21st Century Learning in Primary Science Subject via Flipped Classroom Method: A Teacher's Perspective

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Abstract*: The flipped classroom is one of the approaches used in 21st-century teaching practices. Contrary in primary education, various works of literature on the flipped classroom approach were studied in the secondary and tertiary education level. Thus, continuing the contribution to the body of knowledge, this preliminary research is done to explore the main themes in conducting a flipped classroom approach to promote 21st-century learning in primary school science. From the selection of a teacher, series of interviews, classroom observations and document reviews were analyzed systematically. The findings reveal three themes in primary science flipped classroom implementations including the affordances, assistance, and challenges. There are various aspects taken into consideration from the teacher and teaching surrounding for the flipped classroom settings to be conducive. The teacher realized that although flipped classroom helped her in many ways yet there are challenges that she needs to resolve. These findings provided a foundation for preliminary direction for the researcher to do further research planning.

***Keywords*: 21st Century learning, flipped classroom, primary education, science education.**

I. INTRODUCTION

Nowadays, vast innovations have immersed in education including the 21st-century teaching and learning approaches in the science field. Educational pedagogy keeps on transforming into a more advanced environment. There were also varieties of interactive teaching tools, and teaching approaches have been applied in teaching and learning activities. Numerous studies had been conducted to test and verified numerous techniques and methods in teaching and learning. In this research, the flip classroom was centered on this exploratory case study.

A flip classroom can be closely related to the inverted classroom that promotes learning outside the classroom (Lage, Platt, & Treglia, 2000). In conducting the FC teaching and learning session, students are given some learning materials so that they can learn by themselves first before entering the class on the next day. Since the flipped classroom is still at its early phase in Malaysia, there are limited studies done in this area (Rahman, Aris, Mohammed, Zaid, & Abdullah, 2014).

21st-Century learning enhances the empowering of the student as the main focus in a teaching and learning process. The use of technology and digital literacy is crucial to enhance and to nourish the learning environment (B Boholano, 2017). The 4C skills which comprising of creativity, critical thinking, collaboration and communication need to be emphasized so that learners could adapt to the 21st Century learning (Sipayung, Sani, & Bunawan, 2018). A teaching and learning session learning should be more activity oriented, inquiry and project-based so that the 21st-century education and skill could be provided to the learners (Garba, Byabazaire, & Busthami, 2015).

Not to be neglected, the role of teachers is significant to facilitate the learner experiencing meaningful learning. For mastery learning, teachers will guide and scaffold the learners' learning processes especially from the elementary level to truly become an expert (Krahenbuhl, 2016). This include in the approaches such as discovery learning, inquiry learning, and problem-based learning.

The following aspects such as the TPACK, ICT literacy, inquiry approach, and self-regulated learning will reflect on the themes related to the findings. These aspects should be taken into consideration in primary science flipped classroom implementation.

A. Technological pedagogical content knowledge (TPACK)

As an individual center of the teaching and learning process in a classroom, a competent teacher should be equipped with the technological knowledge (TK), pedagogical knowledge (PK) and content knowledge (CK) (Koehler & Mishra, 2009). These will help the teacher to play the role of facilitating the learning process. Teachers need to have the TPAC to deal with 21st-century teaching and learning.

B. ICT literacy

ICT literacy is very crucial among teachers. It is to assist many innovative teaching tools, which require the teacher to be skillful in searching related information, create and integrate information, and organizing the information in a virtual platform (Mazalah, Jamaludin, Ahmad Zamri, Aidah Abdul, & Fariza, 2015). 21st-century students are indeed

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familiar with the use of current informational devices. From here, to help students achieve the learning outcomes, the new learning schemata could be harness from the channeling of social connectedness and cognitive connectedness in this ICT mediated learning (Sontag, 2009).

