EMPOWERING STUDENTS' CHEMISTRY LEARNING: THE INTEGRATION OF ETHNOCHEMISTRY IN CULTURALLY RESPONSIVE TEACHING

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Abstract. The overall aim of this two-year longitudinal study is to empower chemistry students in secondary schools through the integration of ethnochemistry as a Culturally Responsive Teaching (CRT) approach. The CRT approach in this study refers to the position promoted by Gay (2000) and the following five basic principles of CRT by Hernandez, Morales, and Shroyer (2013): content integration, facilitating knowledge construction, prejudice reduction, social justice, and academic development. The integration of ethnochemistry is applied to the basic principle of content integration to engage students with their Indonesia indigenous knowledge. Indonesia has around 300 ethnic groups with differences in values, beliefs, and practices which are explored in a limited way in the context of chemistry education. This research was conducted in four secondary schools using qualitative methodology with multiple methods of observation, interviews, and reflective journals. The results showed that the model of ethnochemistry integration in CRT approach was developed in this study and involved five main steps of self-identification, cultural understanding, collaboration, critical reflective thinking, and transformative construction can be implemented in Indonesia chemistry classrooms. The students were empowered to explore their cultural identity and develop their cultural awareness of appreciating differences. The learning model provides opportunities for students to develop their abilities in collaboration skills, empathy communication, and higher order thinking skills alongside their engagement in chemistry learning. Students found that the learning experiences have empowered them to engage in critical self-awareness of their cultural identity, and character development within meaningful learning experiences which are relevant to current Indonesia curriculum reform.

Keywords: culturally responsive teaching; ethnochemistry; chemistry learning; character development; culture identity

Introduction

Chemistry, is one branch of science that studies materials that exist in the universe, the interactions among them and changes in energy-related or caused by

the changes of nature (Oxtoby et al., 2001; Brady, 2009). In chemistry learning, students are expected to understand chemistry concepts in order to solve problems through building their individual knowledge (Taber, 2002; Koballa Jr. et al., 2000). However, in order to achieve this, students face challenges as many chemistry concepts are considered complex and difficult to contextualise with student lives (Taber, 2002; Pfundt & Duit, 1998). In addition to the characteristic of chemistry learning is intact and meaningful if it is associated with the three levels of macroscopic, microscopic and symbolic (Johnstone, 1991; Gabel et al., 1992; Garnet et al., 1995). However the research shows that generally, students experience difficulties with chemistry because of their inability to visualize the structure and process at the submicroscopic level and connect it with the other chemical representative levels (Chittleborough & Treagust, 2007). In the Indonesia context, several problems are evident as related to learning chemistry generally. Linking abstract concepts with students' daily lives, an overloaded curriculum, and rote learning or memorizing all contribute to the problem of effective chemistry education (Rahmawati, 2013). It is expected that students not only understand chemistry concepts, but also relate the issues to chemistry and play an active role in solving problems, either in the form of ideas or actions. Thus, to achieve these objectives, learning chemistry must be able to be a means of developing students' abilities in social life; to resolve the kinds of problems that require the chemistry teacher to be more creative in applying chemistry to contextual issues in everyday life to create meaningful learning experiences.

As related to student learning, Aikenhead (2000) points out that students' learning stages can be identified as, rote learning, in-depth meaning making, and learning as a cultural phenomenon. These stages correlate to Habermas' three interests - technical, practical and critical. In the culturally responsive teaching , teachers play an important role in engaging students in these ways of knowing. In learning as a cultural phenomenon, students will have the opportunity to engage not only Western science but with multicultural science, in order to understand themselves in relation to their own culture. Learning outcomes and experiences are successful only when students' identities and their ability to harmonise their own culture (their everyday language) aligns with Western science or have experienced a smooth transition through their border crossing between indigenous to Western knowledge.

