CRITICAL REFLECTIONS OF A CHEMISTRY TEACHER EDUCATOR IN REVEALING TEACHING IDENTITY: A CRITICAL AUTEOTHNOGRAPHY RESEARCH

Yuli Rahmawati, M.Sc, Ph.D[1]. A/Prof. Peter C. Taylor[2] . dan Dr. Rekha Koul[2]
[1]   Department of Chemistry, Faculty of Mathematics and Sciences, Universitas Negeri Jakarta, Jl. Pemuda No
      10, Rawamangun. Jakarta. Indonesia
[2]   Science Mathematics Education Centre, Faculty Science and Technology, Curtin University, Bentley,
      Western Australia. 6102

Abstract

This article focuses on critical reflections on my teaching identity when I engaged as a co-teacher with three science teachers and their students from different social and cultural backgrounds. I am a university based chemistry teacher educator from Indonesia who worked in a 3-year longitudinal co-teaching project in lower secondary schools in Western Australia. As the research involved critical reflection on my own professional praxis, I adopted a multi-paradigmatic research approach with critical auto/ethnography as the research methodology. Over time, critical reflection enabled me to develop difference awareness, empathy and rapport, sharing of control and power, mutual understanding and negotiation. However, I found myself struggling to engage deeply with the science teachers and their students, due in part to socio-cultural factors. In this article, I investigate my autobiographical self as a science teacher educator facing the dilemma of aspiring to become increasingly empowered whilst simultaneously being controlled by external socio-cultural forces. As I worked with the 3 science teachers I found within their characters a mirror of my own history as a science teacher. I came to realise the power of meaning making for students' learning and also that in my own teaching history I had ignored it when the power of the technical interest strongly controlled the science classroom. The journey of working closely with the three science teachers invoked in me continuous reflection on my own evolving teaching identity as a science educator who is committed to transformative learning theory, who has faith in constructivism as a pedagogical referent, who envisions better teacher-student relationships, and who is trying to establish the wisdom of dialectical thinking; a set of beliefs that I hope will help me to stay on the pathway of increasing empowerment for better education.

Key Words
Co-teaching, teaching identity, auto/ethnography, transformative learning

Abstrak

Paper ini fokus pada refleksi kritis terhadap identitas mengajar saya ketika saya terlibat sebagai guru pendamping dengan tiga guru sains dan murid-murid mereka yang berasal dari latar belakang sosial dan budaya yang berbeda. Saya adalah dosen sebuah universitas di Indonesia yang mendidik para calon guru kimia,saya telah bekerja di sebuah proyek co-teaching in sekolah-sekolah menengah di Western Australia. Berdasarkan karakteristik penelitian ini yang melibatkan refleksi diri terhadap praktik professional saya, saya menggunakan penelitian multi-paradigmatic dengan critical auto-etnography sebagai metodologi penelitian. Refleksi diri secara kritis telah membantu saya menyadari pentingnya menghargai perbedaan, berempati, membangun hubungan secara integral, berbagi control, saling memahami dan bernegosiasi. Akan tetapi, saya berjuang untuk dapat bekerja sama dengan guru-guru dan murid-murid, terutama dalam hal memahami perbedaan sosial dan budaya di antara kami. Pada artikel ini, saya menginvetigasi biografi diri saya ketika menghadapi dilemma untuk prinsip mengajar saya, tapi banyak faktor yang membuat saya kembali ke praktek saya sebelumnya. Ketika saya bekerja dengan tiga guru sains tersebut, saya melihat diri saya pada diri mereka. Saya semakin menyadari, seringkali mengabaikan pemahaman murid-murid saya, karena terlalu fokus pada selesainya topik pada kurikulum yang saya sampaikan. Saya semakin menyadari kuatnya technical interest pada identitas saya sebagai guru sains. Perjalanan saya bekerja sama dengan guru-guru sains tersebut membuat saya selalu merefleksikan diri saya dan berkomitmen bahwa saya ingin menjadi pendidik yang berkomitmen terhadap transformative learning, memegang prinsip kontruktivism sebagai arahan menngajar serta membangun hubungan yang baik dengan murid-murid saya, dan memegang prinsip berpikir secara dialektik. Satu set belief ini saya percaya akan membuat saya tetap menjadi pendidik yang terus mempunyai visi melakukan perubahan pendidikan ke arah yang lebih baik.

