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A Comparison of Malaysian and German Science Teachers' Conceptions in Teaching Science in Secondary Schools

(Perbandingan Konsepsi Guru Sains Malaysia dan Jerman dalam Pengajaran Sains di Sekolah Menengah)

TAY AI JING* & SALMIZA SALEH

ABSTRACT

In this advanced world, our younger generation has been exposed to science and technology since they were born. Hence, there is an obvious need to prepare our younger generation for a better future. Malaysian and German classroom have similar physical appearance and students in both nations perceive science as a difficult and boring subject. Nonetheless, Germany scored higher than Malaysia in Programme for International Student Assessment (PISA) for science in 2012. Since Malaysia is looking forward to improving our science education, sharing and exchanging views between Malaysia and Germany are great ideas for a better science education. This case study is aimed to compare Malaysian and German secondary school science teachers' conceptions in teaching science. Data were collected through semi-structured interviews with four Malaysian science teachers and four German science teachers in their respective secondary schools. As the result of this study, there showed some improvements in Malaysia science teachers' conceptions of teaching science where they prefer to practise student-centred conceptions of teaching during the practical session and apply teacher-centred conceptions of teaching during theory lesson. On the other hand, most of the German science teachers prefer student-centred conceptions of teaching. This has added a useful and different perspective of Malaysian science teachers' conceptions in teaching science.

Keywords: Teachers' conceptions, Science education, Secondary school level, Malaysia, Germany

ABSTRAK

Dalam dunia maju ini, generasi muda kita telah didedahkan kepada sains dan teknologi sejak kecil. Oleh itu, pendidikan sains telah menjadi suatu kewajipan untuk mempersiapkan generasi muda kita terhadap masa depan yang lebih baik. Kelas-kelas di Malaysia dan Jerman mempunyai penampilan fizikal yang sama dan pelajar di kedua-dua negara menyatakan sains merupakan subjek yang sukar dan bosan. Walau bagaimanapun, Jerman mendapat skor yang lebih tinggi daripada Malaysia dalam Program Penilaian Siswazah Antarabangsa (PISA) untuk sains pada tahun 2012. Perkongsian dan pertukaran idea antara Malaysia dan Jerman adalah idea yang bagus untuk menghasilkan pendidikan sains yang lebih baik. Kajian ini bertujuan untuk membandingkan konsepi guru-guru sains terhadap pengajaran sains antara sekolah menengah Malaysia dengan sekolah menengah Jerman. Data ini dikumpulkan melalui temubual dengan empat orang guru sains di Malaysia dan empat orang guru sains di Jerman. Hasil daripada kajian ini menunjukkan bahawa terdapat beberapa peningkatan dalam konsep sains pengajaran sains Malaysia di mana mereka lebih suka mengamalkan konsep pengajaran yang berpusatkan pelajar semasa menjalankan sesi praktikal dan menggunakan konsep pengajaran yang berpusatkan guru semasa pengajaran teori. Sebaliknya, kebanyakan guru sains Jerman memilih konsep pengajaran yang berpusatkan pelajar. Ini telah menambah perspektif yang berbeza dari konsep-konsep guru sains Malaysia dalam pengajaran sains.

Kata kunci: Konsep guru, pendidikan Sains, peringkat sekolah menengah, Malaysia, Jerman

INTRODUCTION

Nowadays, we have observed a steady increase in the levels of enthusiasm for science and technology in our younger generation. However, the interest profoundly diminished when they come to learn science in school (Mohd-Salleh et al. 2012; Yong & Phang, 2015). The quantity of students taking up science in upper secondary school has declined over the last decade (Mohd-Salleh et al., 2012; Yong & Phang, 2015). Research has found that Malaysian students perceive science subjects as difficult and boring (Abd. Karim et

al. 2006; Checkley, 2010; Yong & Phang, 2015). This phenomenon was not only happening among Malaysian students, but it also struck developed nations such as Germany. Young generation in Germany was also losing interest towards the learning of science (Reiss 2000; Dieck 2003; European Commission 2007; Tröbst, et al 2016) and marked it as difficult and boring subjects (Reiss, 2000; Dieck, 2003; Tröbst et al, 2016).

According to Programme for International Student Assessment (PISA) for science in 2012, Germany scored higher than Malaysia. As indicated in the outcome report released by the Organisation for Economic Cooperation and Development (OECD), Germany scored 524 in science, while Malaysia scored 420, which was still below the average global score. Although Germany is not in the top PISA ranking, Malaysia and Germany faced the same problems, where the school students in both nations labelled science as a difficult and boring subject (Reiss, 2000; Dieck 2003; Abd. Karim et al. 2006; Checkley, 2010). Besides, the physical appearances of Malaysian and German classrooms are similar. The students were either sat in group or pairs (Saleh & Liew 2018). Moreover, the OECD reflected that both Malaysian and German students believe that mathematics and science are important for their future careers, in addition to positively perceive their mathematics and science competency (OECD 2012b).