C. Inquiry approach

Teacher and student should break the silence in the traditional classroom. Active learning based on questioning session and two ways teacher students' communication is needed in the elementary science education (Lin, Liu, Chen, Wang, & Kao, 2016). This way of communication is to ensure that inquiry is happening in the learning process (Martin-Hansen, 2002) as the five features in inquiry learning;

1. Learner engages in scientifically oriented questions
2. Learner gives priority to evidence in responding to questions
3. Learner formulates explanations from evidence
4. Learner connects explanations to scientific knowledge
5. Learner communicates and justifies explanations

By using the flipped classroom approach, students can communicate with peers and teachers frequently and whenever they needed. Via online communication, teacher and student are capable of initiating the pre, while and post information discussions. The three phases of scaffolding learning will strengthen students' learning (Clark & Graves, 2005). Students can be guided to accomplish the science subject tasks through the flipped classroom approach.

D. Self-regulated learning

Self-regulated learning generally means the ability of an individual to have control over his learning process that is also associated with motivation, cognitive, metacognitive and individual attitudes (de Boer, Donker-Bergstra, Kostons, Korpershoek, & van der Werd, 2013). On the other hand, it also refers to the tendency of an individual or student to have a desire to draw lessons with his or her initiative. Someone who has this tendency will have a high desire to study. In this case, cognitive processes have relationships with individual affective, self-assessment, motivation and behavior of individuals (Bandura, 1991). The other aspect should be further explored so that the flipped classroom approach can be implemented in primary science education and also the other educational courses. The teacher plays an important role to guide the learning process. Students deserve to experience active learning that they should communicate with related information meaningfully.

E. Problem Statement

The main issue relating to this study is that the flipped classroom implementation is still limited among Malaysian primary educators. Based on the literature, this may be due to the challenges in the planning and implementation process. For example, some senior educators are having difficulties blending with the new teaching technologies nowadays (Nilsson & van Driel, 2010). Even in a higher education level, constraints such as lack of resources, Internet connection problem and lecturer skills that create a barrier to conduct flipped classroom effectively (S. Z. M. Osman, Jamaludin, & Mokhtar, 2014). The same situation goes to the teachers and also students in primary school. They are still not familiar with learning science via the flip classroom. It is undeniable that some of them are literate in using the ICT, but they chose not to use it. The school ICT center is not efficiently functioning, and the online learning links provided in the science textbook seemed to be non-beneficial for the learners.

Indeed, most of the learning communities are trapped in a conventional learning culture. Some of the teachers were demotivated of the difficulty to access the available and limited ICT facilities at the school thus limiting the 21st-century learning experience among the learners (Garba et al., 2015). Especially in science education, most of the students are still lacking the opportunities to have a new way of discovery in acquiring scientific knowledge. Up until now, they only relied on textbooks and did not have the intrinsic will to search for more information on their own. They are merely studying what was given by the teachers. Many of them have no experiences on the flip classroom. They did not even realize their potential and connect their skills in ICT, which may benefit their learning. This potential unawareness will disengage the students' interest in learning more about science. This situation shall be prevented so that the primary school positive attitude toward science will face no degrading on the 7th grade (Mihladiz, Duran, & Doğan, 2011).

Another aspect is about the limited teaching and learning period in primary science lessons. Most of the primary school students will be having only two hours lesson in a week. This limitation is somehow affecting the communication quality among the students, teachers, and peers. Students should be taught to ask questions while learning, to promote reasoning and problem-solving skills (Gillies, Nichols, Burgh, & Haynes, 2013). However, within that limited time of the lesson, not much question is expected from the students. From the data in 2001, only 31 percent of Malaysia's 7127 primary schools were supplied with the computer (Belawati, 2001). This number must be proliferating until 2017. However, still, with only that limited time for science learning, not much can be done by the teachers. Some of them only able to focus on remediating the low achiever student but not for the enrichment activity (Smeets, 2005).

Some students appeared to be less interested in the way of teaching and learning at their school (Suduc, Bizoi, & Gorghiu, 2015). Nowadays it is the same scenario happening in a typical primary school. None ICT medium for them to use, besides the teachers also facing the problem to conduct blended learning in school due to the latest Malaysians' computer to learner ratio of 13:1 (UNESCO, 2016). The student did facing problem to imagine the process of the moon phase because they are still lack of the experience to the knowledge that is more theory and abstract (K. Osman, 2012). For example, in the topic of moon phases, no useful teaching aids such as interactive video were used to explain the moon phases.

