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ORIGINAL PAPER

The implementation of a social constructivist approach in primary science education in Confucian heritage culture: the case of Vietnam

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Abstract Social constructivism has been increasingly studied and implemented in science school education. Nevertheless, there is a lack of holistic studies on the implementation of social constructivist approach in primary science education in Confucian heritage culture. This study aims to determine to what extent a social constructivist approach is implemented in primary science education in Confucian heritage culture and to give explanations for the implementation from a cultural perspective. Findings reveal that in Confucian heritage culture a social constructivist approach has so far not implemented well in primary science education. The implementation has been considerably influenced by Confucian heritage culture, which has characteristics divergent from and aligning with those of social constructivism. This study indicates a need for design-based research on social constructivism-based science curriculum for Confucian heritage culture.

Tóm tắt Lý thuyết kiến tạo xã hội đang ngày càng được nghiên cứu và vận dụng nhiều trong giáo dục môn khoa học ở nhà trường phổ thông. Mặc dù vậy, hiện vẫn còn thiếu những nghiên cứu có cái nhìn đầy đủ về việc thực hiện lối kiến tạo xã hội trong hoạt động giáo dục

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khoa học cấp tiểu học ở nền văn hóa kế thừa Nho giáo. Nghiên cứu này nhằm mục đích xác định mức độ thực hiện lý thuyết này trong hoạt động giáo dục khoa học cấp tiểu học ở nền văn hóa kế thừa Nho giáo và nhằm giải thích sự thực hiện đó từ góc nhìn văn hóa. Các phát hiện cho thấy trong nền văn hóa kế thừa Nho giáo, lối dạy học kiến tạo xã hội đối với môn khoa học vẫn còn chưa được thực hiện tốt. Nó bị ảnh hưởng đáng kể bởi văn hóa kế thừa Nho giáo, là nền văn hóa có cả những đặc điểm tương đồng lẫn khác biệt với những đặc điểm của tư tưởng kiến tạo xã hội. Việc tìm hiểu cho thấy cần có những nghiên cứu về xây dựng chương trình môn khoa học cấp tiểu học theo lối kiến tạo xã hội phù hợp với nền văn hóa kế thừa Nho giáo.

Keywords Social constructivist approach · Primary science education · Confucian heritage culture · Divergent · Alignment

Social constructivist approaches in science education

Social constructivist ideas (Tobin 1993) have gained increasing attention from various researchers and educators over the past years. It is considered as the outcome of critiques against approaches that tend to overemphasize individual learning and neglect social aspects in the knowledge-construction process (Duit and Treagust 1998). In a social constructivist classroom, cooperative activities can create a learning community giving students strong social and emotional support that enables them to take risks and develop ownership (Beck and Kosnik 2006). It can thereby help students to develop not only knowledge but also critical thinking (Totten et al. 1991) and communicating skills (Confrey 1985).

Under influences of integration and globalization, a constructivist approach has been implemented in primary school in non-Western cultures. It is found in many studies that a social constructivist approach has come into focus for primary science education in Confucian heritage cultures through recent school reforms. In Japan, since 1999, science teachers have been encouraged to develop curricula in a way that places fieldwork and outdoor learning at the centre of learning (Gato 2000). The application of inquiry-based and social constructivist approaches also has been encouraged as in the reformed science curriculum in China (Ministry of Education [China] 2010). In Taiwan, the new science curriculum started in 2001 aims to support students in developing inquiry and research abilities, including applying scientific methods (Ministry of Education [Taiwan] 1999). It is also reported that the emphasis on inquiry orientation was recently brought into the science curriculum in South Korea (Ministry of Education and Human Resources [Republic of Korea] 2007).

Vietnam has implemented innovating teaching and learning approaches for its centralised education in primary schools through a curriculum reform which took place in year 2000 with the application of more advanced educational theories (Hoan 2002). Recently, basically and comprehensively innovating education and training is considered an objective and urgent task of the enterprise of fostering industrialisation and modernisation in Vietnam (Centre Committee [Vietnam] 2012). Although not explicitly stated, the general trend of the reforms is to move education to what in theory is described as a social constructivist approach. The Vietnamese Ministry of Education and Training considers cooperative learning as a modern innovative learning method and affirms that the education system must aim to develop cooperative abilities of students (Mai 2008). Also, innovative teaching and learning methods such as discovery, inquiry, and problem solving, have been increasingly introduced in educational documents (i.e. Ministry of Education and Training [Vietnam] 2005).

Nevertheless, there is insufficient in-depth and holistic knowledge about the implementation of a social constructivist approach in primary science education in Vietnam in

particular and in Confucian heritage culture in general. Furthermore, there is also a lack of studies about how Confucian heritage culture influences the implementation of a social constructivist approach in primary science education. Such studies are needed because the culture with its distinct characteristics is a crucial factor that considerably influences teaching and learning (Hofstede 1986). In response, this study was carried out and had the following two aims: (1) to determine to what extent a social constructivist approach is implemented in primary science education in Confucian heritage culture; and (2) to explain this implementation from a Confucian cultural perspective. The explanation can explicate cultural influences that are useful for (re)designing and applying social constructivism-based curricula in Confucian heritage culture. This knowledge may be used for the understanding how culturally appropriate designs of science curricula can be enhanced for primary science education through a design-based research approach (Bulte et al. 2006).