It is astounding that both nations' students claim that science as a difficult and boring subject, despite them having different performance in PISA in 2012. Therefore, there might be some differences in the way that these two nations carry out the teaching and learning of science in school for the past decades. In 2016, the OECD discovered that German science teachers explain scientific ideas and adapt lessons to the students' needs (OECD, 2016a), and that German teachers monitor individual student progress consistently throughout the academic year (Mullis et al 2012a). This approach is more inclined towards student-centred. On the other hand, Malaysian science teachers outfit their lesson towards exam preparations (Mullis et al 2012b). Malaysian science teachers also fail to accept the role as facilitators due to the exam-oriented education system in Malaysia (Habsah 2000).

The studies mentioned above reported that there were differences the way that the German science teachers and the Malaysian science teachers carry out the teaching and learning in the past. This phenomenon might be related to the teachers' conceptions in teaching. This study was conducted to compare the current Malaysian and German secondary school science teachers' conceptions in teaching science. The specific aim of this study was:

1. To explore the current Malaysian secondary school science teachers' conceptions in teaching science.
2. To explore the current German secondary school science teachers' conceptions in teaching science.
3. To analyse the similarities and differences of Malaysian and German science teachers' conceptions in teaching science.

TEACHERS' CONCEPTIONS IN TEACHING SCIENCE

Conception is defined as a thought of what something or someone like or a fundamental comprehension of a situation. It is a firmly held opinion or conviction (Pearsall & Hanks 1998) and a perspective in which trust is placed in some individual or thing (Cahyadi 2007; Loucks-Horsley et al. 2010; Woolf 1974 cited in Buabeng 2015). Disarray exists among researchers about the definitions of beliefs (Laksani 2019; Galvis 2012; Pajares 1992). Ponte (1994) argued that both beliefs and conceptions are part of knowledge, but they are of different nature. Some researchers consider beliefs as a subclass of conceptions (Benny et al 2013). After due consideration, the word "conceptions" is preferred in this study as there has been an existing body of literature on conceptions of teaching, though mostly have been undertaken in the context of higher education (Biggs 1989; Christensen et al. 1995; Kember & Gow 1994; Prosser et al. 1994; Benny et al. 2013; Li 2018).

Kember (1997) made a comparison between many categories and created a framework considering the relationship between the teacher, the student and the learning content. Traditional view and constructivist view have immense differences in the conceptions of teaching and learning. The traditional view supports teacher-centred conceptions where teacher takes charge of the transmission of the knowledge. In this view, the teacher passes on the knowledge to the students accurately and clearly. Students are not expected to participate in the teaching and learning process. However, constructivist view believes that knowledge is created through interaction. Students relied upon the interaction to develop their own learning. In this approach, teacher acts as a facilitator. They facilitate the ongoing teaching to cover such development (Lam & Kember 2006; Watkins 1998 cited in Devlin 2006; Li 2018). The teachers help their students in changing their views on the subject that they are studying (Parpala & Lindblom-Ylänne 2007; Parpala & Rytkönen 2011; Li 2018).

MALAYSIAN VS GERMAN TEACHERS' CONCEPTIONS IN TEACHING SCIENCE

For the past decades, the Malaysian education system for primary and secondary school has been teacher-centred (Kasim 2014). Therefore, teachers have been accustomed to being knowledge transmitters in an exam-oriented education system. In addition to that, according to the study by Zul and Amas (2013), Malaysian science teachers tend to give more monitoring and support towards students with amazing academic records, sadly in the meantime de-prioritizing the less affluent students. Even though lately the education system has been revised to move towards a more student-centred approach through the Malaysian Education Blueprint 2013-2025 (Ministry of Education 2013), not all Malaysian secondary school teachers understood and acknowledged their roles as facilitators, as they are already proficient and experienced as knowledge transmitters (Ismail et al. 2011; Sulaiman et al. 2017; Habsah 2000; Habsah et al. 2004). A number of the teachers still neglected to accept roles as facilitators as their essential concern was to transfer knowledge and complete the syllabus for the goal of examinations (Habsah et al., 2004; Ismail et al. 2011).

The recent change in curriculum has introduced student-centred learning approach in the Malaysian education scene. A few researches has been done on the topic. For example, Lim (2014) found that students who are actively engaged in the learning process are mindful of their own duties and have more autonomy in learning when exposed to components of student-centred learning. Salmiza and Nooraida (2014) then found that physics teachers in general have alternative conceptions about physics instruction, and that there was no significant difference between urban and rural physics teachers' conceptions towards physics instruction (Salmiza & Nooraida 2014). Furthermore, Nuraini and Leong (2016) found that constructivist beliefs are stronger than the direct transmission beliefs for both the male and female teachers.