Kata Kunci
Co-teaching, identitas mengajar, auto/ethnography, teori belajar transformatif

1. Introduction

I started my journey as a chemistry teacher without any passion in teaching. In my country, you need to pass the national test to be able to study in the public university. I had to study in public university due to my family's not being able to afford the expense of a private university. I did the test with two public universities. My first choice was the best university in the country and the second was the pedagogy university which was not my passion. I had a dream to study in the first university, unfortunately my test results did not fulfil the standard requirements. Rather than not have a university degree, I decided to study in the pedagogy university to become a chemistry teacher. I finished my study in 2003 and still did not have passion for being a teacher, even though both of my parents are teachers. My destiny as a teacher involved another opportunity - to become a chemistry lecturer in pedagogical university in 2004. During 2-years teaching experience, I struggled with all the challenges and dilemmas of being a teacher. Standardised assessments, overloaded curricula, large classes, and other factors were challenges that shaped my character as a teacher. I controlled my classroom to fulfil the requirement of a standardised education system. In the overloaded curricula, I focused on finishing the content within the allocated time. I was more focused on transferring knowledge than on generating meaningful understanding amongst the students. I realised my teaching had restricted my students' thinking development, restrained their creativity, and separated their lived experiences from the learning process. I also came to understand that education becomes a meaningless process when it only lists the content of knowledge to be taught to the students so they can pass the examination.

After two years chemistry teaching experience at university, I had the opportunity to pursue postgraduate diploma and master degree in science education in 2007 in SMEC, Curtin University, Australia. I finished the program in 2008, and received another opportunity to start my PhD at the same institution in 2009. During my study in Australia, I became more aware that teachers have great moral responsibility for their society and for humanity. Becoming a teacher means educating people to be the holistic individuals who will play their roles in the society. The "good" holistic individual, the great people and leaders, are shaped through education. I believe that education plays an important role in building communities. Thus, I am now committed to become a transformative science educator who not simply has good pedagogy skills, but also has passion to empower students to actively participate in their society within their different roles. Students as lifelong learners will always learn to develop knowledge for their whole lives.

During my doctoral study I was challenged by the opportunity to conduct a project on co-teaching and co-generative dialogue in Australian schools. My journey with three different science teachers challenged me to deal with many differences. As an Indonesian woman and a Moslem, I faced different degrees of challenge in engaging with teachers from Europe, Australia and Asia with diverse social and cultural backgrounds. During the process of co-teaching, social and cultural discourse cannot be avoided. I learned to step out of my comfort zone and to face the differences in engaging with the teachers and students, not only to transform myself but also their classroom practices. According to Palmer (2007), fear of life begins from fear of diversity. I agree with Palmer's statement, because every time I came to the classroom I really felt this fear. I always questioned myself as to how I could engage with them if I feared facing the differences between us. I always

worried that they would not accept me as their co-teacher. I thought it would be easier if I conducted co-teaching in my home country.

In early 1973, Miller and Trump defined co-teaching as two or more teachers working together to plan, instruct, and evaluate in the subject/s (as cited in Bacharach, Heek, & Dahlberg, 2010). Tobin (2006) and Murphy and Scantlebury (2010) also defined co-teaching as collaboration of two or more teachers in teaching a diverse group of students, while at the same time learning from each other. I agree with the ideal of learning from each other. I have had valuable learning experiences from my co-teachers, not only learning their pedagogical skills but also their values and beliefs about teaching. Co-teaching has been introduced in different contexts including pre-service-teachers, special education, and elementary, secondary and higher education. Innovative work by Roth and Tobin on integrating co-teaching with co-generative dialogue has been used for teacher evaluation (Roth & Tobin, 2001), classroom praxis (Roth & Tobin, & Zimmermahn, 2002; Martin, 2006), transforming classroom culture (Lehner, 2007), and transforming teachers' beliefs and practices (Carambo & Stickney, 2009). Because co-teaching and co-generative dialogue provides opportunities for sustaining the transformation process (Martin, 2006), I found it to be powerful for transforming myself as a science educator.

In the context of this research, I have been worked in a 3-year longitudinal study. The overall aim of this study was to investigate the effectiveness of co-teaching and co-generative dialogue in the learning and teaching of environmental education in lower secondary science classes (years 8 to 10), especially for improving teacher-student interactions and students' awareness of their place in the environment. It was hoped that improved student-teacher interactions would lead to improvement of students' achievement and teachers' pedagogical practices. In this study, a higher incidence of teaching in co-taught classrooms was not only experienced by the science teachers and students, but also by

myself as a co-teacher and researcher. When I was in class with other teachers, and co-teaching with them, I learned about a variety of ways that teachers and students interactions can occur, enabling me to have confidence-building experiences in order to reveal and develop my own teaching identity.

The concept of identity is commonly derived from Erikson, Vygotsky and Burner, for whom identity is shaped by multi-dimensional aspects, including social and cultural. Danielewicz (as cited in Witt, 2011), argues that to become a teacher an individual needs to have an identity. Co-teaching as learning to teach (Tobin, 2006) is a process of developing a teaching identity which involves learning about ourselves and making personal choices of who we are as a teacher (Green as cited in Witt, 2011, p.11). According to Palmer (2007), good teaching comes from a teacher's identity and integrity. Teachers need to know about and integrate the multiple dimensions that shape their lives. According to O'Connor (2008), teaching identity has reflective and active dimensions. Thus, teachers should reflect on and use their identity to engage with their work.

