consultation with participant B to understand the specific gaps in her understanding, with his own tutorial section being used in the exchange (seen in Figure 2).

- | | |
|----------|---|
| A | Okay so basically if you look at this right, you can see that this red line connects each of the box very clearly, unlike the one over there, so right for example when I activate it (<i>a clicking sound is heard, followed by a sound of a series of notes</i>), it goes out, and there's a connection la, okay basically the idea is that you want to make sure that the electricity goes so that you can play a sound, like that. Now how do I make it delay, I used the repeater, so the repeater it delays the circuit. It comes, then it holds the current for like a split second, then it lets it pass. So you can make this one play first, then a split second later this, and so on and so forth. You keep making the split second until you get a beat. And that's how you make the song. When it's like this, it's very close it's like instantaneous, when its far, the delay gets... |
| B | Longer and longer? |
| A | Yah. That's the idea la! That's all. |

Extract 3. A transcription of Participant A's explanation to Participant B about the simplified tutorial which he had build

It was unclear whether the participants were engaged in the discursive, or the adaptive phase (Bostock, 1996), given so as the information is deemed as something new for participant B, yet was previously mentioned by participants A and D. Despite so, Participant A begins his explanation with a reiteration of the ideas presented in the tutorial zones, and showed them to participant B. Participant A continued his explanation of the *Redstone Repeater* in a detailed manner, which he had not previously done so before participant B finally display signs that she had understood the concept through her answers that had participant A in agreement. With that, participant A concluded his teaching segment as he had realized that participant B has indeed understood these concepts with her iteration.

It is also striking to note that another expert-novice relation has appeared between participant E (the expert) and participant D (the novice) where participant D questions the validity of the music they have collaboratively produced.

- | | |
|----------|---|
| E | Yah... it's all dirt then you play it, it has different sounds what! |
| E | We are just making some weird music... but it's still some music. This is actually like Mario eh... |
| A | No it isn't? |
| E | This is a music piece what. |
| D | It's a music piece meh? |
| E | Yah... it's a piece. But it's not like that one. Can we hear like ours before we continue? |
| C | This is ours? What kind of a song is that? |
| D | Dude... Music prodigy... do some music notes la.. |
| E | Cannot arh wah! I don't really Minecraft...I'm so confused. |

Extract 4. A transcription of Participant E's explanation on how their music can be considered a "music piece."

With reference to Extract 4, it was observed that participant E clarifies with participant A and D that their music can be considered as a "piece." This reverses their original expert-novice relationship, in the case where participant E is now the expert, and participant D, the novice. This contrasts with the previous instant, where participant E, the novice, needed participant D's help in operating the *Minecraft* objects. Participant D, a novice with little music background, queried participant E about the realistic nature of the music they produced. Participant E clears participant D's doubt, with the use of music terminology, before the role reverses back to its original form, in the case where participant E (the novice, now) needs aid by participant D (the expert, now) in the use of *Minecraft*. Participant D's choice of words in describing Participant E ("Music prodigy") was also interesting, as it connoted a subservient behavior. Participant D is reliant on participant E in creating the music piece as it was observed that participant E has a higher-ordered music background compared to participant D.

The collaborative music making process continued and it was observed that in one instant, the participants did not engage themselves in expert-novice relations, but instead decided to work cohesively together. Participant A instructed the group to stop their tasks after he had realized their music piece was somewhat disorganized and needed it to be rearranged for clarity and for them to have a neater working environment.

- | | |
|----------|--|
| A | We should get a person to try out this. Whatever this is, we need to try it out. |
| C | You want me to switch on arh. (<i>a series of disjointed notes play</i>). |
| A | The horror... |
| E | I think we put another note sounds better. |
| D | I think this is probably gonna work like a horror music? |
| E | But might not assume it with the first note leh. |
| A | I think it's better if we standardise like piano or something like that, then we just change the tune so that it sounds consistent. Then like if we want to change the movement right, we do parallel so this whole row we do piano, then we change the tune so it goes up down. |
| E | But my first part I still want to do... |
| D | You want it then you move it back lo. |
| B | Only dirt? |
| A | Yah, only dirt. |
| C | That means only the left hand side you want to err... filter whatever you want? |
| A | Yah the left-hand side we choose another instrument |

- C Which is... can change la?
 A Can change la... guitar or whatever.
 C So you want that one consistent?
 A Yah so is easier then we can change based on that.
 C So we can put all dirt la?
 A Yah so we just change all to dirt. Some is already dirt so it's fine.

Extract 5. A transcription on how the collaborative task is redefined and standardised by participant A in order to simplify it.