Key features of a social constructivist approach in science education

The multiple roots of social constructivism are based on the research of Jean Piaget and Lev Vygotsky. Piaget's research is understood to be about cognitive constructivism, which regards the development of human intellect to proceed through adaptation and organization; learning therefore was defined as a process of accommodation, assimilation, and equilibration. Rejecting Piaget's assumption that it was possible to separate learning from its social context, Lev Vygotsky argued for the importance of culture and context in forming understanding; hence, learning was defined not to be a purely individual process but a social construct as mediated by language via social discourse (Pitsoe 2007). Beyond this, a social constructivist view considers the social context in which learning occurs as central to learning itself (Pitsoe 2007). The common idea of the two perspectives of constructivism is the notion that the individual is "active"; accordingly, human cognitive development is not just responding to stimuli, as in behaviourism, but engaging, grappling, and seeking to make sense of things based on utilizing prior knowledge and experiences (Pitsoe 2007).

With widespread acceptance, social constructivist approaches are considered to create a paradigm change in science education (Coll and Taylor 2012). At the level of primary science education, social constructivist approaches have been increasingly applied in many countries connected to Western cultural traditions through the predominance of inquiry-based approaches (Anderson 2007) and the emphasis on the "nature of science" in science education. Fouad Abd-El-Khalick and Norman Lederman (2000) connected inquiry and the nature of science to science education organizations' conceptions of the nature of science. According to Ronald Anderson (2007), "what is called inquiry learning is very similar to what others call constructivist learning" and "as with inquiry, the constructivist label can be applied to the nature of science, learning and teaching" (p. 809). In this study, a social constructivist approach combines mainstream cooperative learning (cited in Mai 2008) and inquiry-based learning.

Social constructivist perspectives have provided implications to teaching and learning and re-conceptualized teaching and learning. In a social constructivist perspective, teaching and learning is defined to be about negotiation (Hand 2011) in which learners are actively involved in social activities with the teacher and peers and use their existing knowledge to construct new knowledge. Key features of a social constructivist approach were formulated in many studies and proved to be consistent with characteristics of inquiry-based learning (Anderson 2007) that emphasizes process skills (Abd-El-Khalick and Lederman 2000). In this study, we applied the ones introduced by Clive Beck and Clare Kosnik (2006). These key features are summarized in Table 1.

Table 1 Features and indicators for a social constructivist (SC) approach

Feature	Indicator
1. Learning is social	i. Students work in whole class, and/or
	ii. Students work in small groups
	iii. Students actively share ideas
2. Knowledge is experience-based	i. Students' experiences are provoked
	ii. Students interpret experiences
3. Knowledge is constructed by learners	i. Students are immersed in realistic learning situations
	ii. Students elaborate interpretations of their experiences
	iii. Students test interpretations of their experiences
	iv. Students make meanings
4. All aspects of a person are connected	i. Students' attitudes and emotions are revealed in learning
	ii. Students take part in hands-on activities
	iii. Students' values are employed and capitalized in learning
5. Learning communities should be inclusive and equitable	i. Types of communities, e.g., families, organizations, institutions, etc., are involved to support students' learning
	ii. Interactions of teacher-student and student–student should be equitable other than hierarchical

Applying knowledge of curriculum representations of Jan van den Akker, a curriculum developer, in this study, social constructivism is used to make key feature of the *intended curriculum* explicit to provide a ground for analysis of the *formal curriculum*, and to determine its implementation in primary science education, or the *implemented curriculum* (Van den Akker 2003).

Features of Confucian heritage culture

Confucian heritage culture refers to settings influenced by Confucianism. This is an ethical and philosophical system developed from the teachings of the Chinese philosopher Confucius. The core of Confucianism is humanism with the focus on spiritual concern regarding the world and the family. Countries strongly influenced by Confucianism include Greater China, Taiwan, Korea, Japan, Vietnam, and Singapore. The following features briefly characterize Confucian heritage culture.

a. *The collectivist root.* Confucian heritage countries share characteristics of a collectivist society (Phuong-Mai et al. 2005) with an agriculture-rooted culture that requires individuals to live a settled life with a fixed residence and value collectivity and solidarity as well (Thêm 1997).
b. *The harmony and stability preference as a cultural and human value.* Confucian heritage individuals prefer to remain stable and in harmony with natural and social environments (Berthrong and Berthrong 2000). This can be influenced by an agriculture-rooted culture of Confucian heritage countries that originally promoted settled cultivations and fixed residences which required individuals to depend on nature (see Thêm 1997). Harmony is supported and recommended by Confucianism to

help individuals obtain a consensus that can lead to a common peace and a stable life (Đạm 1994).