Other than that, the traditional teaching and learning session is still in the exam-oriented mode. There was a culture of learning only at school, finishing homework at home, and revise to excel in the exam. Most of the students are still out of the 'need to know' attitude zone. They were still in their comfort zone, 'because it is only needed for test'. Some of them have the mindset that learning science is only to learn what the teachers told them to learn (Tugurian & Carrier, 2016). Moreover, the 2016 Malaysian department of statistic data reported an increase in Internet use among the citizen. On average, a student spent three hours in a day to access the Internet and 94.7% claimed that they used the Internet for study purposes. However, still, why is the flip classroom is not widely used in primary science education?

Since science flip classroom is still new in primary education, there is an ambiguous aspect of how it conducted. This question emphasizes the same concern from (Savelsbergh et al., 2016) that, any innovative teaching approach is indeed practical in many ways. However, it is how the content knowledge was delivered and how to implement the approach is that crucially matters. In Malaysians' school context, the flipped classroom issues were not very popular based on the current limited study (Rahman et al., 2014). It is not impossible for the flipped classroom to be successfully done in Malaysian education.

Hence, further exploration could be done to inspect the emerging aspects regarding its implementation process. I agree to (Azlina A Rahman, Hasnah Mohamed, Baharuddin Aris, & Norasykin Mohd Zaid, 2014) including the learning styles and activities, and the process of creating the flipped learning pattern starting from school, especially in primary education stream. This exploration will also be contributing to the needs of more sources of information to expand the potential of the flipped classroom in Asia (Chua & Lateef, 2014) and the other field of learning subject weather science or social studies (Zainuddin & Attaran, 2016).

The research question that was examined in this study is, what is the teacher's perception of promoting 21st-century learning in primary science subject via implementing the flipped classroom approach?

F. Theoretical Framework

In the 1970s an "open classroom" was started to be a phenomenon in the west education before the one student-one laptop in the next decade (Fulton, 2012). The terminology and the idea of the blended learning, inverted classroom and flip classroom were next. Indeed, the flip classroom has been trending in the recent study. Learning outside the classroom means learning through the use of the Internet and the social platform such as Facebook (Li, Lou, Tseng, & Huang, 2013) and YouTube (See & Conry, 2014), that focuses on the active learning and students explorations. Videotape lecture was not compulsory as it is only will help in assisting the students' comprehension of what they are learning (See & Conry, 2014).

Based on the Vygotskian theory of socio-cultural learning, learners were given the responsibility to autonomously learn by themselves (Panhwar, Ansari, & Ansari, 2016). This independent learning was happening from two learning setting which is the inter-psychological and the intra-psychological. From these learning setting, learners will first gain knowledge from other individuals and society and then strengthening their learning from reapplying it to the new context.

The constructivist theory of learning explains about learners' process of knowledge acquisition. The theory is originating from the psychologist and educators such as Jerome Bruner, Lev Vygotsky, and Jean Piaget. Those scholars believed in two different aspects in the constructivism, which are the cognitive constructivism and the social constructivism (Liu, 2010).

II. METHODOLOGY

A. The participant

In this case study, purposive sampling is used in a qualitative way to an emphasis on the views of those who are known to encounter the same phenomenal experience (Groenewald, 2004). A Science teacher was selected purposely as a sample from one district in Sabah. The teacher was from primary school. This teacher is majoring in Science, had a very well experienced in Science teaching with the title of "Lead primary science teacher," applied the FC approach in her teaching sessions and a minimum of 10 years in service. This selection was based on the recommendation from the professional authorities (Gomez-Zwiep, 2008).

B. Plan and setting

After the teachers' selection session, the selected teacher was brief about the role and needs of the study in the first session of the meeting. The next step of data collection was recorded as in Table 3.1.