Meanwhile, in Germany, Koballa et al. (2000) found that the chemistry teaching is conceptualised as transferring knowledge, problem-posing and interacting with the students. They agreed that students should learn actively and be more motivated to learn chemistry when the teacher knew them well and gave them chances to make contributions during the lesson. However, Markic et al. (2006) found that German chemistry and physics students expressed that their teachers have quite traditional beliefs in teaching and learning science, whereas biology and primary school students expressed that their teachers' beliefs are more in accordance with modern education theory. More recently, Al-Amoush et al. (2014) demonstrated that German teachers' conceptions fall significantly more in line with modern education theory and that teachers held more student-centred beliefs about teaching than students (Päuler-Kuppinger & Jucks 2017).

Based on a review of past literature, some researchers found that Malaysian science teachers had traditional conceptions of science teaching and some found the other way round. Their conceptions formed according to the education system. On the contrary, researchers claimed that German science teachers are usually in line with the student-centred conceptions in teaching science. This study is conducted to explore on the current Malaysian and German science teachers' conceptions and seek any changes of the science teachers' conceptions in teaching science.

KEMBER'S MODEL OF TEACHING CONCEPTIONS

This study is framed by Kember's Model of Teaching Conceptions. Kember (1997) proposed two higher order orientations to finish his model, which incorporate the teacher-centred and student-centred approaches. To illustrate this model, in Malaysia, previous study reports that teachers focused on a clear presentation of knowledge transferred to students in an effortlessly editable frame (teacher-centred). Conversely, with the change in the curriculum orientation, students are expected to process information effectively with the teacher who acts as a facilitator of their learning (student-centred).

In sum, Kember's Model portrays teaching conceptions as a continuum along two extremes of teacher-centred and student-centred conceptions, as illustrated in Table 1.

TABLE 1. The conceptions of teaching (Adapted from Kember 1997).

Teacher-centred conception of teaching	Student-centred conception of teaching
The teacher is viewed as presenter of information and knowledge.	Teaching is viewed as a process of facilitating students' learning.
Students are considered as passive receiver.	Students are considered to have agency and responsibility of how to learn.
Knowledge is possessed by the teacher.	Knowledge is constructed by the students.

METHODOLOGY

RESEARCH DESIGN

This study is a comparative case study attempting to compare science education in Malaysian and German secondary school by looking at the current science teachers' conceptions in teaching science. This research design allowed the researcher to understand and compare the teachers' conceptions of two nations. Case study methods are provided with the requirement for a straightforward and fair process of data analysis with accurate presentation of carefully selected information (Hakim 2000). The authorization to conduct the study was obtained from the Ministry of Education Malaysia (Reference No: KPM.600-3/2/3-eras(465)), Selangor Education Department (Reference No: JPNS.PPN 600-1/49 JLD.81(40)) and Wilayah Persekutuan Kuala Lumpur Education Department (Reference No: JPNWP.900-6/1/7 Jld.19(72)). Written consent to participate in this study has been obtained from the respective school administrators and from the respective science teachers.

RESEARCH PARTICIPANTS

A total of eight science teachers had participated in this study through purposive sampling method due to the small sample size required. Ritchie et al (2003) expressed that samples for qualitative studies are fewer than those utilized in quantitative studies. There are no guidelines for sample size in qualitative inquiry. Sample size relies upon the reason for the inquiry and on the things that the researcher wants to know (Patton 2002). Parahoo (1997) depicts purposive sampling as a method of sampling where the researcher chooses individuals to be participated in the study in light of their capacity to give essential information. The sampling techniques involved two stages; the first stage was to purposively select a school from one state in both countries respectively, then followed by the purposive sampling technique to draw the science teachers from the selected schools. The teachers involved in this study were the ones who were willing and agreed to participate in the interview sessions.

The participants were four German secondary school teachers who are currently teaching science subjects in Year 8 to Year 10 in Germany and four Malaysian secondary school science teachers who teach the Form 4 science classes in Malaysia. They were three physics teachers, two biology teachers, two chemistry teachers and a general science teacher. In this study, the Malaysian science teachers who teach science, physics, biology and chemistry respectively were labelled as Teacher A, Teacher B, Teacher C and Teacher D. The German science teachers who teach chemistry and biology respectively were labelled Teacher E and Teacher F, whereas the German science teachers who teach physics were labelled as Teacher G and Teacher H.

DATA COLLECTION METHOD

This study used semi-structured interviews as the main data collection method. Semi-structured interview is a more adaptable variant of the structured interview as it provides the opportunity for the interviewer to probe and expand the interviewee's responses (Alshenqeeti, 2014). It is suitable for probing views and enable respondents to develop and expand on their own responses (Gray, 2009). There were several questions asked in the semi-structured interview which focused on teaching views, students' roles and knowledge perspectives in science classroom, as shown in Table 2. At the end of the interview sessions, the participants were given a chance to raise remarks or make inquiries.

During the interviews, the participants were guaranteed that their responses would be treated confidentially and would be used for research purposes only. Verbal informed consent and agreement were obtained from the participants before starting the interview. All the semi-structured interview sessions were conducted on the dates, locations, and times convenient to the participants.