c. *The virtue focus.* The cultivation of virtue is emphasized with the aim that the individual be *a good person*. Benevolence, righteousness, civility, knowledge, and loyalty are strongly stressed in Confucian heritage culture (Doãn 1999). Accordingly, personal interests of *I* should be limited to the interests of *We*.
d. *The support of hierarchical order.* Confucianism stresses a hierarchical order with its core objective of building a stable and well-ordered society (Berthrong and Berthrong 2000). In Confucian heritage culture, hierarchical relationships are manifested by respect for age, position and family background. Accordingly, two kinds of subjects, superior and inferior are determined for human interactions and social communications. In the support of hierarchical order of Confucian heritage culture, sacrilege is avoided and patriarchal behaviours are promoted (Đạm 1994).
e. *The family value.* Confucianism considers family to be a foundation community from which societal communities are expanded (Đạm 1994). Confucianism also considers family as a miniature version of the country and cannot be separated from society as a whole (Doãn 1999). Confucian individuals are required to keep the family at the centre of their life (Doãn 1999) and family relationship is regarded to be more valuable than the law of the land (Đạm 1994). In Confucian heritage culture, family is viewed as an educational environment for individuals to cultivate virtue and to have significant influence on the stability of society (Doãn 1999).
f. *The emphasis on theoretical knowledge.* Knowledge is considered as one of complementary aspects of the ideal person and *the full knower [trên thông thiên văn dưới tường địa lí]*. Theoretical knowledge in ancient classics is traditionally appreciated and considered universally correct. Along with these, the method of *educating by ancient classic works [giáo dục lục nghệ]*, and the method of quoting and citing of classics and examples *[tầm chương trích cú], which has been largely applied in social communications and also in teaching and learning (Chan 1999), has stimulated rote learning [học vẹt]*.

The above features are considered to have influenced all aspects of living of individuals in Confucian heritage culture, especially the tradition *respecting teacher and valuing moral principles [tôn sư trọng đạo]*.

Confucianism has influenced Vietnam for hundreds of years under cultural exchanges with China, especially in the period Vietnam was constrained by China about more tha one thousand years ago (Thêm 1997). This period formed up in Vietnam the cultural layer of exchanging with China and the region (Thêm 1997). This cultural layer is considered as one of three main cultural layers of Vietnam, ranked the second while the first is the domestic cultural layer and the third is the cultural layer of exchanging with Western countries (Thêm 1997). Culture is taken as a point of departure in this research, because the understanding of the interrelation between social constructivism and Confucianism is essential to provide a rationale with guidelines and argumentation how social constructivist approaches can be effectively applied in Confucian heritage culture as is often intended by policy makers.

Reform in primary science education in Vietnam

This research was carried out in Vietnam. Primary science education in Vietnam is integrated into primary education that emphasises the mission of training students to be future labourers who have the necessary knowledge, skills, and attitudes to cope with the rapid changes of modern times and to contribute to the industrialisation of the country (Hoan 2002). The primary science curriculum in Vietnam is centralised and authorised by the Ministry of Education and Training.

The primary science curriculum in Vietnam has been in use since the recent curriculum reform began in the year 2000. Science is a compulsory subject taught in all levels of primary education from Grade 1 (students aged 6) to Grade 5 (students aged 10). From Grade 1 to Grade 3, science is integrated into the subject called *Nature and Society*. From Grade 4 to Grade 5, science stays separate in the subject named *Science*.

Science lessons are planned to last around 35 min. They are often taught by teachers in charge of the classroom who tend to teach most of the subject areas. In *School Curriculum —For Primary Education Level* (Ministry of Education and Training [Vietnam] 2006), goals of the primary science curriculum are stated. Science should help students gain:

1. Initial and fundamental knowledge on:
   - Human metabolism, nutrient demands, reproduction, and growth;
   - How to prevent some common diseases and infectious diseases;
   - Metabolism and reproduction of animals and plants;
   - Characteristics and applicability of some substances, materials, and energy sources common in real life and in manufacture.
2. Initial skills:
   - React suitably in some situations related to the health of oneself, as well as one's family and community;
   - Observe and do some simple experiments related to real life and manufacture;
   - Ask questions in science class, seek information for answers, and express ideas in words, texts, drawings, diagrams, and so forth.
3. Attitudes and behaviours:
   - Follow hygiene rules consciously and safely for oneself, as well as one's family and community;
   - Be interested in science, and consciously apply the lessons learned to real life;
   - Actively take part in protecting the environment.

However, there are often gaps between the intended curriculum (the ideal perspectives of education as expressed in policy rhetoric), the implemented curriculum (real life practices in school and classroom), and the attained curriculum (learning outcomes) (Van den Akker 2003). The primary science education integrated into the standard primary education has been strongly criticised for being less than suitable for educating students to become future labourers (Tụy 2011).

The Embodied Research on the implementation of a social constructivist approach in primary science education in Confucian heritage culture

This study aims to provide a holistic view of the extent to which a social constructivist approach is implemented in primary science education in Confucian heritage culture and give explanations for this implementation from a cultural perspective to explain alignment and divergences between Confucianism and Social constructivist approaches. Therefore, the study answers the following research questions.

1. *To what extent is a social constructivist approach implemented in primary science education in Confucian heritage culture?*
2. *How can this implementation be explained from a Confucian cultural perspective and what cultural factors align with and diverge from social constructivism?*

For the first research question

Data collection and participants

To answer the first research question (*To what extent is a social constructivist approach implemented in primary science education in Confucian heritage culture?),* multiple data collection was employed, including: classroom observations, interviews, questionnaires, and analyses of science textbooks and curriculum guidelines. This collection of multiple data was chosen to provide thorough answers from different perspectives and participants. The use of multiple data sources can help authors characterise the implementation of a social constructivist approach based on several curriculum representations (Van den Akker 2003). Below we argue why and how the different data sources were analysed to answer the first research question in the study.

A. Classroom observations

Classroom observations allow the authors to develop a holistic perspective on the implementation of social constructivism in science classroom practices, i.e. understanding of the context within which a social constructivist approach is implemented, characterizing teachers' and students' activities, and recognizing which teaching and learning sequence is applied and how it is organized.