Table 3.1: The sessions involved in the study.

Session	Activity	Setting
1.	First meeting with the selected teacher	Date and time (1) at selected place or room.
2.	First Interview session	Date and time (2) at the same place or room.
3.	Observation session	Date and time (3) at the same place or room.
4.	Second Interview session	Date and time (4) at the same place or room.
5.	Analysing related document	Date and time (5) at the same place or room.

C. Data Collection Methods

The data collected in this research was conducted to discover who, what, and how about the situation (Handcock, Ockleford, & Windridge, 2009). All of the data were collected using the semi-structured interview, participant observation and document review on teacher's and student's work samples. A list of interview protocols was

suggested based on the research question. This protocol was also based on the Feedback Questionnaire on Flipped Classroom Activity, which validated by (Barua & Kumar Shiva Gubbiyappa, Hasnain Zafar Baloch, 2014). This protocol was tested with the teacher as a pilot procedure to have a better interview question (Turner, 2010).

From the modified protocols, we can acquire in-depth and more detailed information to respond to the research questions respectively. The researcher will use the interview at the beginning and the end of the research period. In the same time, an observation session and document review (Creswell, 2013) process were conducted. The data collection methods were used in a different time to triangulate the findings. Table 3.2 shows the data collection method in this study.

Table 3.2: The data collection method used in the study.

	Research Questions	Interviews	Observations	Document Analysis
	What is the teacher's perception on the implementation of flipped classroom approach in primary science subject?	2	1	1

D. Data Analysis

The design of qualitative data analysis is mainly to understand the participant's thought and to answer the research questions. A grounded theory analysis technique was used in this study (Strayer, 2012). Qualitative content analysis is a dynamic form of analysis of verbal and visual data that is oriented toward summarizing the informational contents of that data (Sandelowski, 2000). Hence a systematic transcription process was made in term of making meaning to data. These include coding, the emerging keys (Unruh, Peters, & Willis, 2016), subcategories and categories, sub-themes and the central theme (Taylor-Powell & Marcus renner, 2003). All the data were compared, and contrast before joined into the same cluster respectively. This procedure will use a few processes including an iterative, inductive and finally a reductive process that organized the entire information following the three stages. These stages formed data that were labeled with open, axial, and selective coding (Walker & Myrick, 2011). The researcher was comparing all the observation session for data triangulation. From this, it was then decided which data from the observations align with the related categories (Dey, 2003).

E. Data Presentations

The final expected outcome of this study would provide direct descriptive summaries of the informational contents of data organized in a way that best fits the research question (Sandelowski, 2000). The final phase of data analysis, according to Miles and Huberman (1994), consists of drawing initial conclusions based on the cross-case data findings and then using these initial conclusions to verification procedures. In this study, the data was cross-case between the pre and post findings. From the comparison, codes were merged and differentiated in respective categories. These procedures are intended to confirm that findings are appropriate before they are labeled as conclusive results. At last, this will then gave rich elaborations of the research questions and more in-depth insight into the complete study (Dey, 2003).

III. RESULT AND DISCUSSION

The result indicates that there are three themes based on the implementation of primary science flipped classroom to promote 21st-century learning as in Figure 4.1. Every theme was viewed based on the teacher's perspectives through her experience teaching science via a flipped classroom approach. On each theme, some supporting aspects had contributed to the themes.