DATA ANALYSIS METHOD

The data collected from semi-structured interviews were analysed thematically. Braun and Clarke's (2006) thematic analysis structure approaches with six-phase guide was used to analyse the data. The six phases are i) familiarization, ii) generating initial codes, iii) searching for themes, iv) reviewing themes, v) defining and naming themes, and vi) producing the report. The familiarisation process starts with the transcription of the data from the audio recordings to a word document. The audio recordings recorded during the semi-structure interview were transcribed into rich verbatim transcripts. It was then forwarded to the interviewees to amend and check on the accuracy before it was used to analyse to ensure validity of the data through member-checking.

The transcripts were then read carefully and systematically, looking for highlights in the text that were of interest with respects to the research questions. Each interview transcript was coded line-by-line. Once the data set had been read, re-read, coded and re-coded, all codes created were collated into possible themes. The researcher identified emerging themes that could group codes together. The related codes were then listed in categories according to Kember's Model of Teaching Conceptions

The initial codes that were identified during the previous procedure outline were reviewed and examined. Two expert science teachers read through

the coded text extracts of the eight science teachers to determine inter coder agreement. They rated '1' as agree and '0' as disagree. By using Cohen kappa, it was found that they had agreed with the coding. The final categories were formed, and the report was produced.

RESULTS AND DISCUSSION

Based on the interview transcripts, the codes were created and collated as shown in Table 3. In summary, Malaysian science teachers transfer all the knowledge to the students and the lessons were dominated by the teachers. They prefer chalk and talk method when teaching science. Although sometime Malaysian students have to discuss among themselves in the lesson, they still act as a passive receiver where they prefer spoon feeding. Malaysia science teachers prefer conceptual knowledge where they transfer all the science knowledge to the students and only allow students to construct their own knowledge in simple lesson.

On the other hand, the findings show that German science teacher have two ways interaction between teacher and students in the lesson. They always guide their students in the lesson. However, they prefer to transfer science knowledge to a weaker class. It is also found that German students share their science knowledge with their friends during the lesson and the students are actively involved in the lesson where they discussed the science knowledge among each other. German students are responsible on their own learning and they are passive receiver only when they face hard topics. German science teachers prefer procedural knowledge and acts as a facilitator in the classroom where their students constructed their own knowledge throughout the lesson.

TABLE 2. The interview protocols

Questions	Purpose	Content
Opening	Provide interviewee details for the study question, aims, objectives and ask for permission to record the conversation	Introduction to the Interview
1	To investigate the secondary school science teachers' teaching views	What are the effective ways for you to teach science? Why do you think it is effective?
2	To investigate the students' role in learning science	Which do you prefer students-centred or teacher-centred? Why?
3	To investigate the knowledge perspectives in leaning science	In general, your class focus on the development of procedural knowledge or conceptual knowledge? Why?

TABLE 3. Conceptions categories and codes

Categories	Sub-categories	Codes
Malaysia	Teaching view	• Transfer knowledge to the students • Chalk and talk method • Have some interaction between teacher and students
	Student role	• Passive receiver • Like to be spoon fe • Students discuss among themselves
	Knowledge	• Knowledge is possessed by the teacher • Knowledge is constructed by the students in general knowledge lesson
Germany	Teaching view	• Have some interaction between teacher and students • Guide the students • Link the topic to the surroundings • Transfer knowledge to the weaker class
	Student role	• Students responsible on their own learning • Students discuss among themselves • Passive receiver in tough topics
	Knowledge	• Knowledge is constructed by the students • Procedural knowledge

CURRENT MALAYSIAN SECONDARY SCHOOL SCIENCE TEACHERS' TEACHING CONCEPTIONS

The analysis from four Malaysian science teachers shows that one teacher prefers teacher-centred conceptions of teaching, one teacher prefers student-centred conceptions of teachings and another two teachers prefer balanced in both teacher-centred and students-centred conceptions of teaching. This shows that the conceptions of the Malaysian science teachers are moving towards students-centred conceptions of teachings which the role of teacher eventually change from being the knowledge transmitter to facilitator (Lee 2000).

Most of the Malaysian science teachers prefer teacher-centred conceptions of teaching for the theory lesson whereas they prefer student-centred conception of teaching during conducting experiments or doing exercise. Teacher B believes that teacher should teach the students and make sure that the students understand the topic first. She said that she prefers chalk and talk method in the theory lesson because she believes that this way can make the students concentrate on her teaching. While Teacher C prefers teaching conceptions which favour teacher-centred in a tough and complicated topic like digestive system. She prefers student-centred conceptions of teaching in general knowledge lesson such as determining the symptoms and effects of smoking.