Two primary schools in two provinces in Vietnam were selected for classroom observations. The first province is Hanoi, the capital city of Vietnam, and the second province is Bacninh, an urban area. Both of the schools are public schools and labelled as the national standard. These two schools were considered to provide science lesson practices that can be representative of others in Vietnam.

Given that demonstrative science lessons are often different to daily ones, the first author asked for permission to have classroom observations without informing teachers in advance about specific lessons. With enthusiastic support from the school boards and teachers, the first author had good opportunities to observe representative science classes of which teachers and students were different from each other. In total, seven science lessons taught by seven teachers were observed with note taking and video recording. Information about the observed classes is presented in Table 2.

Table 2 The observed science classrooms

Class	Lesson theme	Time amount	Grade	Class size	Class code
I	Using medicine safely	37 min	5 (aged 10)	35	1
II	Using medicine safely	45	5	27	2
III	Preventing some infectious diseases of the digestion system	38	4 (aged 9)	31	3
IV	Preventing some infectious diseases of the digestion system	47	4	32	4
V	Eating vegetables and ripe fruits—use fresh and safe food	41	4	43	5
VI	Cleaning out the body excretory system of urine	22	3 (aged 8)	21	6
VII	A balanced diet	25	2 (aged 7)	25	7

The classroom practices were observed based on the following schemes.

- How are lessons structured?
- Which teaching and learning methods are applied and how?
- Which learning forms and learning tasks are applied and how?
- Are students active and curious in their learning of science?
- What kind of interactions takes place? How much time for each kind of interactions?
- Interviews

The interviews allowed the first author to identify opinions and evaluations of primary teachers and students about the current science curriculum, to recognize difficulties, advantages, and expectations that they may have with the implementation of the current science curriculum. Two kinds of semi-structured interviews were applied, as described below.

B1. Interviews with teachers

Eight female primary teachers, seven of them were approached through classroom observations, were interviewed face-to-face individually or in groups by the first author for approximately 1 h. The teachers were different in terms of educational levels and in the age (from 35 to 50 years). They have had at least 15 years of experience and won several prizes for efficient teaching. All of them were encouraged to be free in answering open-ended questions, which were focused on the science curriculum, teaching and learning methods, and/or the particular observed science lesson. Main questions for teachers were:

- What do you think about the current primary science curriculum? Why do you think so?
- What do you think about the current science lessons? Why do you think so?
- Do you apply group learning for your science classes? Why and how?
- What do you think about the application of group learning for science classes? Why?

B2. Interview with students

The first author randomly selected eleven students from the first five observed classrooms (Table 2) for interviewing. They were interviewed face-to-face individually or in groups for about 20–30 min. All of them were encouraged to be free in answering open-ended questions, which were focused on the particular observed science lesson and ideal ones. Main questions for students to answer were:

- What do you think about your science lesson(s)? Why do you think so?
- What is your ideal science lesson? Why do you want to have a science lesson like that?

These questions were often elaborated in the interviews.

All of the interviews with the teachers and students were audio-recorded and afterwards transcribed verbatim.

C. Questionnaires

Questionnaires were employed to get information from a large population of teachers and students who could provide information regarding the implementation of the current science curriculum. Two kinds of questionnaires were utilized.

C1. Teacher questionnaires (Appendix 1)

One hundred and thirty-two (132) primary teachers from various primary schools in three Northern provinces, including Hanoi, Bacninh, and Namdinh, were involved in the teacher questionnaire survey. The mean age of the teachers was 34 years and the mean teaching experience was 12 years; 91 % of them are female. The teachers were asked to answer questions regarding the current primary science curriculum, forms of cooperative learning applied to science classes, and teacher roles in science lessons.

C2. Student questionnaires (Appendix 2)

Seventy-four (74) primary students of grade 4 and 5 from two Northern provinces, Hanoi and Bacninh, were involved in the student questionnaire survey. They were asked to answer questions regarding their science lessons and their expectation about science lessons.

D. Analyses of primary science textbooks and curriculum guidelines

D1. Analysis of primary science textbooks

Given the assumption that teachers and students often rely on textbooks as a main source of information for teaching and learning, the official science textbooks were collected and analysed. This study focused on the lesson approaches and knowledge representations in science textbooks.

D2. Analysis of the science curriculum guidelines

The science curriculum guidelines are considered to be important in shaping lessons in the science textbooks and influencing teaching and learning in science classrooms. The analysis of the science curriculum guidelines can help the authors to identify objectives of science lessons and teaching methods which teachers are instructed to apply in science classrooms. To do this, the document *Schooling Curricular—For Primary Education Level* (Ministry of Education and Training [Vietnam] 2006) and primary science syllabi were collected and analysed.

Data analysis

Both quantitative and qualitative data were concurrently analyzed and compared. Prior to comparing and analyzing the combined data, the quantitative data were analyzed by SPSS in order to obtain frequencies and means for each item in the questionnaires.

Classroom observations were utilized as a primary data source of which findings later were clarified and triangulated (Jick 1979) by data from the other sources. The utilization of data sources is presented in Table 3.