In this study, during co-teaching with teachers from different social and cultural backgrounds, I came to realise how difficult it is to become a transformative science educator. Becoming a transformative science educator is part of my ongoing journey which, in this research context, involved embracing opportunities to think critically, think reflectively about myself, and envision my future life, especially my pedagogical praxis. During the study I came to realise that educators need to understand critically the historical, social, and cultural forces that shape their lives. This critical awareness helps to develop 'new eyes' and higher-order thinking and feeling (Brookfield and O'Sullivan's study as cited in Pereira, Settelmaier, & Taylor, 2005). According to (Taylor, 2007, p.4),

transformation in personal agency involves developing diverse ways of thinking and new modes of consciousness - critical reflective thinking, metaphoric reasoning, dialectical thinking, metacognition, spiritual awareness, poetic thinking, integral thinking, envisioning". This research journey inspired me to further develop my teaching identity as a university-based chemistry teacher educator committed to practising transformative teaching in my home country.

2. Research Design

Research Paradigm

The study was governed by multiple research paradigms in order to bring out a more complete picture of the research. According to Taylor, Settlemaier and Luitel (2011), multi-paradigmatic research gives more opportunity for transformative research design and transforming teaching and learning science. I employed the interpretive, critical and post-modern paradigms, thereby giving myself the opportunity for critical self-reflection, a narrative voice and multi-perspectival thinking.

Research Methodology

Drawing on multiple paradigms, I designed a critical auto/ethnography and constructivist inquiry as to bring an integral perspective to my research. Critical auto/ethnography helped me to represent my personal experiences, self-narrative and relationships with others (Burdell & Swadener, 1999; Ellis & Bocher, 2000). According to Taylor (2008) and Taylor and Settlemaier (2003), auto/ethnographic research involves an autobiography of individual lived experience to engage the reader via pedagogical thoughtfulness and critical reflexivity which can stimulate the reader to reflect on their own experiences in order to improve their students' learning. I believe that exploring imaginative self-

reflection is a powerful way to improve my pedagogical practice and to envision my future life.

Research Methods

The study involved three secondary schools in Western Australia. Three science teachers and their students from those schools participated in this research. I conducted co-teaching with the teachers for one whole year. Research methods include narrative inquiry, observations, interviews, and reflective journals. Multiple research methods helped me to integrate different ways of knowing about myself and my participants.

The Participants

School A is a public school with a good academic reputation and achievement in sport and art. This school has outstanding science teaching learning resources: a wide range of science videos and textbooks and arguably the best school science laboratory in the State. I worked with an enthusiastic and excellent science teacher. Tony is a young male Australian science teacher around 30 years old with 5 years science teaching experience. Tony employs an interactive technology system in his teaching and his passion in education for sustainability inspires him to integrate this empowering idea in many classroom activities.

School B is a public school with an excellent reputation in academic and other achievements. The school has very good science teaching and learning resources which benefit both teachers and students. I worked with 25 students in the selected year-9 class where the students were not highly motivated to learn science. Compared to other year 9 classes in the school, the students in this class demonstrated lower levels of academic achievement. The class science teacher has changed three times in the past year. I worked with an Asian female relief teacher, Tina,

around 40 years old. She had been working as a teacher for 21 years. She is a well-organised teacher with passion for improving her students' understanding. These circumstances contributed to the implementation of co-teaching and co-generative dialogue in this class being the least successful.

School C is an Islamic private school with a good reputation and a multicultural environment. Compared to other schools, this school has less science teaching resources, and thus the teachers have difficulties finding resources such as science textbooks, an audio-visual classroom, and laboratory equipment. The students come from a variety of countries with different cultural backgrounds. Most were not highly motivated or engaged in the science classroom. I worked with a 43 year old Asian Moslem female science teacher, Emilia, who had been teaching for 23 years. I chose to work intensively in her classroom because of problems such as student misbehaviour and poor student engagement. She is an enthusiastic teacher with a passion to engage her students. Her character as a lifelong learner created open and critical discourse during co-teaching.

For this paper, I selected 3 students from School C to represent students' voices:

Sandra was one of the excellent students in the classroom. She was very engaged in the science activities. Her dream to become a doctor encouraged her to gain the best learning experience.

Natalie is a good student who always expressed her critical voice. She engaged in different learning activities. Her critical voice helped me and the teacher to identify better ways to transform our practices.

Anita was a challenging student. She was disengaged in the classroom and often misbehaved. During co-teaching she became more involved in the learning activities and her behaviour also changed greatly.