Moreover, it is found that Teacher A acts as a facilitator to support students' learning in her classroom. She always motivates her students to actively engage in her lesson and she does not like her students to listen passively to what she taught. However, Teacher D said that Malaysian students are not ready for student-centred learning although the Ministry of Education are transforming the teaching and learning process to student-centred. She stated that Malaysian students are used to spoon-feeding. Thus, she prefers teacher-centred conceptions of teaching. From this study, it is found that most of the teachers teach their students by asking the students to remain quiet and copy down the notes during theory lesson. They believed that teacher-centred allows their students to understand the topic much better. As indicated by Nagaraju et al. (2013), teacher-centred classroom is suitable for large classes which it goes well in Malaysian secondary school where the number of the students in a classroom is about 30 to 40 students.

Besides, the Malaysian science teachers said that the students have to carry out discussion among themselves. Teacher A sometimes asked the students to explain science concepts to their classmates in front of the classroom where students constructed their knowledge and understandings. Teacher B also believed that the students are responsible for their own learning where the students should communicate with their classmates and learn from each other. As confirmed by Molungo (2013)'s research findings, group work can stimulate learning as the students are involved in the learning activities. Students can cooperate in pairs or groups when they compare and discuss their answers, and furthermore, recommending improvements to their classmates (Zohrabi et al. 2012) as found in this study. However, Teacher C and Teacher D still believed that the students are passive receivers where the teachers have to transfer all the science knowledge to their students.

It is undeniable that every student has different attitude and different problems. Teacher A encourages peer-tutoring where she asked the students who are coping well with their learning to guide students who are weaker while Teacher C believed that teachers have to guide the students in conducting classroom activities. However, Teacher B and Teacher D believed that both teacher-centred and student-centred conceptions of teaching are useful. It depends on how the teacher guide the students. At the end of the day, neither student-centred nor teacher-centred approach will be effective entirely in the teaching and learning process. Harmer (2011) fortifies that there is no teaching method is entirely obliged to only one approach which implies that various teaching methods should be used by teachers to meet all of students' needs.

CURRENT GERMAN SECONDARY SCHOOL SCIENCE TEACHERS' TEACHING CONCEPTIONS

From the findings of the interviews with four German science teachers, it was revealed that most of the German science teachers prefers student-centred conceptions of teaching, where only one teacher believes in blending both teacher-centred and student-centred conceptions in teaching science. This supported the findings of Al-Amoush et al. (2014) where German teachers' conceptions fall significantly more in line with modern educational theory.

Some of the German science teachers in this study said that the conception of teachings depends on the difficulties of topics and classes. Teacher E said that he prefers student-centred conception of teaching, but teacher-centred conception of teaching sometime works better in some of the classes. He said that the perspective of teaching science depends on the classes. Same goes to Teacher G and Teacher H. Teacher G believes that his lesson is always a mix method, where there is one part of his lesson will be conducted in traditional method whereas Teacher H said that he will allow the students to learn by themselves if the topics are easy. However, for a difficult topic, he will pre-teach the theory before allowing them to construct their own knowledge. Nonetheless, Teacher F believes that the teacher's role is changing in a way that teacher acts as a facilitator. Emaliana (2011) suggests that teachers need to select teaching media which meet the students' needs. The German science teachers said that they can

use student-centred conceptions of teaching in some classes but not all of them. Teacher-centred conception of teaching sometimes shows better results in some of the classes. The teachers should be primed with a lot of teaching approaches depending on the topics.

Besides, the German science teachers believe that the students have to do their own work in their own way. Teacher H said that everyone has a goal that they want to achieve but the way to the goal is different among students. Teacher G also believes that students are responsible to discover a new method autonomously by themselves. Teacher H used flipped classroom in his lesson where his students watched tutorials before the lesson and then they discussed about the tutorials in the following class. They prefer their students to think and understand the topic by themselves. The students must be mindful about their own learning and are always welcomed to ask any questions if they do not understand. The majority of German science teachers want to encourage students' collaboration and provide them with the skills to solve their problems. It supports the previous finding where the teachers agreed that the students should learn actively and be more motivated to learn when the students were given chances to make contributions during the lesson (Koballa et al. 2000).

When comes to the sources of knowledge, German science teachers believes that the students have to construct knowledge by themselves. However, it depends on the topic and the classes. As per Teacher E's experience, he must guide his students entirely in some classes. However, in some classes, he can teach relatively free with just a little guidance and students are able to answer on their own. With modern technologies, Teacher F believes that students can easily obtain science knowledge by themselves just on one click to search the information via the internet. Besides, Teacher G assigns students to carry out the experiment at home and exchange ideas in the classroom whereas Teacher H states that knowledge can be constructed by his students when they discuss among themselves.

The findings of this study agreed with Stevenson and Nerison-Low (2002) where there is no single mode of teaching characterises German education practices. Teacher E said that teachers must have diverse ways of teachings and it depends on the classes and the age of the students. Teacher G and Teacher H also agreed that the conception of teaching is depending on the difficulties of the topic conducted in the lesson.