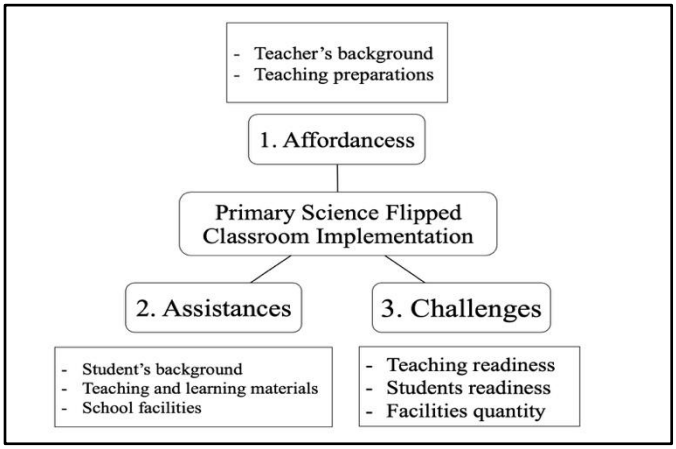

Figure 4.1 Teacher's View on Primary Science Flipped Classroom Implementation

A. Discussion on the Emerging Themes

Three main themes were developed from the categories. Each category was formed from the related subcategories as recorded in Table 4.1 to 4.3. These tables showed the overview of each theme followed by the quotes' descriptions.

The first theme is regarding the teacher's affordance that divided into two sub-themes which are the teacher's background and the teaching preparations as recorded in Table 4.1.

Table 4.1: Overview of the teacher's affordances.

Affordances	Teacher's background	Teachers' knowledge about FC
		Teachers' Pedagogical knowledge
		Teachers' attitude on flipped classroom
	Teaching	Selection of topic

	preparations	Selection of activity
		Developing the lesson plan
		Identification of student's learning ability

About the teacher's background, knowing about the flipped classroom approach, well experienced in the primary school science content knowledge and the willingness toward FC application is the factors that contribute to the affordance. Moreover, a systematic preparation before conducting the FC class is a phase that also needs to be emphasized to ensure a successful teaching and learning session. As stated in the following excerpts, the teacher gave her perceptions on the implementation of a flipped classroom in a science class and how she does the teaching preparation.

"I have had exposed with this way of teaching from a senior teaching course facilitator…" and "actually, this method is famous in modern countries." She realized the current lifestyle that is based on ICT technology. She also has the intention to teach her students about ICT based knowledge when she said, "… my students need to know how to use the ICT and could find the related information at home". Besides, proper teaching preparations could be seen by the teacher. She stated some preparation and the science FC lesson activities that she did such as "… yes, preparation must be made" "… need to see any suitable topic…", "at first I've asked my kids either they have the internet at home..", "It depends on the topic …sometime I brought my kids to the ICT room," "… They do group work… they make a short presentation with their friends" and "I will check and add some information on their presentation." The teacher always said, "I need to plan the material and run through the materials before considering to be applied in my flipped learning class." It was observed that the teacher had prepared the hands-on activity. The activities such as science project, gallery walk, and peers discussion were chosen by the teacher in teaching science using the flipped classroom approach.

As observed from the results, the teacher is a focal point for 21st-century learning to happen. The teacher plays a vital role as a mastermind on what will the learner's learn and under what circumstance the learning activity will happen. A proactive teacher has the initiative to search and explore new teaching approach to convey the knowledge to the learners. The teacher expressed the fond of using the flipped classroom approach as it had benefited both the teacher and learners in terms of flexible learning time, positive learning engagement, and the adaptation of 21st-century learning skills. Instead of deciding to apply the flipped classroom approach to promote the 21st learning in a primary science learning session, the aspect of activity selection that will be used in the flipped classroom also needs to be considered. The teacher had focused on the activity. It was realized that regardless of any approach that planned to be used, the selection of activity is crucial if one wants to promote active learning.

The second themes are the learner's background, teaching and learning materials, and the school environment was observed to be the assistance that helps the teacher implementing the science FC as recorded in Table 4.2.

Table 4.2: Overview of primary science FC assistance.