Data Analysis Presentation

As the nature of my research, I provide rich and thick descriptions of the data (Merriam, 2002) which are generated from my own reflections and envisioning, classroom observations, questionnaire results, interviews, and reflective journalling. They are represented through multiple genres within arts-based research, such as poetic, storied and other impressionistic writing.

Quality Standards

I drew upon quality standards from the three paradigms to shape my engagement in in-depth self-reflection. The research standards also guided me to monitor my own constructions (Guba & Lincoln, 1989) of the meanings of the phenomena within my narratives. Five research quality standards - praxis, critical reflexivity, trustworthiness and authenticity, representation, and crystallization - helped me to not only reflect on my experiences and engage my readers but also empower others to think and act for a better future.

3. Discussion

In this paper, I focus primarily on my own journey as a co-teacher and researcher. I have written other papers that focus on the students' and teachers' journeys. During my journey I transformed from a state of apathy as a beginning teacher to an empowered teacher enlightened enough to realise the value of challenges for transforming my professional self. The journey became very challenging when I struggled to stay empowered while conducting co-teaching with three different teaching characters from different socio-cultural backgrounds. The following discussion represents some of my

self-critical reflections during my personal journey in this research.

What I have learnt in co-teaching: Working in differences

Because She is Asian

I come to the classroom with my co-teacher (Ms Tina). We have planned to do an experiment on the influence of heat on different metals. Conversations with students have shown that they enjoy experiment in the classroom; we try to often integrate experiments into the science topics. Today, before starting the class, we discuss several misbehaving students who usually create problems in the classroom. We plan and hope that the experiments will change their behaviour. We come to the classroom and manage the students. Mrs Tina starts the lesson and explains the experiment. I ask the students to take the equipment from the front table. Most of the students take their equipment and start the experiment. I notice there is one group, Mike and Kylie, who keep talking to each other and ignore the instruction. I am aware that Mike and Kylie are often disengaged in the classroom. I walk slowly to their desk and ask them to take the equipment. After a short discussion, they finally take the equipment hesitantly. They start the experiment, but it does not take long until they start to chat and disturb other students. Once again, I walk to their desk and try to talk to them. I try to engage with them instead of judging them. As Mike and Kylie decide to continue to disturb the classroom, I take the initiative to take them out of the class to have a conversation. I start to explore their reasons for disrupting the class and why they choose to disengage. Mike says he does not like Ms. Tina's teaching method which is "boring". Kylie does not like Ms Tina's "annoying voice" because "she is Asian". Since

I am also Asian, I am quite surprised by Kylie's answers but I stay calm and composed and try to find more reasons for their disengagement in the class. The conversation takes about 10 minutes before I ask them to re-join the class.

WHY WE SHOULD BE ONE?

Why should we be one?
If God creates in us the differences
Why should we be worry for differences?
As if we have different cultures, different religions, and different values

Why should we be one?
If all national identities depend on someone's culture
If all values rely on personal experiences
If all beliefs care for the value of truth

Why should everything be in one colour?
Why should everything be one picture?
Why should everything be one shape?
Why should everything be one measurement?

If differences is more colourful, if multicultural is more powerful
If understanding the differences is more valuable,
If appreciating personal values is more imperative
Why should we be one? If we have opportunities to be different
Why should we overlook the differences? If we feel that's more prevailing

We need to accept differences
We need to celebrate harmony
Under a multicultural layer
Worlds should be more colourful, powerful and beautiful
Humans should be more empathic, caring and understanding
So, why we should be one?

That was one of my experiences in conducting co-teaching in one of the schools. I wasn't surprised with the students' answers, and I tried to think and act positively because I understand why people behave differently. I learnt to develop 'difference awareness', not for keeping the gap but for developing understanding of diversity. I realise that sometimes diversity influences someone to think and act in a different way. According to Palmer (2007), by embracing diversity, we will realise connectedness with others which is empowering for transforming our lives. In the differences, I also learnt to be more empathetic. Empathy helps me to understand how others are feeling and why they behave in

particular ways. During my co-teaching, I can gradually see a similar response from my co-teachers when they see me, a stranger, taking their role in the class and promising to improve their classroom.

Another important way of conducting co-teaching is 'rapport relationship'. For the first couple of months, I worked intensively in developing a connection with teachers and students as a passive observer in their classrooms, in order to understand the classroom culture and social interactions. This helped both teachers and students to be familiar with me and not see me as a stranger. Later on, this building relationship was important for successful co-teaching. During the process, the rapport relationship between teacher, researcher and students was maintained in the process of collaboration, dialogue, and critical reflexivity within the classroom. The rapport relationship amongst me, the teacher and the students influenced the way we co-taught in the classroom. One of the students was feeling happy about the change in the classroom during that time. But, it was not a short period of time, the change happened after I engaged in the classroom for almost one year.