According to Hollan (2000), cultural processes must be highly dynamic and ever changing because the nature of mind and self relies on personal meanings and subjectivity. Therefore, including culture in science will help teachers to engage students in their personal worlds. However, in an Indonesia context, beside the challenges of losing cultural identity (Rahmawati & Taylor, 2017), there is the challenge of addressing the needs of a polulation that consists of more than 17.000 islands with 300 ethnic groups that speak more than 250 dialects (Rahmawati et al., 2017). These ethnic groups have different cultural mores which influence their

values, beliefs, and practices. Therefore, Indonesia students grow up with different cultural backgrounds which influence the set of values and beliefs they hold, including beliefs about learning. In addition to the globalization, it influences the cross cultural interactions among ethnic groups, and international regions creates different cultural identities which puts pressure on individual cultural identity (Rahmawati et al., 2017). Even though, it is realised that people can experience different complex norms which will shape their cultural identity, the problem of lose cultural identity need to be identified (Rahmawati, 2013; Rahmawati & Taylor, 2015).

One of teaching approaches that can integrate culture in the classroom is Culturally Responsive Teaching (CRT); a pedagogy that recognizes the importance of including students' cultural references in all aspects of learning (Ladson-Billings, 1995). According to Gay (2000), CRT applies the cultural knowledge, prior experiences, and performance styles of diverse students to create meaningful learning experiences for these students through their strengths. Culturally responsive teachers develop intellectual, social, emotional, and political learning by "using cultural referents to impart knowledge, skills, and attitudes" Ladson-Billings (1992) explains that culturally responsive teachers realize not only the importance of academic achievement but also the maintenance of cultural identity and heritage (Gay, 2000).

Multidimensional CRT involves many things: curriculum content, learning context, classroom climate, student-teacher relationships instructional techniques, and performance assessments. Students can also participate actively in their own performance evaluations by being better human beings and more successful learners (Gay, 2000). This context is relevant to empowerment which can be described as academic competence, self-efficacy, and initiative. The CRT approach provides opportunities for students in respecting the cultures and experiences of various groups and then uses these opportunities as resources for teaching and learning. In the context of learning chemistry from cultural perspectives, ethnochemistry can be integrated. Ethnochemistry, as part of ethnoscience, looks at culture from a scientific perspective (Atran, 1991). Ethnoscience helps to understand how people develop with different forms of knowledge and beliefs and focuses on the ecological and historical contributions people have made from a cross-discipline (social sciences and humanities e.g., anthropology, sociology, psychology, and philosophy) perspective (Atran, 1991; Ingold, 2000). Ethnoscience is the application of indigenous knowledge which forms the basis, in science, of relevant parts of traditional cultural narratives. The notion of ethnoscience has been influential in education where programs of reform in a number of countries have been based on incorporating Indigenous knowledge into the school science curriculum (Aikenhead & Michell, 2011). Therefore, integrating ethnochemistry into the CRT approach in chemistry learning provids opportunities for engaging students in their world and cultural identity.

Indonesia has a standards-based education system which consist of eight national education standards of graduate competencies, content, process, assessment,

educators and supporting staff, financial, and management standards (Government Law 20/2003). These standards guide the educational process in all educational types and levels in Indonesia, including formal and non-formal education. These different types of schools are managed by the Ministry of Education and Culture and the Ministry of Higher Education. In relation to the standard based system, a curriculum framework was developed based on the standards of graduate competences, content, process, and evaluation standards. Throughout the curriculum changes takig place in Indonesia, the current curriculum, Curricula 2013, was developed based on the principles of competencies. Curricula 2013 is different from previous curriculum which is focused on content subject matter, in that it focuses on both structure and outcomes. Curricula 2013 emphasises attitude to learning as a higher priority than skill competencies and knowledge. These changes have several impacts on education in Indonesia such as, on teaching approaches, assessment, and student learning.