SIMILARITIES AND DIFFERENCES OF SCIENCE TEACHERS' CONCEPTIONS IN MALAYSIAN AND GERMAN SECONDARY SCHOOL

According to Habsah (2000), Malaysian science teachers neglected to accept roles as facilitators as their essential concern was to transfer knowledge and complete the syllabus before the end of the year. It is bolstered by the discoveries in this study where the Malaysian science teachers believe that it is their responsibilities to teach theories and transfer knowledge to them. As a result, Malaysian science teachers believe that they are the presenter of the information and knowledge in the theory lessons as Malaysian students still prefer spoon-feeding. Malaysian students are not ready for student-centred learning where the students are still leaning towards spoon-feeding which they are used to since they were young. Thus, Malaysian science teachers slowly changing their views from teacher-centred conceptions of teaching to student-centred conceptions of teaching where one of the Malaysian science teachers believes that teacher should act as facilitator and two of them believes that teacher should act as both presenter and facilitator in the science classroom.

On the contrary, German science teachers support student-centred conceptions of teaching where they allow their students to construct their learning through conducting experiment and searching information through Internet. The findings supported Stevenson & Nerison-Low (2002)'s study, where German teachers believe it is their duty to convey knowledge to the weaker students through the lesson by helping them and giving negligible guided instruction to their students (Tytler et al. 2017). It is found in this study that the German science teachers expressed that the students have to learn by themselves and discuss with their classmates in the lesson. By discussing with each other, they can learn better and are more motivated to learn (Koballa et al. 2000). However, they also stated that they prefer to use teacher-centred conceptions of teaching once in a while.

Nevertheless, both Malaysian and German teachers expressed that their preferred teaching methods rely upon the topics and the classes. Both Malaysian and German science teachers stated that the teacher must apply different teaching methods in science lesson. The teachers should be primed to use different methods which is suitable for their students. The teachers ought to be aware of the circumstance and use of strategies to suit the students. This is because every student has different learning pace and needs. They should transfer science knowledge if the topic is difficult and conduct activity by allowing students to construct knowledge when necessary.

CONCLUSION

This study explored and compared the current Malaysian and German secondary school science teachers' conceptions in teaching science. Findings show that most of the Malaysian science teachers prefer teacher-centred conceptions of teaching for the theory lesson whereas they prefer student-centred

conceptions of teaching during practical session. Meanwhile, most of the German teachers prefer student-centred conceptions of teaching, where they believe that it is their duty to assist the weaker students and they give minimal guided instruction to their students. Moreover, both the Malaysian and German science teachers have some similarities in conceptions in teaching science. Both nations have the same perspective where teachers should apply different methods of teaching in their lessons. The methods should depend on the topics and their students. Science teachers should utilise different teaching methods in the classroom which will be beneficial to the teachers in employing effective learning in their classroom. The findings implicate that by understanding the needs of the students and studying the benefits of quality education, these teachers and students should be guaranteed to gain the upper hand on their education. Besides, different ways are expected to inspire the students to learn science with the goal that science will be an interesting subject for them to learn. This study might help the future researcher to obtain the proficient method to build the interest of students towards learning science based on science teachers' conceptions in teaching science.

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REFERENCES

Abd. Karim, M. M., Hussain, B. H., Md. Yusoh, O., Abd. Razak, N., Musa, M., Rahmat, F. & Azmi, N. A. 2006. Kajian profil kemasukan dan prestasi pelajar Fakulti Sains dan Teknologi, UPSI Penerbit Universiti Sultan Idris.

Al-Amoush, S., Markic, S., Usak, M., Erdogan, M. & Eilks, I. 2014. Beliefs about chemistry teaching and learning: A comparison of teachers' and student teachers' beliefs from Jordan, Turkey and Germany. *International Journal of Science and Mathematics Education.*

Alshenqeeti, H. 2014. Interviewing as a data collection method: A critical review. *English Linguistics Research, 3*(1).

Barbour, R. & Schostak, J. F. 2005. Interviewing and focus groups. In B. Somekh & C. Lewin, (Eds.) *Research Methods in the Social Sciences* (pp. 41-48). London: Sage.

Benny, H. W. Y., Zhu, Y. , Siu, L. W., Man, W. C. & Fei, Y. L. 2013. Teachers' and students' conceptions of good science teaching, *International Journal of Science Education, 35*(14), 2435-2461.

Biggs, J. B. 1989. Approaches to the enhancement of tertiary teaching. *Higher Education Research and Development, 8*, 7–26.

Braun, V. & Clarke, V. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology,* 3, 77-101.

Buabeng, I. 2015. *Teaching and learning of physics in New Zealand high schools* (Doctoral dissertation). University of Canterbury, Christchurch.

Cahyadi, M. V. 2007. Improving teaching and learning in introductory physics (Doctoral dissertation, University of Canterbury).

Christensen, C. A., Massey, D. R., Issac, P. J. & Synott, J. 1995. Beginning teacher education students' conceptions of teaching and approaches to learning. *Australia Journal of Teacher Education, 20*(1), 19–29.

Checkley, D. 2010. High School Students' Preception of Physics.