Table 3 The utilization of the data sources

Social constructivist feature	Classroom observation	Interview		Questionnaires		Curriculum documents	
		Teacher	Student	Teacher	Student	Textbook	Guidelines
1. Learning is social	X	X	X	X	X		
2. Knowledge is experience-based	X	X		X		X	X
3. Knowledge is constructed by learners	X	X		X			
4. All aspects of a person are connected	X	X	X	X	X		
5. Learning communities should be inclusive and equitable	X	X		X		X	

X means the data source was utilized

The analysis of data sources was implemented in three main cycles. In the first cycle, the author analysed the data sources using the social constructivist features and corresponding indicators (Table 1) as the organizing elements in order to go to the findings. To present the findings, each of the social constructivist features was used as the leading theme for the description of the corresponding finding related to the implementation of that social constructivist feature. The description of the findings started with summaries as subthemes for the implementation and followed by evidences from the data sources.

The second cycle analysis had the involvement of the second and the third author. In this cycle, the analysis made by the first author was thoroughly discussed with the other authors for several times. The second and the third authors validated the findings formulated by the first author.

The third cycle analysis had the involvement of the entire research team. The analysis and findings from the former discussions were then discussed and validated again in the entire research team for a consensual validation (Creswell 2007, p. 204) of the research team on the findings. The discussions of many cycles of analysis along with the involvement of four researchers in total provided opportunities to do cross-check and validate data (Creswell 2007). Thereby, a thorough description about the implementation of a social constructivist approach in primary science education was completed.

For the second research question

Data collection

To answer the second research question (*How can this implementation be explained from a Confucian cultural perspective and what cultural factors align with and diverge from social constructivism?*), diverse cultural literature, including cultural studies, cultural traditions, folklore and custom practices experienced by the general population, were needed for references and searched for. This is because culture is a collective phenomenon that "consists of the unwritten rules of the social game" (Hofstede et al. 2010, p. 6). The

analysis of literature on Confucian heritage culture can provide an in-depth cultural explanation for the implementation of a social constructivist approach in primary school science in Confucian heritage culture.

Data analysis

To formulate the cultural explanations for the implementation of a social constructivist approach in primary science education in Confucian heritage culture, the six Confucian cultural features (a–f) were relied on and used as the leading themes for the presentation of the explanations. These themes were often clarified by evidences from the literature of Confucian heritage culture.

The analysis of the cultural literature took place in several steps. Firstly, knowledge of Confucian heritage culture corresponding to each of the features of Confucian heritage culture (a–f) was generalized. Secondly, it was explored in relation to science education and compared to a social constructivist perspective embedded into Western philosophy of science education. Subsequently, cross-cultural comparative knowledge was connected to the findings of the implementation of social constructivist features. In this way, cultural explanations for the implementation were formulated and led to characterizations of Confucian heritage cultural influences on the implementation of a social constructivist approach. Alignment and divergences themes emerged and were categorized into characterizations of cultural influences.

The analysis process was carried out in several cycles. The first author accomplished the first analysis of Confucian cultural features and formulated the cultural explanations for the implementation of a social constructivist approach in primary science education. After that, the analysis and the formulated explanations were thoroughly discussed with the second and third author. The analysis and the cultural explanations were then discussed again by the entire research team for a consensual validation (Creswell 2007, p. 204). Thereby, the careful explanations showing the influences of Confucian heritage culture on the implementation of a social constructivist approach in primary science education was created.

The implementation of a social constructivist approach in primary science education in Vietnam

To present the findings, the indicators of social constructivist features (Table 1) are used as organizing elements that provide themes for the implementation of a social constructivist approach in primary science education. The description starts with summaries as subthemes for the implementation and followed by evidence from the data sources. The findings are subsequently summarized in Table 4.

Table 4 The implementation of a social constructivist approach in primary science education

Social constructivist feature	Implementation
1. Learning is social	1.1. Whole class grouping was dominant for social learning
	1.2. Short-term pair grouping was dominant for group learning
	1.3. Learning in small groups was appreciated
2. Knowledge is experience-based	2.1. Teaching and learning was textbook-based
	2.2. Teaching and learning was teacher-centred
	2.3. Lessons were focused on factual knowledge
3. Knowledge is constructed by learners	3.1. Reproduction of knowledge directly taught by the teacher
	3.2. Hands-on complex tasks were absent
4. All aspects of a person are connected	4.1. Students' personal aspects were discounted
	4.2. Students would prefer cooperative learning and experimental tasks
5. Learning communities should be inclusive and equitable	5.1. Families and fieldwork were included to support school science
	5.2. Hierarchical interactions remained in science classroom practices

1. SC Feature 1: Learning is social

1.1 Whole class grouping was dominant for social learning

The amount of time spent for whole class activities was significantly higher than for group learning in the observed science classrooms. On average, 32 min were spent for the whole class activities and 3 min were spent for group learning (Source: Observations). Group tasks were applied in separate periods and on average two group tasks were utilized for cooperative learning in a science lesson (Source: Observations).

The dominance of whole class grouping (in which the teacher combines the whole class as a group) could be inferred from results of teacher questionnaires. It was found that this whole class grouping was applied more than pair grouping and other learning forms, e.g. learning in a group of four, learning in a group of six, and individual learning (Source: Teacher questionnaires). Only 20 % of the primary teachers applied group learning for all of their science classroom practices, 33 % of them applied it for the majority of science classroom practices, 29 % of them applied it for half of science classroom practices, 16 % of them applied it for some science classroom practices, and 2 % of them almost never applied group learning for their science classroom practices (Source: Teacher questionnaires).