In relation to chemistry education in Indonesia, one of the main aims in Curricula 2013 is to develop students' scientific inquiry through connected, engaged, and meaningful chemistry learning in relation to the national character which is consist of the 18 characters on nationality, cultural competences, spirituality, and collaboration skills.[1)] Scientific inquiry refers to the activities through which a student develops knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world. In addition, Curricula 2013 embraces student-centered learning in accordance with their background, characteristics, and a students' prior knowledge.[2)]

The integration of ethnochemistry in CRT could be one way to integrate scientific inquiry with students' cultural background, in relation to the national character, as CRT could empowers students intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills, and attitudes (Ladson-Billings, 1994). In chemistry learning, western knowledge dominates at every level of the curriculum and students learning causing students to disconnecting from their cultural background, as culture is central to learning and motivation (Rahmawati, 2013). However, the chalenge for teachers is to implement a learning process that takes into account differences in cultural background and student characteristics and use these as resources for teaching and learning. This study explores the implementation of an integration of ethnochemistry in CRT into secondary chemistry classrooms by exploring cultural practices that relate to students' background and the Indonesian chemistry curricula.

Methodology

A qualitative method was employed in the study using observation, interviews, reflective journals, and document analysis as data collection. This study embraced an interpretivism paradigm which focused on in-depth understanding of all con-

texts in the research and with the participants. This study deeply explored all aspects in the development and implementation of CRT. The research was conducted at secondary schools in year 10 and 11, three public schools and one private Islamic school, in relation to the concepts of acid-base, electrolyte solution, and hydrolysis. The study consisted of three main research phases: the preliminary phase of exploring classroom and students' cultural background through observations and interviews, the second phase of CRT model development (in this phase, ethnochemistry articles as a worksheet for students understanding of their cultural background from chemistry perspectives were developed) and the third phase was CRT implementation by understanding students' differences and their soft skills development.

In this study, the ethnochemistry CRT model was developed in reference to Hernandez et al. (2013) which consists of five basic principles: content integration, facilitating of knowledge construction, prejudice reduction, social justice, and academic development. The researchers developed the model which involved five main steps: self-identification, cultural understanding, collaboration, critical reflective thinking, and transformative construction. In these five steps, students had opportunities to develop self-understanding of their character, their learning style, and their cultural identity. They also learned about others and collaborated as shown in model below.

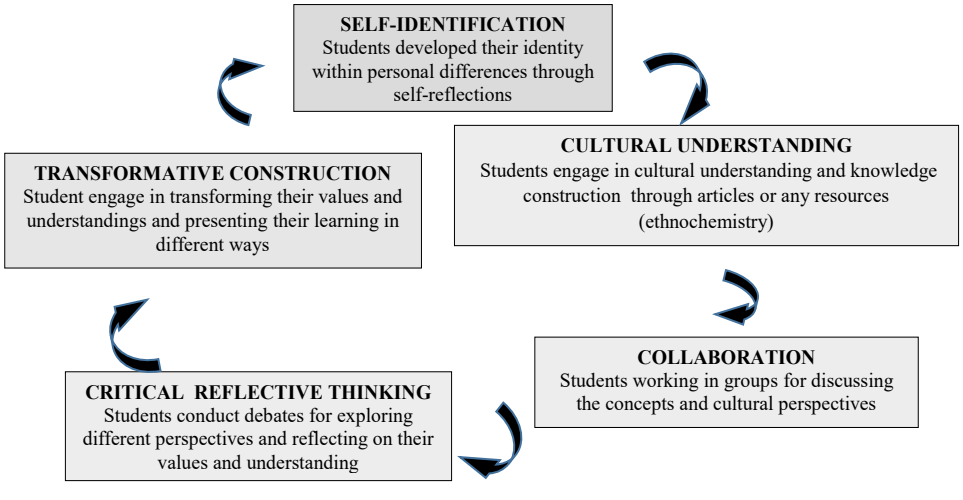

Figure 1. Ethnochemistry CRT Model (Rahmawati et al., 2017)

The process above can be modified based on specific classroom learning environment. This model not only aims to equip teachers to realize and respect the culture, and differences of their students but also tominitiate deeper chemistry knowledge.