Devlin, M. 2006. Challenging accepted wisdom about the place of conceptions of teaching in university teaching improvement. *International Journal of Teaching and Learning in Higher Education, 18*(2), 112-118.

Dieck, H. T. 2003. Science education on the secondary school level in Germany with special emphasis on chemistry as an example. Chemistry Education in Germany.

Emaliana, I. 2011. A Survey on the Relationship between Motivation and Achievement of English Department Students of State University of Malang. In Cahyani, Hilda. and Cahyono, Bambang Yudi (Eds.), *Best Practices in the Teaching of English*. Malang: State University of Malang Press.

European Commission. 2007. Science education now: A new pedagogy for the future of Europe. *Directorate-General for Research, Information and Communication Unit, Brussels.*

Galvis, H. A. 2012. Understanding Beliefs, Teachers' Beliefs and Their Impact on the Use of Computer Technology. PROFILE(14)2.

Gray, D. E. 2009. Doing research in the real world (2nd ed.). Thousand Oaks, California: SAGE Publications Inc.

Harmer, J. 2011. *The Practice of English Language Teaching*. Longman: New York.

Heindrik, T. D. n.d.. Science education on the secondary school level in Germany with special emphasis on chemistry as an example. Retrieved from: http://www.rmse.es/comis/educ/senado/q5a.pdf.

Habsah Ismail. 2000. *Teachers' understanding of the concept of holistic education in the integrated secondary school curriculum (KBSM) in Malaysia*. Unpublished PhD thesis. Universiti Kebangsaan Malaysia.

Habsah Ismail, Ramlah Hamzah,Hapsah Nawawi, Rosini Abu, Aida Suraya Yunus & Wan Zah Wan Ali. 2004. Teachers' belief towards the principle underlying the national philosophy of education in Malaysia. *The International Journal of Learning, 13*(9), 91-104.

Ismail, S. A., Dorner, D., & Oliver, G. 2011. Issues Related to Information Literacy: Education in Malaysian Schools. In *International Conference on Sociallityy & Economics Development, IPEDR* (Vol. 10).

Kasim, T. S. A. T. 2014. Teaching paradigms: An analysis of traditional and student-centred approaches. *Jurnal Usuluddin, 40*, 199-218.

Kember, D. 1997. A reconceptualisation of the research into university academics' conceptions of teaching. *Learning and Instruction, 7*(3), 255-275.

Kember, D. & Gow, L. 1994. Orientations to teaching and their effect on the quality of student learning. *Journal of Higher Education, 65*(1), 57–74.

Kementerian Pendidikan Malaysia. 2013. Pelan Pembangunan Pendidikan Malaysia 2013-2025. *Putrajaya, Malaysia: Kementerian Pendidikan Malaysia*.

Koballa, T. R., Glynn, S. M. & Upson, L. 2005. Conceptions of teaching science held by novice teachers in an alternative certification program. *Journal of Science Teacher Education, 16*(4), 287-308.

Lam B.H. & Kember.D. 2006. The relationship betweenconceptions of teaching and approaches to teaching, Teachers and Teaching, 12:6, 693-713

Laksani, H. 2019. Teacher's Belief About Digital Literacy Based On Theory Of Planned Behavior. *Teaching and Learning English in Multiculture Context, 3*(2).

Lee, M. N. N. 1992. School science curriculum reforms in Malaysia: World influences and national context. *International Journal of Science Education, 14*, 249–263.

Lim, E. K. S. 2014. Investigating teachers' views of student-centred learning approach. *International Education Studies, 7*(7).

Loucks-Horsley, S., Stiles, K. E., Mundry, S., Love, N., & Hewson, P. W. 2010. *Designing professional development for teachers of science and mathematics*. Thousand Oaks, California: Corwin.

Mohd-Salleh, A., Phang, F. A., Mohamad, B. A., & Salmiza, S. 2012. Science education policy in Malaysia. In L. M. Tahir, & H.Said (Eds.), Educational Issues, Research and Policies (pp.113-128). Johor: UTM Press.

Mullis, I. V. S., Martin, M. O., Minnich, C. A., Stanco, G. M., Arora, A., Centurino, V. A. S. & Castle, C. E. 2012a. *TIMSS 2011 encyclopedia volume 1: A–K* . U.S.: TIMSS & PIRLS International Study Center.

Mullis, I. V. S., Martin, M. O., Minnich, C. A., Stanco, G. M., Arora, A., Centurino, V. A. S. & Castle, C. E. 2012b. *TIMSS 2011 encyclopedia volume 2: L-Z and benchmarking participants*. U.S.: TIMSS & PIRLS International Study Center.

Nagaraju, C., Madhavaiah, G. & Peter, S. 2013. Teacher-Centred Learning and Student-Centred Learning in English Classroom: the Teaching Methods Realizing the Dreams of Language Learners. *International Journal of Scientific Research and Reviews, 2*(3), 125-131.

OECD 2016a. Programme for international student assessment (PISA) results from PISA 2015: Germany. Retrieved from: http://www.oecd.org/pisa/pisa-2015-Germany.pdf

Pajares, M. F. 1992. Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*(3), 307-332.