> *It is important to work as a team, working as a team (you and Mrs. Tina) will accomplish more, and give us more of an understanding. We learn more; seek more knowledge that will stay in our brains. We became motivated and interested in science study, after showing us the different ways of learning science. Also when one teacher is absent the other already knows what we are doing in class therefore we can continue with our work and not waste time. (Natalie, student interview)*

In the context of sharing control and power, teachers not only learnt to share the workload but also shared the control and power of the classroom with me and students. This method was quite challenging as it was not a common practice in the past. During the study, every member in the classroom learnt to share their control and power, we learnt to accept the roles of each person in order to improve teaching practices and student learning. This sometimes made teachers wary about losing their control. I was grateful when one of the teachers agreed to co-teach with me in her classroom. Her students were happy because the teachers' collaboration contributed to their learning and helped them engage more the teacher.

> *I have no problem sharing control of the class with you. I think two heads are better than one. The students in my class find difficulty in staying focused, and are easily distracted. I can only give them a small amount of control, otherwise there will be chaos. However, if they perform well, I will definitely consider giving them more control of their activities. (Emilia, teacher interview)*

> *I think that sharing the power between two teachers is very beneficial to both students and the teacher. It benefits us as students because we have an extra teacher to help us in lab work and class work. It benefits the teacher because she has the help of an extra teacher to help her learn more teaching skills. Both can learn from each other. (Sandra, student interview)*

In the research, studying the process of understanding and negotiation played an important role; we developed an understanding towards each other and co-developed ideas for improving classroom teaching and learning practices. For example, when the teachers received feedback from students regarding improvement in their teaching practices, the teachers came to understand students' feedback and learned how to negotiate changes in their teaching style.

> *It is always important to know how your student is feeling and how you can improve it and make things better for the student, and the class. This may improve the student's knowledge/understanding.*
> *(Natalie, student interview)*

I found co-teaching was not really successful when I worked with high achiever students and a very enthusiastic teacher. I noted that co-teaching had not been really useful in this classroom, as the teacher stated.

> *My teaching beliefs have not changed greatly. I aim to do the best I can with them and give them the opportunity to benefit from activities I provide. Ideally being able to think critically and abstractly, as well as respecting others in group situations is a priority. I believe the students should always do their best and never give up, or if they feel they don't understand something – they are empowered to find out.*
> *(Emilia, teacher interview)*

Finally, working with three science teachers from three different schools was really challenging, not only in managing my time, but also in focusing on the transformational process in each classroom. I realised the limitations of myself as a co-teacher as well as a researcher.

Reflections on my teaching identity

Couple months ago, before I return to my home country, I realise that I need to prepare myself carefully and skilfully in order to remain empowered as a transformative educator in accordance with my newfound teaching identity. I intend to embrace transformative learning theory, such as applying transformative learning, constructivism as a pedagogical referent, envisioning and dialectical thinking. It will be a challenge for me to apply these teaching views in my home country and I understand the difficulty in remaining empowered. When I conducted co-teaching during this study, I often found myself trapped by the power of objectivism, rationalism, cold reason and hard control (Taylor, 1996). I am very aware that the values and beliefs associated with teacher control have significant power in my own teaching identity. The language of "transferring knowledge" and "controlling the classroom" has strongly influenced my teaching approach. I am aware also that these perspectives can restrict students' thinking development, restrain their creativity, and separate their experiences from the learning process. During co-teaching, it was important for both teacher and students to focus on students' achievements and development instead of just focusing on "transferring knowledge" and staying in control. One of the students remarked:

> *Since you came to our class, we have done more experiments and class discussions like we wanted…My scores have really improved, I usually used to always get below the 60s but now I get above it, that's a*

> *major improvement (Anita, student interview)*

The ideal of getting a good mark in science as a standard of good teaching led me and the co-teacher to focus on students' science scores and for them to pass the exam. I discovered that collaboration during teaching practice provided an opportunity for me to examine my own values and beliefs about teaching and learning. The science teachers also felt this challenge to their teaching beliefs. We learnt from each other to resist the power of the technical interest which always threatened to play a strong role in our teaching. We tried to put more consideration on serving the practical and emancipatory interests which guided us to appreciate students' engagement during lessons and the impact of teaching on students' future lives. However, we could only achieve a level of improvement in pedagogical skills rather than teaching empowerment, as is evident in the teachers' statements.