Assistance	Learners' background	Learners' ICT knowledge
		Positive learning attitude
		Parents' support
	Teaching and Learning materials	Text books and additional reference book
		Online learning materials
	School environment	ICT room
		The classroom
		Internet facility

Besides the teacher's background, a flipped learning session also depends on the learner condition. Most children had already exposed to the use of ICT especially at home keen on using the ICT as a routine. In the same time, parents play supporting roles in terms of giving guidance and monitoring their child's learning progress. At home, learners had chosen the textbook and online website as information sources. At the school, a room equipped with ICT and the Internet facility, and a conducive classroom have become the contributor to the right school environment to promote the 21st – century learning. The following excerpts are about what is the assistance, which helps the teacher to conduct the flipped classroom:

The teacher mentioned that "kids nowadays… they were born in this era of technology" when she reflected on her students. She was grateful with her student's positive learning as in "I am grateful that my students in that class have good discipline in completing any task given such as finding some information for learning." She added, "…Only a few of them had complaints that they didn't have the phone access at home… most got permitted by their parents" and "I believe the parents gave permission and let them use phones or other gadgets at home." Gadgets and Internet access allowed students to access related information. The teacher also makes use of the textbook and other learning materials by mentioning "…Links are provided in our textbook... it's already there for them" and "just Google and many learning materials there… but need to choose". Additionally from her statement "GB (the headmaster of the school) always welcome the use of new way of teaching...", it is noticed that the school administration gives teachers the authority to choose the teaching approach that suits them. It was also observed that the ICT room, well function Internet capability and conducive classroom at the school also support the teacher.

For the learners, proper monitoring from the teacher, parents, and peers is essential to assist them learned using the flipped classroom approach effectively. In a group activity, group leaders need to be trained to check and help their group

members in doing any learning activity. The check and help role by the group leaders had promoted a peer's monitoring session. They could assist their group members to complete and succeed any task in the learning activity. Instead of the teacher as the primary facilitator, parents could also become the second facilitator at home. Parents could also monitor their child's learning in terms of guiding the ICT usage and as a moral supporter.

The third theme in table 4.3 shows the challenges experienced by the teacher while conducting FC in the science lesson. The challenges were divided into three contributors, which is on the facilities, teaching readiness and the learners' readiness.

Table 4.3: Overview on the challenges in implementing the primary science FC.

Challenges	Facilities limitation	ICT equipments
		Maintenance cost
	Teaching readiness	Limited time on teaching session
		Schools' teaching communities
	Learners' readiness	Learners' abilities differences
		Learners' negative perceptions
		Learners' learning habits

The challenges had become the factor in demotivating the teacher and learners. The facilities limitation at school was caused by the limitation on the usage of ICT equipment and the maintenance cost for a malfunction LCD projectors. Other than that, teaching via FC initially was also challenging if some colleagues comment negative perceptions on FC. It was also challenging to introduce a new way of delivering science lesson to the learners at the beginning. Moreover, learners' negative impressions about FC was due to the initial shock when they have to go out of their learning comfort zone and adapt to the FC learning style. The following excerpts will highlight the challenges in conducting the FC approach:

The teacher mentioned that, they seldom use the ICT room at school as in her reason, "we only have one ICT room," "the internet is okay, but not all PC can be used." The teachers have to make a booking to use the ICT room but priority to the ICT class. In the beginning, the situation somehow difficult her to teach her students especially the low achiever students group to learn FC. The teacher agreed that she face the difficulty at initial to change their traditional learning style to a new learning style. Especially teaching in the low-performance class, implementing FC is quite challenging. She said that "…but different class has a different kid's attitude, different level.. I need to adjust" "..need more time and sometimes demotivating me" "I shouldn't force them" "they felt using this way is difficult.. they want the older way of learning". Apart from that, she also faces negative perception from her colleagues. She said, "I received critics from few colleagues," "my friend believe that not writing notes on a whiteboard means not delivering proper teaching."

It is implementing a new way of teaching approach always not easy for the first time. Getting aware of the matters that have to interfere with the flipped classroom session had sparked the teacher to go over the problems. Instead of making excuses that finally would demotivate her, the teacher converts the shortcomings to an opportunity, to prove that she could apply the 21st-century learning using the FC approach. Becoming a proactive teacher, flexibility in planning the learning session, positive thinking, willingness to explore a new way of teaching, and working determination are crucial factors. In the learners' perspective, scaffolding the way of learning would allow them to get familiar and be able to have an excellent 21st-century learning experience in learning science using the FC approach.