Parahoo, K. 1997. *Nursing research: Principles, process and issues.* Basingstoke: Macmillan.

Parpala, A. & Lindblom-Ylänne, S. 2007. University teachers' conceptions of good teaching in the units of high-quality education. *Studies in Educational Evaluation, 33*, 355–370.

Parpala, A. S. & Rytkönen, H. 2011. Students' conceptions of good teaching in three different disciplines. Assessment & Evaluation in Higher Education, 36, 549–563.

Patton, M. Q. 2002. *Qualitative research & evaluation methods* (3rd ed.). Thousand Oaks: Sage Publications.

Päuler-Kuppinger, L. & Jucks, R. 2017. Perspectives on teaching: Conceptions of teaching and epistemological beliefs of university academics and students in different domains. *Active Learning in Higher Education, 18*(1), 63-76.

Ponte, J. P. 1994. Knowledge, beliefs, and conceptions in mathematics teaching and learning. In L.Bazzini (Ed.), *Proceedings of the fifth international conference on systematic cooperation between theory and practice in mathematics education* (pp. 169–177). Grado, Italia: University of Pavia.

Prosser, M., Trigwell, K. & Taylor, P. 1994. A phenomenographic study of academics' conceptions of science teaching and learning. *Learning and Instruction, 4*, 217–231.

Reiss, F. 2000. Problems with German science education. *Science and Education, 9*(4), 327-331.

Ritchie, J., Lewis, J. & Elam, G. 2003. Designing and selecting samples. In Jane Ritchie & Jane Lewis (Eds.), *Qualitative research practice. A guide for social science students and researchers* (pp. 77–108). Thousand Oaks, CA: Sage.

Salmiza Saleh & Nooraida Yakob. 2014. Teachers' conceptions about physics instruction: A case study in Malaysian Sshools. *Australian Journal of Basic and Applied Sciences, 8*(24), 340-347.

Stevenson, H. W. & Nerison-Low, R. 2002. To Sum It Up: Case Studies of Education in Germany, Japan, and the United States. National Institute on Student Achievement, Curriculum, and Assessment Office of Educational Research and Improvement U.S. Department of Education.

Sulaiman, S., Sulaiman, T., & Rahim, S. S. A. 2017. Teachers' Perceptions of the Standard-Based English Language Curriculum in Malaysian Primary Schools. *International Journal of Instruction, 10*(3), 195-208.

Tytler, R., Chen, H. S. & Freitag-Amtmann, I. 2017. Inquiry teaching and learning within and across cultures. Paper presented at ESERA 2017 Conference Dublin City University, Dublin, Ireland, 21-29 August 2017.

Utusan Malaysia. 2009. Dasar 40:60 Pelajar sains-sastera belum tercapai. Retrieved from: http://2pendidikanmy.blogspot.com/2009/03/dasar-4060-pelakar-sastera-sains-belum.html.

Zul Fikri Zamir & Amas Alam Faizli. 2013. TIMSS 2011: An analysis of Malaysia's achievement. Retrieved from: http://aafaizli.com/timss-2011-an-analysis-of-malaysias-achievement/

Nuraini Mohd Zikri & Leong Kwan Eu. 2016. Malaysian Mathematics teachers' beliefs about the nature of teaching ang learning. *The Malaysian Online Journal of Educational Science 2016, 4*(1).

The Star. 2017. Students taking up STEM subjects on decline last 10 years Retrieved from https://www.thestar.com.my/news/nation/2017/07/16/students-taking-up-stem-subjects-on-decline-last-10-years-ratio-of-science-to-arts-classes-reversed/

The Star. 2020. Don't kill interest in the sciences. Retrieved from:

https://www.thestar.com.my/news/education/2020/08/23/dont-kill-interest-in-the-sciences

Tröbst, S., Kleickmann, T., Lange-Schubert, K., Rothkopf, A. & Möller, K. 2016. nstruction and Students' Declining Interest in Science: An Analysis of German Fourth- and Sixth-Grade Classrooms. *American Education Research Journal* 53(1), 123-193.

Li, X. D. 2018. Teaching beliefs and learning beliefs in translator and interpreter education: an exploratory case study. The Interpreter and Translator Trainer 12:2, pages 132-151.

Yong, X.H. & Phang, F.A. 2015. Science and Arts Streams Students' Scientific Epistemological Beliefs. International Education Studies 8(13), 88-92.

Zohrabi, M., Torabi, M. A. & Baybourdiani, P. 2012. Teacher-centered and/or Student-centered Learning: English Language in Iran. English Language and Literature Studies 2(3).

Tay Ai Jing
Faculty of Education
Universiti Sains Malaysia
Email: aijing1@hotmail.com

Salmiza Saleh
Faculty of Education
Universiti Sains Malaysia
Email: salmiza@usm.my

*Author for correspondence, email: aijing1@hotmail.com

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