Discussion

The study results show the process of integrating ethnochemistry in a CRT approach in the context of chemistry learning. The researchers worked with the teachers to integrate the model for engaging students. Discussions are explained in two parts according to the model of integration and are followed by the implications that can be made on student empowerment in chemistry learning.

Model of integration ethnochemistry in CRT

The model consists of five main steps: self-identification, cultural understanding, collaboration, critical reflective thinking, and transformative construction which relate to the basic principles of content integration, facilitating of knowledge construction, prejudice reduction, social justice, and academic development, as described by Hernandez et al. (2013).

Self-identification and cultural understanding

Self-identification and cultural understanding were implemented as the first step in the process by exploring students' diverse backgrounds through in-depth interview. It was found that 80% of students were born in Jakarta, however most of their parents came from Java which is a different ethnic group. The students reflected on their their cultural identity within different roles as family members and as students. The researcher conducted classroom observations before implementing the CRT so as to understand classroom culture. The students in public schools appeared to be inactive compared to private school students and appeared to follow the teachers' instructions more readily. Government schools students are selected by assessment of their academic achievement, therefore most of them are considered to be high achieving students. Most of students in the private Islamic schools were actively engaged in asking questions and were strongly influenced by Islamic practices, especially in classroom interactions In the debate, the students stated that the debate should be related to the rules in islam which is not allowed with meaningless debate.

For cultural understanding, the content integration principle by Hernandez et al. (2013) was employed by providing learning materials associated with the students' cultural background, daily lives, and the chemistry curricula. The example of cultural practice in articles was Roti Buaya from the Jakarta culture (Betawi's ethic group) and Dewi Sri from the Javanese culture (Java's ethic group). The chemistry topics discussed in this study were acid-base, hydrolysis and electrolyte solutions with the cultural practices embedded in the stories of Roti Buaya, Jeruk Nipis, Green Coconut Water, Cuka Bali, Dewi Sri. The teacher provided a task for students to ask about their parents about cultural practices which lead to cultural understanding from their own family. These stories helped them to understand their culture from a chemistry perspective. For example, the reaction of hydrolysis of

sodium bicarbonate as baking soda in Roti Buaya, hydrolysis of fertilizer on plants making fertile rice in Dewi Sri "Dewi Kesuburan Tanah", The use of green coconut water in Javanese culture that is in Tingkeban is useful in removing urine to avoid the urinary tract infections because green coconut water contains electrolytes, and the Cuka Bali Alami, called Tuak, contains alcohol as the result of the fermentation of sugar contained in the water of Nira. The addition of lau in Tuak can accelerate the rate of alcohol formation because the lau contains enzyme-producing bacteria that plays a role in the fermentation of sugar in the water of Nira. The stories have been developing in different chemistry curricula for engaging students in their culture and in chemistry concepts. Below is one of the stories developed.

Roti Buaya in Betawi culture

A traditional wedding ceremony is one of the cultural practices in Indonesia which uses a bread-shaped crocodile (Roti Buaya) as an important element in the Betawi Cultural practice in a wedding ceremony from Jakarta. The prospective bridegroom's family gives the Roti Buaya as part of the gift for the bride. This Roti Buaya is usually made as a pair, a woman and a man) and is about 1 meter long. To distinguish the female from the male crocodile, a small crocodile bun is inserted next to a female crocodile. In the history and philosophy of Betawi, the presence of Roti Buaya at the wedding has a deeper meaning. Crocodiles are referred to as being patient, loyal, and having a long life. In Betawi culture, the crocodile is a symbol of life guard to people lives. In the past, Crocodiles were regarded as guardians of springs that are vital to life. Therefore, crocodiles have become symbols of strength in maintaining life.