B. Association of the Emerging Themes

As mentioned in the previous sections, the teacher had chosen the flipped classroom approach to promote 21st-century learning in primary school science. The following section will further discuss the relationship between each theme.

Based on figure 4.2, each theme associate on each other in term of what affecting others. It noticed that the affordance could affect the assistance whereas the challenges could affect both the affordances and also the assistance. In this study, the affordances are the capability or quality that the teacher and the learner already have. Meanwhile, the assistance is the capability or condition that was equipped by the teaching and learning settings. In other words, the affordance that is personal learning capability could support the assistance that is the outer learning capability or quality. For example, a teacher can apply their deep understanding of the pedagogical and technological knowledge to the learner's learning in the classroom (Koehler & Mishra, 2009). The other way round, the assistance could also help the affordance. Meanwhile, both the inner and outer learning's ability will be affected by the related challenges mentioned earlier.

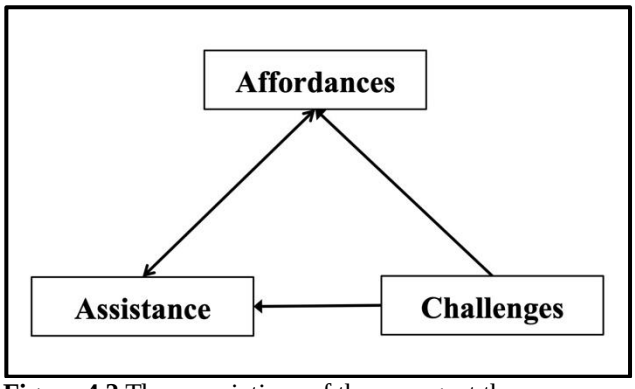

Figure 4.2 The associations of the emergent themes

Why is affordance associated to the assistance?

Each aspect would support and rely on each other. The teacher should have sufficient knowledge regarding the flipped classroom. In 21st century learning, the teacher is the primary catalyst to conduct any successful teaching and learning session. However, having a good teacher alone is not enough if we neglect the other factors that could assist the teacher's capabilities and initiatives. On the other hand, the learners themselves were one of the catalysts in any successful learning session if the teacher could engage with them. It is because, a positive teacher-student relationship would promote the mutual understanding, respect, obedience and increase the learners' confidence level in a teaching-learning session (Hussain, Nawaz, Nasir, Kiani, & Hussain, 2013).

Why are the challenges affecting the affordance and assistance?

In implementing the flipped classroom, it identified that some challenges such as the facility, teaching readiness, and learners' readiness could interfere with the affordance and assistance. Even though the teacher is well experienced and has a good competence teaching the primary school science, some lacks regarding the teaching and learning limitation could block the teacher's teaching potential. For example, learners who did not have the interest will cause difficulties learning using ICT (Ng Kee Chuan, 2014). The same challenges would also intervene negatively the learners' capability to experience 21st-century learning activities. This situation could become unsolved if the teacher did not be able to solve the related problem that she was facing alternatively.

IV. CONCLUSION

There are three themes related to promoting 21st-century learning when teaching the science subject using the flipped classroom approach. For the researcher, identifying these three themes would give some additional insights on how a primary school science teacher had implemented the flipped classroom approach to promoting 21st-century learning among the learners. By noticing the affordance, assistance, and challenges, it is possible for implementing a new way of teaching and learning approach in primary science education. It depends on the teacher as a prime mover in any teaching-learning activity. On the other hand, although the flipped classroom is not famous among the primary teachers, a positive notion to have the willingness and motivation to try the FC approach needs to nurture among them. In the future, we hope that implementing the primary science flipped classroom in Malaysian education context could become more familiar among the primary teachers. Many science teachers, especially in primary school, will understand more about the FC approach if more themes are continuously studied. Some modifications could be studied and made on implementing the FC in primary science education. Furthermore, in-depth understanding regarding the findings will help to overcome the barriers in primary science flipped classroom implementation.

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