1.2 Short-term pair grouping was dominant for group learning

Eighty-five per cent (85 %) of cooperative tasks in the observed classroom practices were applied for pair grouping, which took place on average for 2 min (Source: Observations). Six of the eight teachers confirmed the dominance of pair grouping for group learning for science lessons (Source: Teacher interviews). They explained its use based on convenience, suitability with discussion content and classroom material conditions of pair group in comparison to other group forms (Source: Teacher interviews). The short time for

group learning was confirmed by both teachers and students (Sources: Teacher and student interviews). It was explained by time constraint for science lessons and the overlooking to the subject of science in the primary school curricula (Sources: Teacher interviews and teacher questionnaires).

1.3 Learning in small groups was appreciated

It was observed that group learning with the participation of more than two students was rare but took place more actively and excitedly than learning in other forms (Source: Observations). Majority of the teachers and students reported that they appreciated group learning with the participation of more than two students for science lessons (Sources: Teacher and student interviews, Teacher and student questionnaires). According to them, students felt freer and learned more actively in group learning with the participation of more than two students than in other learning forms (Sources: Teacher and student interviews).

2. SC Feature 2: Knowledge is experience-based

2.1 Teaching and learning was textbook-based

Science textbooks were used as a main source for teachers and students to follow (Source: Observation). Teaching and learning was implemented by teachers asking questions and students reading textbooks (Source: Observations). All of the interviewed teachers confirmed the high dependence on science textbooks (Sources: Teacher interviews) and explained this dependence by work overload, their limited pedagogical content knowledge, and institutional constraints (Sources: Teacher interviews and teacher questionnaires).

- If you do not follow it, "your body will be beaten to pulp"… (Teacher Y., Class 6, explained for the rigid dependence of the primary teachers on science textbooks, Source: Teacher interviews)

2.2 Teaching and learning was teacher-centred

For whole class activities, time spent for teacher activities was significantly higher than for student activities (Source: Observations). On average, teacher activities consumed 21 min and student activities consumed 11 min (Source: Observations). In the majority of teaching time, the teachers stood in front of students to ask questions and taught knowledge as if it could be transferred in a one-way communication (teacher-centred; Source: Observations). For few cases of group learning, the teachers communicated with individual students rather than with groups as a whole (Source: Observations). During students' group discussions, the teachers not only provided students with judgments on their discourses but also adjusted students' discussions and gave them information to answer discussed questions (Source: Observations). The majority of group discussions stopped or were stopped earlier than time announced (Source: Observations). These findings were confirmed by the teachers reporting that they applied oral methods more often than practical methods for science lessons (Source: Teacher questionnaires).

2.3 Lessons were focused on factual knowledge

Teaching was mainly focused on factual knowledge in the observed science classrooms (Source: Observations). This is consistent with the lesson design in the science textbooks (Source: Science Textbooks). The lessons were structured with different learning phases,

which are labelled as (i) *Observing and Answering*, (ii) *Relating and Answering*, (iii) *Game playing*, (iv) *Drawing*, (v) *Practicing*, and (vi) *Key note* (Source: Science Textbooks). However, these so-called different learning phases could provide similar activities and were structured in varied orders (Source: Science Textbooks). Moreover, they were different in times of application in lessons and among lessons (Source: Science Textbooks). The phase *Observing and Answering* was applied more than the other phases (Source: Science Textbooks). Yet, representative questions about *What*, *When*, *Where*, or *How*, related to subject-matter frequently appeared along with illustrative figures, which could reveal the information for answering questions (Source: Science Textbooks). These designs were consistent with the science curriculum's priority of learning goals with a strong emphasis on factual knowledge (Source: Curriculum guidelines). Typical scientific skills (i.e. hypothesizing, experimenting, and arguing) and attitudes (i.e. curiosity and response to science) were almost absent in the learning goals (Source: Curriculum guidelines). The priority of learning goals of factual knowledge of the science curriculum was confirmed by seven of the eight interviewed teachers (Source: Teacher interviews). The goal of knowledge was also admitted to be emphasised higher than those of skills and attitudes (Source: Teacher questionnaires).

3. SC Feature 3: Knowledge is constructed by learners

3.1 Reproduction of knowledge directly taught by the teacher

For the whole class activities, student reproduced knowledge which was directly taught by the teacher as main activities for teaching and learning (Source: Observations); it followed a communication pattern as presented in Fig. 1.

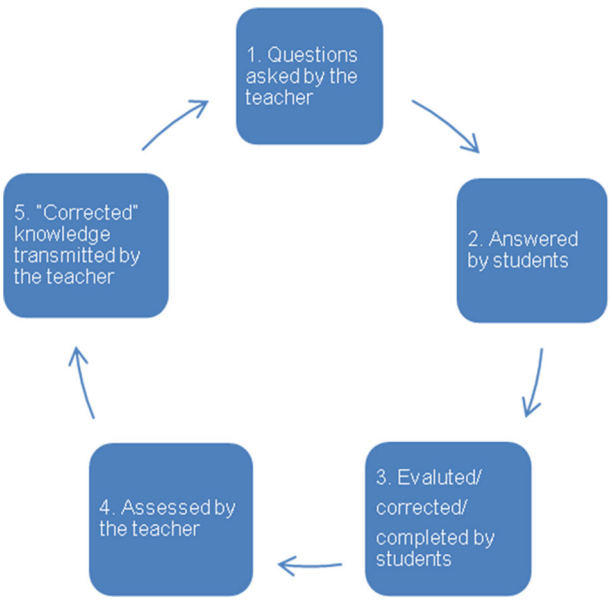

Fig. 1 A communication pattern in the science classroom practices (*source*: observations)

Sometimes, Actions 3 and 4 (Fig. 1) were skipped and Action 5 (Fig. 1) appeared longer than the others (Source: Observations).