Roti Buaya are made with good quality bread so as to benefit the community when it is cut and distributed to neighbors to avoid wasting food. Roti Buaya in a big shape is usually only made for weddings, small shape Roti Buaya are produced every day and can be ordered at a number of traditional bakeries in Jakarta that maintain the cultural practice. Roti Buaya is made from wheat flour, eggs, butter, and baking soda. The process of making crocodile bread dough involves chemical reactions. The ingredients of the cake is one of the determinants of the success of bread dough making. An ingredient of the cake is sodium bicarbonate which has the formula $NaHCO_3$. These compounds are also known as baking soda (also called bicarbonate soda) or sodium bicarbonate. Baking soda is used to develop the dough because it makes the baked dough expand through making carbon dioxide gas bubbles. Baking soda releases carbon dioxide gas as soon as it is in contact with acidic liquids. The gas bubbles are released in the wet dough and then expand because of the heat of the oven. Once the dough is hardened the bubbles are trapped so they produce a light foamy cake.

Students are expected to find the relation of chemistry concepts and of the chemical reaction of hydrolysis that they find in the story. Through this content integration, the teacher can develop positive teacher-student relationships by building a comfortable learning environment through positive relationships between teachers and students. The teacher holds high expectations by encouraging students to achieve the learning objectives. Teachers must believe in their students ability to learning and trust that students bring valuable experiences into the classroom (Hernandez et al., 2013).

Collaborations

After students have reflected on themselves the next step in the research process was the collaboration with teachers and students. In this step, the teachers developed positive student-student interactions by implemented cooperative teaching models such as Jigsaw, STAD, and Think Pair Share. Students engaged in active discussions and collaborations within a group. Teachers provided time for the students to interact with their peers in positive interactions helping them to improve collaboration and communication skills. This step is relevant to the prejudice reduction in the classroom mentioned by Hernandez et al. (2013) by creating an enjoyable learning environment to make students become excited about learning. The teachers were available to answer questions from students without discrimination which made students felt comfortable, happy, and engaged in the lesson.

It is important to provide the opportunity for students to achieve academic success. In this context, the teacher created opportunities in the classroom by using a variety of learning methods. In the study, the teachers implemented different methods of the cooperative learning models to develop students academic ability and learning motivation. The teacher also created the group based on their differences in learning achievement, sex (gender), learning styles and ethnic backgrounds. In this study, the students preferred heterogeneous groups. Meanwhile, when students were grouped by the same ethnic group, they responded positively since it helps them to have the better understanding of ethnochemistry topics. Such an approach is relevant to the principle of constructivism as described by Hernandez et al. (2013) who consider that CRT, in facilitating knowledge construction, is constructing knowledge based on students' prior knowledge. The students are expected to understand from both a chemistry and cultural meanings perspective. Integrated learning with CRT can be more relevant and effective for students by using cultural knowledge in order to create meaningful learning experience and introduce new concepts (Gay, 2000)

Critical reflective thinking and transformative construction

The next research phase, after collaboration, was critical reflective thinking and transformative construction. Debates were conducted so that the stu-

dents could explore different perspectives and reflect on their values and understanding. After reflecting, students engaged in transforming their values and understanding and presenting them in different ways by reflecting on the question *How have the values and perspectives that they hold transformed because of the learning experiences?* The question is relevant to the five ways of being involved in transformative learning, as expressed by Taylor (2013): cultural-self knowing (self-realisation), relational knowing (opening to difference), critical knowing, visionary and ethical knowing (over the horizon thinking), and knowing in action (making a difference). These ways of knowing provide opportunities for students to understand themselves and develop the cultural awareness of appreciating differences, especially in collaborating with others.

Teachers in culturally responsive learning environments encourage students to ask questions and/or challenge the status quo. By this means, students can develop an awareness to be more critical of their status in a multicultural learning environment. Also important is to assist students in learning to be critical, independent thinkers who are open to other ways of knowing. According to Hernandez et al. (2013), CRT can help students to become critical and reflective thinkers, understand, and represent information provided. In this context, teachers communicate with the language that students understand. The teacher appreciated students' questions which lead to students' self-confidence. CRT helps students became more confident in expressing their opinion and, therefore, better at learning chemistry. Teachers act as facilitators, consultants and mediators in group discussions, and monitor the activities of each group.