Participant A realises the need for consistency such that they were able to work together on a singular music piece, instead of loitering around the overworld. Participant A also realises that Participant C is unclear of what she should do to contribute to the music-making process, and hence used his role as the “expert”, to command and instruct the “novice”, participant C, by giving her a simple task of clearing and removing the unwanted objects. Initially, participant C questioned participant A on the reasons for doing so, before setting out to meet his objectives. From the perspective of an “expert,” the reason participant A may have done so was, perhaps, because participant C would have been able to feel accomplished. She was able to complete tasks, given that she was observed to be rather confused about *Redstone circuitry* and did not want to intervene.

- C Plays yours leh let me hear!
 D (*plays the music*) You all also won't know the title.
 D Wait wait play again?
 E I forgot that there's a thing, you need to make it very slow.
 E It's much better than yours.
 B Oh this is nice.
 C What you all guys doing? Why you put the box below.
 D Never mind never mind you just hear.
 E I don't even know what it sounds like.
 E Yah. Guys it sounds like Turkish March.
 C Oh you just put the jukebox itself it sounds like piano?
 D Eh continue making your music leh. I want hear the cool piece.
 C Why you destroy the note?

Extract 6. The transcription on a conversation between participants B, C, D and E about the completion of the first music piece.

When the first music piece was completed, participants were unclear of its identity until it was revealed by participant E to be Mozart's Turkish March. The expert-novice relationship is prompted here through participant E's music background, where he explained the context of the music piece to the other participants as they marvel on it, and learn the process in which they had created this. This may be Laurillard's fourth phase of the learning encounter, the reflective phase (Bostock, 1996), where they revisit the concepts that they had previously learnt before, after accomplishing the task.

After the participants have successfully created the three music pieces, all of them had decided to stop creating, and/or replicating music pieces. They had decided to engage in a discussion that was more task-oriented and had focused back on the larger issue, to decide if they had indeed completed the task given to them or not.

C	This is yours arh?
D, E	Yah.
C	Oh my god... This is..
D	AMAZING!
E	But it's very tiring
D	Do it again, and now it should loop
E	Yah it loops.
D	So your relative pitch is really good ah?
E	Sort of la, but its not really good.
D	Ya la but its near perfect.
B	Wow.
D	Perfect pitch means like in the first note you know exactly what it is.
D	But he's not la.. but he has really good relative pitch la. After hearing one note like he knows what are the rest already.
B	You never set it repeat?
D	I never set it yet la.. later la.
B	It's nice leh.
D	Eh let's move it a little bit leh.
E	How do you want to move it?
D	So that the sound doesn't get further away we loop it back, so like err let me see ah, here, here. Let me set it up.
C	Its only 28 seconds now leh.
D	That's why we have to loop it like 10 times.
B	How do you get it for so long?
D	You want try, you try?
B	Can we hear yours too?
A	Hmm, sure.
D	Ok. I've set it up. Okay now we just wait for him to continue lo. You want try? I think it's (<i>hums Fur Elise</i>)
B	No leh I think it's (<i>hums a series of unrecognizable notes</i>)
C	If it's 1 minute it's going to be until which one?
D	Now I just helping him do the set up.
D	I help you build already. Now you just have to care about the note blocks. Your job is going to make music. It's not going to make music cause I cut off.
D	I can find the sheet music for you what.
E	That's <i>game of thrones</i> , no?
A	No, <i>game of thrones</i> is different.
D	I've already set up everything for you man.

Extract 7. The transcription on the discourse between all of the participants after the completion of the task.

The extract can be split into two different components. The first was where participant D discusses participant E's background on music education and whether his pitch ability was a large determinant in their music-making process. Participant D's explanation on participant E's "near-perfect" pitch can be seen as a form of expert-novice relationship, where participant D wishes to learn more about that particular aspect of music and hinted about his amazement at participant E.

The other component in this extract would be a discussion on whether the participants would need to continue the process of making music, under participant E's leadership, to ensure that the music is a minute long. This was brought up by participant C, who's main priority was the task fulfilment, as she, the novice, realises that they still had an uncompleted task given to them by the operator. Despite participant C's reminders, the participant group decided to stop working on the pieces and deemed everything to be completed.

6. Discussion

Throughout the task, the expert-novice relationship had showed many variants and were constantly changing. With respect to that, the participants' relationships between each other were viewed as depicted in Figure 3.

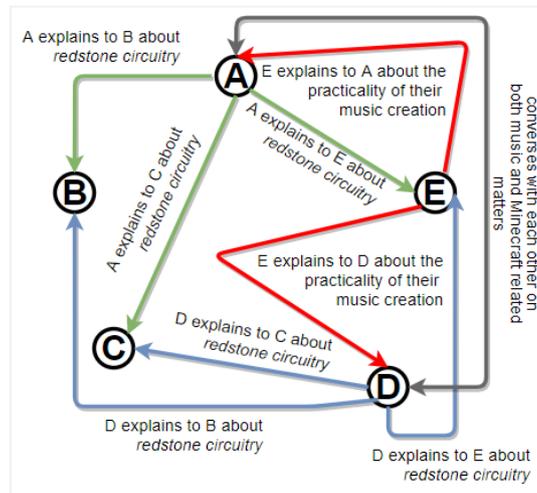


Figure 3: The expert-novice relationships formed between participants

Some participants, such as participants A and D, were observed to take on both roles of the expert and the novice, from teaching the other participants *Minecraft*, and in learning more about the musicality of their created piece from other participants. Because of these interactions, both participants were seen as more dominant participants. They had almost immediately assumed the leader's role, the other participants followed their instructions and based their work on their opinions.