> *I have come to appreciate the value of co-teaching in helping me grow and develop as a teacher. It is helpful to have another person's feedback and suggestions as sometimes we do not realize the things we do. (Emilia, teacher interview)*

> *Co-teaching benefits me greatly in able to optimise each other's strengths in delivering lesson, sharing workload in doing research and preparing lesson. While one is teaching, the other manages to walk around giving assistance, sharing of ideas during pre-planning lessons, where we bounce off ideas toward one another. (Tina, teacher interview)*

> *I also think that there is an improvement in her behaviour towards the class, as she is more co-operative with us as we are of her. We get along with her and she enjoys teaching us. She is very caring and works hard to make sure we understand the lesson. During this research, I think she has really improved in her teaching. (Sandra, student interview)*

I worked hard to develop my teaching identity as a transformative science educator who has faith in constructivism as a pedagogical referent, who envisions better teacher-student relationships, and who is trying to establish the wisdom of dialectical thinking. I have come to realise that it is important to understand students as human beings, rather than as the "empty vessel" for replicating official science knowledge. According to Taylor (1998), the communicative and emancipatory interests will create and maintain "mutual and reciprocal" understanding. Caring is a fundamental ethic to working with students because it helps them to grow and achieve their potential (Sumsions, 2000). I endeavoured to enact these three significant principles (communicative, emancipatory, and caring) during my co-teaching in order to shape teacher-student relationships. I provided the students with a degree of freedom to express their voice emotionally and critically. I also worked to create science learning experiences as a satisfying, meaningful and engaging process.

> *It has been an honour for me to be able to have you as another science teacher. Since you came, you have changed the classroom environment, by making things*

more interesting and realistic. (Natalie, student interview)

This view was challenged when I had to deal with one of the teachers who, for most of the time, held a strong technical interest. The teacher often rejected my feedback and I failed to transform the classroom. I was disappointed to learn that some of those students did not like science and will not take science study in year 11. I struggled to stay empowered and this experience made me realise how difficult it is to be a teacher under the influence of powerful factors.

During co-teaching, I came to realise that focussing my thinking only on using constructivism as powerful ideology and ignoring other theories of learning was not helpful. Instead using constructivism as a "referent" was a powerful strategy. According to Tobin and Tippins (1993), the notion of constructivism as referent, which was developed by Wheatley, is known as 'problem-centred learning' which allows students to construct their own meaning then negotiate it socially in the classroom. I applied the teachers' role in constructivism to monitor students' understanding and guide their points of view by elaborating, justifying and evaluating. From this perspective learning should recognize the social process of meaning making of students' experiences. We (the co-teachers and I) developed varied teaching methods to engage students and diverse ways to assess student learning. For example, practical assessments were used to assess students' performance in the laboratory. The teachers could see that students learn in different ways, some performing better on practical assessment rather than on theoretical assessment. In co-teaching, I tried to ensure that all students had equal opportunities to be responsible for their own knowledge. I could say that using

constructivism as a referent helped me to engage with the students.

I discovered that my attitude to teaching has changed a bit, in my discussion with you, I gained an insight into what the students were expecting, and that was very helpful to me. This has helped me to improvise and change my teaching style to accommodate the needs of my students. (Emilia, teacher interview)

I think that since you came to help our teacher, I have become more engaged in the science classroom and I enjoy the different activities we do. I also think that the students in my classroom are more interested in Science and experiments than they were before. I also think that they are more engaged in the lesson and are eager to learn when the lesson is presented in a fun way. (Sandra, student interview)

Whenever I am conducting co-teaching I always think of the kind of teacher I want to be. I hold strongly to envisioning as part of my teaching identity as a transformative educator. Working with different science teachers provided a picture profile of common science teachers. The co-teaching helped me to learn to identify, transform and envision my teaching identity. One of my visions is becoming an agent for sustainability education which I embraced during co-teaching in this study by applying Green Chemistry in science experiments. The story below represents one of my experiences in empowering students in environmental sustainability.

Should I put one drop?

I arrive at school one hour before the practical chemistry class starts at 10.50am. After collecting the laboratory key, I walk slowly to the laboratory thinking that it would not be a problem for me conducting co-teaching in this school because I have a similar cultural background with my-co-teacher. I soon realise that what I am thinking is wrong because the students have a different cultural background, low academic achievement and there are misbehaviour issues. On top of that, inadequate resources also contribute to the problem. For example, this school does not have a laboratory assistant which causes difficulties for the science teachers to manage their time to prepare laboratory activities and often discourages them from engaging students in practical activities.

I had planned the activities with the teacher a couple days ago, we have agreed that the practical activities should relate with their daily lives and environmental sustainability. Therefore, we have created several ways to minimize environmental effects. In this acids and bases practical, we use daily life products such as dishwashing liquid, soap, shampoo, vinegar, lemon, tomato, and others. Then, we try to minimize use of chemical reagents. For example, for standard acids and bases which are HCl and NaOH, we use the dilute concentration of 0,1M because in the laboratory the available concentrations of NaOH and HCl are 2M and 4M. So, I dilute the reagents. It doesn't influence the results, since the purpose of the activities is identification of acids and bases and their pH. For the identification activity, we use white depression tiles so the students only use a small volume of chemical substances and samples.