Students empowerment in chemistry learning

The CRT approach has impacted on student empowerment in chemistry learning through their engagement, cultural identity and nationalism development, higher order thinking skills, collaboration skills, and empathy communication. These aspects were found in each of the different schools. The following case study in each school will be explored in detail other papers.

Student engagement

The integration of ethnochemistry was an innovation in the chemistry classrooms in this study. The students felt the learning environment was different to the usual chemistry learning environment where practice in solving the mathematics problems in chemistry was the norm. The CRT approach stimulated their curiosity and motivated them to, not only learn chemistry concepts, but also identify different cultural practices related to chemistry concepts. Below ia statement from a student who showed curiosity towards the material covered.

> [I] am curios to know how to make Roti Buaya and put into practice, 'is it true that the chemicals used to make Roti Buaya? Then learning about rice from Dewi Sri's story, it's interesting to learn chemistry in the rice (Student Interview, February 10, 2016).

The students look more enthusiastic when exploring the chemistry concepts in the cultural practices. Their motivation was stimulated by integrating ethnochemistry in the learning because it is related to everyday thinking. According to Hoyningen-Huene (2008) "the whole of science is nothing more than a refinement of everyday thinking" (p. 180), which means the whole of science is nothing more than a systematisation of everyday thinking. The students' motivation is shown in one of students' interview responses below.

> [B]ecause we know the application of chemistry concepts in everyday life, we are motivated to know more. Chemistry seems to be difficult, but it's related to everyday life (Students Interview 14, March 2, 2016).

Ethnochemistry has stimulated the students learning motivation by describing the chemistry concepts as applied in cultural traditions which make students more interested in chemistry learning. This has led to meaningful learning experiences as recognised by studies of student understanding that support solutions through the use of meaningful learning experiences (Rickey & Stacy, 2000; Treagust et al., 2004). In this study, students engagement in a new learning approach, environment, and in relation to students' daily lives.

Cultural identity and nationalism

The ethnochemestry approached is committed to not only developing cognitive value, but it also aims to develop cultural identity and nationalism. Identity can be developed and maintained through dynamic social interactions (Lee & Anderson, 2009). According to Geijsel & Meijers (2005), identity is a learning process; it is something that is constructed with the involvement of emotions which are experienced by the students in this study. The study is relevant according to the definition of cultural identity as development by Erikson (1968) which describes identity as a balance of self-understanding and understanding the social and cultural. When students collaborated with other students they developed their identity was socially constructed in a social/cultural context which included shareing beliefs, relationships, customs, symbol systems (language), knowledge, physical settings, and objects Vygotsky (1978). According to Palmer (2004), identity involves all the forces that constitute our lives, including genetic makeup, our parents, culture, experiences (bad and good, love and suffering), and identity is also a moving intersection of inner and outer forces that make who we are as human beings. In the

following statement students show their cultural identity after it was integrated with the learning culture.

> [C]ertainly, we are Indonesia, but when exploring our own cultural background, its has stimulated me to maintain my culture and share to others (Student Interview, March 15, 2016).

> [I] feel grateful that we have been given a favor all manner what so and we have to preserve our culture (Student Interview, March 3, 2016)

In relation to this, students stimulated to develop their nationalism, students explained that they become more loving towards Indonesia culture. Because of the impact of globalization, they came to understand that they have a limited understanding of their own culture which is considered to be a loss of their cultural identity (Rahmawati, 2013).

In addition to introducing the idea of bringing their indigenous knowledge into the chemistry classroom, Aikenhead (2000) proposes the idea of pluralism in learning science which relates to the interaction between the different cultures of students and science itself (as represented by Western science). School science should consider that pluralism of cultural perspectives be honoured in teaching and learning so that the silenced voices from other cultures will be heard. Since the science classroom is a subculture within the school culture, students will face different cultural experiences, such as the cultures of their own experiences (daily lives) and the cultures of science itself (multi-science). Therefore, learning should recognise this border crossing of cultural experiences by the students. Aikenhead (2000) proposes a different idea of enculturation through the use of pluralistic science in the school/classroom to engage students through their own identity which recognises the equity of all students. Moreover, according to Hollan (2000), cultural processes must be highly dynamic and ever changing because the nature of minds and self also involves personal meanings and subjectivity. Therefore, including culture in science will help teachers to engage students' in their personal worlds.