For students' group activities, the majority of group tasks entailed mutual asking and answering in pairs; for instance students were required to ask each other which medicine they ever used and for what (Class 1, Table 2), whether they ever got any infectious diseases of the digestion system (Class 3, Table 2), and what they often consume for their daily meals (Class 5, Table 2). Eighty-six per cent (86 %) of group tasks had a low complexity without an emphasis on conceptual and procedural knowledge (Source: Observations). Six of the eight interviewed teachers confirmed the utilization of the transmissive method for science lessons and two of them asserted that it could not be replaced under the influence of lesson design in the science textbooks (Source: Teacher interviews).

3.2 Hands-on complex tasks were absent

Hands-on complex tasks with an emphasis on conceptual and procedural knowledge were hardly utilized in the observed science classroom practices (Source: Observations). This was confirmed by three of the interviewed teachers (Source: Teacher interviews). It was explained by various factors, such as institutional constraints of time, teachers' work overload, teachers' limited pedagogical content knowledge (i.e. on doing experiments, organizing of group learning, on scientific subject matters introduced in the textbooks, and so forth), the insufficient and low quality of facilities of primary schools (Source: Teacher questionnaires).

4. SC Feature 4: All aspects of a person are connected

4.1 Students' personal aspects were discounted

The students stayed passive in listening to the teacher and answering representative questions for whole class activities (Source: Observations). In cooperative activities, passive learning was often demonstrated in the activity of reproducing knowledge for simple cooperative tasks (Source: Observations), for instance students were required to tell each other about medicine they ever used (Classes 1 and 2, Table 2), infectious diseases of the digestion system (Classes 3 and 4, Table 2), food consumed for daily meals (Classes 5 and 7, Table 2), and health problems if the excretory system of urine is not cleaned (Class 6, Table 2). The classroom practices were strictly controlled by the teachers to maintain well-ordered classrooms (Source: Observations). According to four of the eight interviewed teachers, low applicability and the overload of the primary science curriculum had made science lessons become less effective in helping students develop scientific skills and attitudes (Source: Teacher interviews). Two of the teachers acknowledged that the institutional focus of assessment's on students' achievements of factual knowledge did not make teachers give up the teaching style of "packing and filling" of knowledge for science lessons (Source: Teacher interviews).

4.2 Students would prefer cooperative learning and experimental tasks

Students were observed to be more excited and enthusiastic in the few cases of group activities, especially in ones which required more than two student participants and provided longer time for cooperation and discussion (Source: Observations). This was confirmed by five of the teachers (Source: Teacher interviews). All of the interviewed students also showed that they would prefer science lessons in which they could do cooperative learning and experimental activities in realistic contexts (Source: Student

interviews). This was consistent with "ideal science lessons" described by many students (Source: Student questionnaires).

5. SC Feature 5: Learning communities should be inclusive and equitable

5.1 Families and fieldwork were included to support school science

Learning tasks, which required students to cooperate with families and adults, were recognized in the observed science classroom practices (Source: Observations), e.g. students of classes 1 and 2 (Table 2) were asked to prepare in advance some medicine and study the names, the ingredients, and the usage of the medicine. Fieldwork was applied for students to learn science (Source: Science textbooks); for instance students visited the zoo to collect materials related to science lessons, etc. According to two of the teachers, the involvement of families and fieldwork was necessary and meaningful since it could help students to apply and to transfer scientific knowledge in a better way (Source: Teacher interviews).

5.2 Hierarchical interactions remained in science classroom practices

Students generally deferred to the teacher and considered her as a superior authority (Source: Observations). Students hardly showed reactions to improper or inadequate interventions from the teacher (Source: Observations). The following (Class 3, Table 2) illustrates this.

> The students were asked to discuss in pair groups by asking each other about infectious diseases of the digestion system they had got in the past. For one group, when asked by his partner whether he had ever got any infectious disease of the digestion system, the student answered "No". After hearing his response, the teacher immediately criticized him and stressed that if the answer was just "no", the group discussion would end because there was nothing more to discuss. Then she asked him to change his answer to "yes" to continue the discussion (Source: Observations).

Three of the teachers agreed that hierarchical interactions remained in science classroom practices (Source: Teacher interviews). Hierarchical interactions between teacher and student could be confirmed by the results of teacher questionnaires in which the teachers considered that the three most important teacher roles for science teaching were (a) delivering the learning task, (b) asking questions, and (c) directing students to learn (Source: Teacher questionnaires). These teacher roles are considered to reflect the superior authority of teachers. Meanwhile, other teacher roles, which are regarded to be more neutral and reflect the equitability in interactions between teacher and students, such as supervising students' learning and facilitating students to learn when necessary, were less valued (Source: Teacher questionnaires).

Explanations for the implementation from a Confucian cultural perspective

The findings on the implementation of a social constructivist approach in primary science education in Vietnam, as summarized in Table 4, were related to Confucian cultural features a-f for explanations. Through the relation and comparison to a social constructivist perspective for science education, the interrelation between Confucian heritage culture and social constructivism were explored and characterized. Accordingly, alignment and divergences in primary science education were determined, which is summarized in Table 5.