After I finish preparing the equipment and substances, at 10.50 am, students are ready in front of the laboratory. Mrs. Emilia asks them to come to the laboratory and prepare the activities. One student entering the laboratory first says Salam to me "Assalamu'alaikum Sister Yuli". I reply "Wa'alaikumussalam, Isa". He comes to me and says, "I got the best mark for today's quiz, I am really happy for that". "That's great Isa, well done, please keep up the good work". "Thank you sister Yuli", he says and goes to his desk. Since I became the co-teacher in this class, I have tried hard to engage with the students. I am happy that students share their feelings. I learn that empowering others needs caring.

After all students have entered the science laboratory, Mrs Emilia starts to explain the main concepts of the day's activities. Then I explain the activities to the students. First, I tell them that we will start to implement Green Chemistry in our laboratory activities. I tell them that the simplest thing is minimizing the amount of chemical substances that is used in your laboratory. A couple days before we conducted this practical activity, I asked them where they threw the waste from the laboratory. All of them said: "to the sink". I ask them to think where probably that chemical waste will be going. They told me that they realized that it will be going through the water and soil around the school. I encouraged them to think that they can do something to save the environment, such as minimizing their laboratory waste by using smaller quantities and less dangerous chemical substances. Therefore, in this acids and bases practical, I told them to use one drop of universal indicator on the sample. Since they are using tiles, they just need to use three drops of the sample and one drop of indicator to identify the acids and bases.

I realised that it needs a prolonged process to engage them in education for sustainability, not only to be aware of the sustainability of

the environment, but also to actively participate in campaigning for the idea. Although sometimes I see that students do not follow the rule - they use many drops of indicator and chemical substances - I keep encouraging them to be aware of their environment. I learn that when I observe the students they will change their behaviour. One student asked me: "should I put one drop? The colour is not really clear". I told her to wait, since it is not yet mixed. Once she mixes the solution, she can see the change in colour. Sometimes, students are not patient to wait for the changes in the experiment. They use a large amount of chemical substance to get a fast result. Sometimes, we do not realise the effects of our behaviour on the environment, because we donot really see the problems. When we throw waste into the sink, we do not see directly where it is going. I realise that it will take time to empower the students, but at least they could start to think about it.

I realise the process of engagement will take enormous time and energy; but I am quite happy that the students have started to think of their roles in environmental sustainability. In addition, the teacher in this school also starts to think about the problem of laboratory waste management. One student commented on her engagement in Green Chemistry and other environmental issues that I integrated in the science classroom:

> We did a lot of experiments throughout the year and we have begun doing these experiments in an environmentally-friendly way. We have used Green Chemistry in our experiments; such as using small amounts of chemical substances. This way, we would reduce the amount of harmful

substances released into the environment. This was a very good idea as it raised awareness of the effects of harmful substances on the environment. I think that we should continue doing this in the future and conduct more of our experiments this way. (Sandra, student interview)

Conducting co-teaching 'in differences' gave me valuable experiences in dialectical thinking. I embraced dialectical thinking as a bridge to understanding different views within my professional practices. The competition between different views during teaching encourages me to think about how it influences my pedagogical practices. I can imagine that if I act only in accordance with the "objectivism" metaphor how this will limit my creative and critical thinking. I also cannot align myself only with the "constructivism" metaphor which could divorce me from social reality, especially in my country which focuses strongly on subject matter and measurement. I learnt to apply dialectical thinking to engage with competing social and cultural realities.

Moreover, I hope that I can apply the metaphor of "teaching as lived as experienced prior to the conceptualisations layer over raw experience as parking lots over organic soil" (Pinar, 2004). Creating lived and meaningful experiences for my students is not only to create a valuable journey for students, but also to empower them. In addition, I always think about the situation in my own country. I realise the two countries – Indonesia and Australia - have significant cultural differences, but I will keep trying to improve science education in my country. Completing this research and other learning experiences in Australia does not mean the end of my journey, but it becomes my starting point to move forward to learn to be a transformative

science educator. Finally, at this stage, I can say that "I am looking forward to seeing how I'll be able to apply this important knowledge to my chemistry students teachers in Indonesia".

3. Conclusions and Implications

The research in co-teaching was a personally transformative journey that challenged my newfound identity as a transformative educator. This journey provided opportunities for me to think critically, reflect on myself, and envision my future life, and helped to reveal my teaching identity as an educator committed to transformative learning theory. During co-teaching with teachers and students from different socio-cultural backgrounds, I learnt to build differences in awareness, empathy, rapport relationship, sharing control and power, negotiation and understanding. I also learnt to remain empowered as a transformative science educator who holds values and beliefs on transformative learning, constructivism as a pedagogical referent, envisioning, and dialectical thinking.

Throughout the writing process in this research, I came to realise how this study has encouraged me to think deeply, reflect critically and imagine creatively. I have become aware also that writing as a process of inquiry is tough, challenging and empowering. Within the limitations of myself and my research, I hope that I can engage my readers in revealing their own personal teaching identities. Finally, I realize this research has provided me with invaluable skills, information and knowledge that I need as I started another journey in my home country.