Higher order thinking skills

Students in the study usually learn chemistry from textbook and followed the teachers instructions. In bringing culture alongside chemistry concepts helped students develop their knowledge. Teachers' diagnostic skills become important in this stage as they explore the students' prior knowledge and use the information to guide students' understanding of new conceptions. In addition, teachers can use students' pre-existing knowledge to create instructions which can avoid the "misunderstanding" of concepts. Teachers should help students to construct their own meaning and knowledge through active processes such as metacognition. While it is a challenge

for teachers to shift their paradigms from standardized tests to facilitating student inquiry (Magestro & Stanford-Blair as cited in Henderson & Kesson, 2004), it has given them a new way of facilitating chemistry learning. Students come to know about the content of chemistry such as, the chemical process,chemical reactions, and energy, while engaging in the process of seeing, hearing, and finding out for themselves, while developing their knowledge about traditions from various regions in Indonesia.

CRT has an impact on the development of creativity and creative thinking to solve problems. Teaching in Indonesian schools requires the promise of making sense of things and the nurturing of humility in the face of complexity, as well as nurturing voice (Rosenblatt, 2011). Teachers need to help students understand that being critical is valuable as it allows them to express themselves if the text contradicts their sense of things (Rosenblatt, 2011). Teachers need to encourage students to exercise their critical judgment of historians and scientists and to offer their own view. Students must be taken seriously, be shown how to tracing the consequence of their learning and test it where possible. According to Feynman, as stated in Rosenblatt (2011), "the first character of effective science teaching is before your begin you must not know the answer"(p. 163). There is a tension between the right answer and the right reasoning. The students have being challenged by critical and creative thinking in facing the given problems.

> [B]ased on the material and approaches implemented, we often being asked about our opinions or answer questions which required critical thinking (Student Reflective Journal, 24 February 2016).

> [T]his study is interesting because tasks have developed our creative thinking while learning about chemistry concepts (Student Interview, 19 February 2016).

> [I] developed understanding of new learning and knowledge within the cultures that related to chemistry and developed my curiosity in implementation of chemistry concepts in daily lives (Student Reflective Journal, 22 January 2016).

The statements demonstrage that the students showed their creativity while solving a problem. As they worked on tasks assigned by the teacher, students worked critically and creatively. Students stated that during the lesson the teacher assigns students to develop their creativity, in the project of developing the poster of ethnochemistry in their own cultural practices. The above statements show that it is important for students to build an effective understanding of modern science which needs a solid foundation and critical habits of mind. According to Bekoff (2000),

"children are inherently and intuitively curious naturalists" (p. 66), it is easy for children to absorb knowledge and retain new knowledge, but as teachers we often forget to help them "to develop their roles as future ambassadors with other animals, nature and ourselves". "So, it makes good sense to teach children well, to be role models, to infuse their education with kindness and compassion so that their decisions are founded on a deeply rooted, automatic reflex-like caring ethic" (p. 66) (Bekoff, 2000).

Collaboration skills

The value of working together can be seen when all the members to work together in completing tasks, such as to answer questions and work on project tasks.

> [I]f I didn't work together, the task will not be completed quickly so that the tasks given to work together and help each other (Reflective Journal, February 24, 2016).

Based on the above statement from either interviews or reflective journals, the students expressed how they felt when cooperating with each other. They also said they learned to understand and appreciate each other. Learning motivation is the ability of students to motivate themselves to achieve success in learning and was stimulated in this study.

> [I] become more motivated, keep telling myself that 'I must perform better" (Student Interview, March 2, 2016).

Based on the above statement, when grouping students based on their level of achievement, it stimulates their motivation to learn chemistry and they tried to perform well in the group.