Other participants, such as participants B and C, were novices throughout the entire intervention as they had no relevant background knowledge in the game. They deemed themselves to be more useful as a supportive role, listening and questioning whenever needed. They hence were more passive the music-making process as they mostly had followed the instructions from the participants. A unique case can be seen in participant E, in the case where even though he adopted the expert's role, his primary concern was the creation of the music piece, as opposed to the operations in *Minecraft*, and only engaged in his expertise, which was in music.

After completing these three music pieces, the task was deemed as completed and the intervention was concluded, despite how the participants were not able to accomplish the original task given. This was done as the participants were seen to have fulfilled the basis of the task requirement, which was to create a music piece collaboratively.

At an elementary level, this intervention can be effectively used in analyzing the benefits of using a virtual world in collaborative learning, particularly in the field of music. *Minecraft* is indeed an effective tool in reducing the pre-assumed knowledge needed in music theory before one can craft and/or create any form of music. Such can be drawn from a comparison to Apple's GarageBand (Bell, 2015), where users would need to understand how these musical instruments and their chords would work before even attempting to play them, or to create any tune from it, due to its complexity.

This pre-requisite is much reduced in the world of *Minecraft*, where a participant, even with their lack of theoretical music knowledge can craft simple melodious tunes without much facilitation and guidance by an external party (such as guidebooks, or walkthroughs), given so once they can operate the game movements. This means that music creation now needs not to be restricted to

professionals and even amateurs and novices in the field can explore the endless possibilities in composing, writing, and even analyzing music.

However, this project has its limitations as its limited scope has many undeveloped sections that can be explored in future projects. Such includes the possibility of adding user-created game modifiers, known as “*mods*”, which can alter the use of objects in Minecraft with the aim of reducing the complexity of the task, or adding further micro and/or macro details in the game. Examples can include automated electronic sensors (in *Redstone*), in the circuitry, ammeters and/or voltmeters, which can be included in the overworld for the participants to observe how the idea of electricity in *Minecraft* would work in correlation to the music-making process. With game modifiers in place, it would be easier for participants to interact, observe and understand any innovative ideas presented to them and can learn many new concepts previously never thought to be used in such a manner.

Another consideration needed would be that participants perhaps may not be accustomed to the controls of *Minecraft*. This was shown rather explicitly in this intervention, as some participants were having difficulties in controlling their movements and operations due to their lack of experience in gaming. A solution to counter such a challenge would be to create another introductory zone for those groups of participants, such that they can adapt easier in the operatives (such as movements and selections) of the game.

7. Concluding Remarks

This project is still in its beta form and can be developed further before its full potential is reached, such as to aid novices and learners to gain knowledge in a virtual world with minimum intervention necessary from teachers and experts. Even so, the results of this intervention are seen to be rather unique as the participants had unexpectedly decided to replicate, instead of crafting their own music pieces, even though they were told to “create” music. Future projects should consider this to ensure a level of originality to avoid any forms of plagiarism, specifically so in commercial uses.

With its flexibility, this form of music-making process can be extended to novices of different educational levels, be it to primary, secondary, or even to tertiary novices. Its application in classrooms can be used for Music, Physics, and even Design and Technology lessons for a better hands-on approach to novices wanting to learn more about both music and electricity at the same time. These ideas can also be further expanded with other different *Minecraft* objects (such as in Geography, with various geographical biomes present in the game). In lessons, teachers may also use this tool in assignments and project-based work for novices to explore and serve as a form of extension to what they have taught in classrooms. With its open-ended nature, *Minecraft* is a viable platform for many user-based contents that awaits learners to explore and master.

Definitions of Minecraft-related terms used in this paper

As this paper focuses on the use of *Minecraft*, participants had referred the object they had used in the world with its *Minecraft* terminology. For simplicity, the definition of the objects would be as such:

(a) Note block

The note block is a block capable of producing sounds (“notes”) when used by the user, or when connected via redstone.

(b) Redstone

The basis of electricity and wire in *Minecraft*. It is used to connect, light up, turn on/off switchable objects in *Minecraft*.

(c) Redstone repeaters

Redstone repeaters causes the delay of the current flow produced by the *redstone*, and can act as battery sources to increase the amount of current flowing through the circuit. In its real -world application, *redstone repeaters* are resistors.

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