Acknowledgement

References

[1]   Burdell P., &   Swadener. (1999). Critical personal narrative and autoethnography in education: Reflections on a genre. *Book Review, Agustus-September.* Sweden: WACRA.

[2]   Carambo, C., & Stickney, C.T. (2009). Co-teaching praxis and professional service: Facilitating the transition of beliefs and practices. *Culture of Science Education*, *4*, 433–441.

[3]   Guba, E. G., & Lincoln, Y. S. (1989). *Fourth generation evaluation*. Newbury Pak, CA: Sage.

[4]   Ellis, C. & Bochner, A. (2000). Autoethnography, personal narrative, reflexivity: Researcher as subject. In N. Denzin & Y. Lincoln (Eds.), *The handbook of qualitative research* (2nd ed.) (pp. 733-768). Newbury Park, CA: Sage.

[5]   Martin, S. (2006). Where practice and theory intersect in the chemistry classroom: Using co-generative dialogue to identify the critical point in science education. *Culture Science of Education*, *1*, 693–720.

[6]   Merriam, S. B. (2002). Introduction to qualitatative inquiry. In S. B. Merriam & Associates (Eds.), *Qualitative research in practice: Example for discussion and analysis* (pp. 3-17). San Francisco, CA: John Wiley & Sons.

[7]   Murphy, C., & Scantleburry, K. (2010). Introduction to co-teaching. In K. Tobin & C. Milne (Eds.), *Co-teaching in international context: Research and practices* (pp.1-10). New York: Springer.

[8]   O'Connor. K. E. (2008). You choose to care: Teachers, emotions and professional identity. *Teaching and Teacher Education, 24*, 117-126.

[9]   Palmer, J. K. (2007). The courage to teach: Exploring the inner landscape of a teacher life. San Francisco, CA: John Wiley & Son.

[10]   Pereira, L., Settelmaier, E., & Taylor, P. C. (2005). Fictive imagining and moral purpose: Autobiographical research as/for transformative development. In W.-M. Roth (Ed.), *Auto/biography and auto/ethnography: Praxis of research method* (pp. 49-74). Rotterdam, The Netherlands: Sense.

[11]   Pinar, W. (2004). *Understanding curriculum: An introduction to study of historical and contemporary curriculum discourses* (Ch. Autobiography: A revolutionary act). New York, NY: Peter Lang.

[12]   Roth, W-M., & Tobin, K. (2001). The implications of co-teaching/co-generative dialogue for teacher evaluation: Learning from multiple perspectives of everyday practice. *Journal of Personnel Evaluation in Education, 15*(1), 7-29.

[13]   Roth, W.-M., Tobin, K., & Zimmermann, A. (2002). Co-teaching/co-generative dialoguing: Learning environments research as classroom praxis. *Learning Environment Research*, *5*, 1-28.

[14]   Sumsion, J. (2000) Caring and empowerment: A teacher educator's reflection on an ethical dilemma. *Teaching In Higher Education, 5*(2), 167-179.

[15]   Taylor, P. C., & Cobern, W. W. (1998). Towards a critical science education. In W. W. Cobern (Ed.), *Socio-cultural perspectives on science education: An international dialogue* (pp. 203-207). Dordrecht, The Netherlands: Kluwer Academic.

[16]   Taylor, P. C. (1996). Mythmaking and mythbreaking in the mathematics classroom. *Educational Studies in Mathematics, 31*(1, 2), 151-173.

[17]   Taylor, P. C. & Settlemaier, E. (2003). Critical autobiographical research for science educators*. Journal of Science Education, 27*(4), 233-244.

[18]   Taylor, P. C. (2007). Critical auto/ethnographic research as/for transformative professional development. Retrieved from http://smec.moodle.com/course/view.php?id=19 on May 6, 2011.

[19]   Taylor, P. C., Settelmaier, E., & Luitel, B. C. (2011/in press). Multi-paradigmatic transformative research as/for teacher education: An integral perspective. In K. Tobin, B. Fraser, & C. McRobbie (Eds.), *International handbook of science education*. Dordrecht, The Netherlands: Springer.

[20]   Tobin, K., & Tippins, D. (1993). Constructivism as a referent for teaching and learning. In K. Tobin (Ed.), *The practice of constructivism in science education* (pp. 3-21). Washington, DC: AAAS.

[21]   Tobin, K. (2006). Learning to teach through co-teaching and co-generative dialogue. *Teacher Education*, *17*(2), 133-142.

[22]   Witt, S. (2010). *Becoming a teacher: An interpretive inquiry into the construction of pre-service teachers' teaching identity*. (Doctoral dissertation). Curtin University, Bentley, WA