Academic development and social justice during the learning had an impact on the students in that they developed the self-confidence necessary to express their opinions and talk to their classmates.

> [T]he approach has helped me to improve my self-confidence, especially in group discussion" (Reflective Journal, February 24, 2016).

Based on the results, the teaching approach which was implemented helped students to develop their self-confidence. Students appeared confident when discussing in groups by expressing opinions and conveying information held to classmates. In addition to the above, there are suggestions that culturally responsive learning has stimulated students to develop responsibility. The learning process, using cooperative discussions, engaged them in understand the task objectives to be completed.

> [E]ach of us developed the self-responsibility in order to quickly complete the task. We tried to talk to others who are not responsible for and participate in group tasks (Reflective Journal, February 24, 2016).

Most of the students in the above example stated that when participating in the chemistry study, they felt a sense of responsibility to participate and complete the tasks.

Empathy communication

Attitudes of understanding, empathy, tolerance, and sensitivity to what others' feel can occurredin this learning environment and had the impact of prejudice reduction.

> [I] learned to develop my empathy communication when working with my friends, I realised that I should respect others opinions (Reflective journal, February 24, 2016).

Based on the students' responses, there were attitudes of empathy and attempts to understand each other during the study. Grouping students based on the differences in gender, achievement levels, and ethnic groups hepled students develop their empathy with others. Attitudes to listen and respect others' opinions are the characteristic of empathy, as stated by Goleman (date) who cites the opinion that empathy is a characteristic which enables one to accept another person's perspective, be able to listen to others, and be sensitive to the others' feelings. Teaching consists of activities that help students' learning including activities carried out both inside and beyond the classroom, that include cultural competence such as broad cultural competences, relational sensitivity, communication skills, and a combination of rigor and imagination fundamental to effective practice (Ball & Forzani, 2009). Cultural competence is the ability to successfully teach students who come from cultures other than our own. It entails developing certain personal and interpersonal awareness and sensitivities, developing certain bodies of cultural knowledge, and mastering a set of skills, that, taken together, underly effective cross-cultural teaching (Diller & Moule, 2005). The teachers tried to understand and implement cultural and the character values of the students during the learning. Attitude to be sensitive about the existence of others, and the need for interdependence, is demonstrated through the following statement.

> [N]ow I often communicate with friends who I never close with, we tried to know each other (Students Interview, February 11, 2016).

Based on the statements from interviews and/or reflective journals, students indicated that their communication frequency with classmates became more frequent

than usual. They stated that they became more used to talk, getting to know their classmates character which lead to being good at working together.

Finally, integrating cultural ethics and values into the standardized education system needs to be of concern in Indonesia. The outcome of character education which is emphasized in the curricula should be integrated into teaching and learning.The problem is not in the usefulness of knowledge but in how to help young people to find the self and social meaning by using their knowledge. Therefore, teachers should integrate learning experiences for the students aligned with the knowledge of the contemporary context of problems, interests, issues, and concerns. In this paper, the discussion focused on teachers being at the centre of implementing curricula and instructions in the classroom, therefore, the importance of teachers' shifting values and beliefs will influences their perspectives of curricula as a guideline for their teaching practices.

Conclusion

The CRT culturally integrated ethnochemistry model which is developed in this study has been implemented in chemistry learning by integrating the five main steps of self-identification, cultural understanding, collaboration, critical reflective thinking, and transformative construction. The students showed empowerment in chemistry learning through their engagement, cultural identity and nationalism development, higher order thinking skills, collaboration skills, and empathy communication. The learning experiences have stimulated their learning motivation and curiosity in order to develop their knowledge of chemistry and culture. The implementation of CRT stimulated students' awareness of the role of chemistry in their everyday lives, especially in their culture that also affected their cultural understanding. In applying this approach, the teacher should develop their creativity and ability to prepare the learning resources for students, especially in ethnochemistry topics. This approach also provides the opportunity for parents to participate in students learning as part of the learning community.

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