Table 5 Influences of Confucian heritage culture (CHC) on the implementation of social constructivism (SC)

CHC feature	Characterisation	Influence on the implementation of SC (in relation to Table 4)	
a. The collectivist root	1. The tradition of learning together	Alignment (1.1; 1.3; 4.2)	
	2. The tradition of peer learning	Alignment (1.3; 4.2)	
	3. The tradition of pair grouping		Divergent (1.2)
	4. The availability of learning contexts	Alignment (5.1)	
b. The harmony and stability preference as a cultural and human value	1. The avoidance of argumentation and confrontation		Divergent (3.1; 3.2)
	2. The discount to rationality		
c. The virtue focus	1. Ritualistic behaviours (over-) stressed		Divergent (4.1)
	2. Personal interests of *I* is limited		
d. The support of hierarchical order	1. A superior teacher		Divergent (2.2; 3.1; 4.1; 5.2)
e. The family value	1. Family considered as an initial learning cradle	Alignment (5.1)	
	2. The parent considered as the teacher		
f. The emphasis on theoretical knowledge	1. Knowledge in ancient classics considered as universally correct		Divergent (2.1; 2.3; 3.1; 3.2
	2. The popular application of classics quoting and citing, revising and reproducing, and rote learning		

a. The collectivist root

Finding 1.1, *whole class grouping was dominant for social learning*, can be explained by the collectivist root of Confucian heritage countries. In Vietnam, there are various folk sayings indicating and educating the significance of collectivity and the power of solidarity, e.g., *One tree cannot build up a forest but many trees can [Một cây làm chẳng nên non. Ba cây chụm lại nên hòn núi cao]*. Learning in a whole class grouping can be a way to educate students about collectivity and solidarity which are stressed in Confucian heritage culture. An extensive application of the form of whole class grouping in classical Confucian classroom practices (Table 5: a.1. the tradition of learning together) was acknowledged and considered to have influenced learning forms in Vietnamese schools at the present time (Đạm 1994).

Finding 1.3, *learning in small groups was appreciated*, and finding 4.2, *students would prefer cooperative learning and experimental tasks*, can also be explained by the collectivist root which can derive to and support the tradition of learning together and peer

learning (a.1 and a.2). The tradition of learning together is assumed to have existed in classical Confucian learning communities, wherein students were taught to consider each other as brothers and sisters and provide mutual academic assistance and affective support to each other. The tradition of peer learning is highlighted in various Vietnamese cultural proverbs, for instance: *Learning from the teacher is not better than learning from the peer [Học thầy không tày học bạn]* and *Learning from the teacher, learning from the peer, numberless prosperity [Học thầy, học bạn, vô vạn phong lưu]*. The cultural value of learning together and peer learning can support the application of *group learning [học nhóm]*, which was acknowledged to have been popular during the 1970s and 1980s and still maintained in Vietnam to date (Mai 2008).

The collectivist root with the cultural value of learning together can influence the fact that field work was included to support school science (Finding 5.1). Confucius' statement *Among any three persons, there must be one who can be my teacher [Tam nhân hành tất hữu ngã sư yên]* (Bách khoa tri thức 2013) shows the availability of learning contexts (a.4.). It is interpreted that learning is considered a social activity that can take place and should take place in any situation, with anyone, not only with the teacher and inside schools. Confucius himself is an authentic specific model for demonstrating the position on the availability of learning contexts since he spent many years for travelling to learn about human life and world affairs (Lê 1992). Value of field work for learning can also be found in Vietnamese folklore, for instance, in the proverb *Travel for a day, gain a lot of wisdom [Đi một ngày đàng học một sàng khôn]*.

With the influence on primary science education, related to finding 1.1, finding 1.3, finding 4.2, and finding 5.1, the collectivist root of a Confucian heritage culture is considered to *be in alignment with* the implementation of a social constructivist approach in primary science education.

Finding 1.2, *short-term pair grouping was dominant for group learning*, can be influenced by the tradition of peer learning which has supported pair learning. The traditional appreciation for pair learning (a.3) has stimulated movements of pair learning in Vietnamese schools, wherein the learning movements such as *Going-forward pair of peers [Đôi bạn cùng tiến]* and *Well-learning pair of peers [Đôi bạn học tốt]* have been largely applied in the past, especially in the years 1970s and 1980s, and remained to date (Mai 2008). The learning approach that involves two students for short tasks in which this one provided an answer for a question asked by the other one was also found to have been applied in China (Watkins 2000).

Since a social constructivist classroom often requires more than two students for group work, the traditional appreciation and application for pair grouping is considered to *diverge from* social constructivism.

b. The harmony and stability preference as a cultural and human value

Finding 3.1, *Reproduction of knowledge directly taught by the teacher*, and finding 3.2, *hands-on complex tasks were absent*, can be influenced by the harmony and stability preference as a cultural and human value of Confucian heritage culture. This cultural feature makes Confucian individuals avoid confrontation and conflicts in their natural and societal relationships in order to obtain a collectivistic consensus and good living (Đạm 1994). This cultural feature is forming and encouraging in individuals a passive and dependent lifestyle (Thêm 1997) that can create conditions for transmissive teaching and reproductive learning of science to take place, and therefore not in line with social constructivism, since argumentation and confrontation is avoided (b.1). Besides, the harmony and stability preference in living philosophy and lifestyles makes Confucian

individuals value humanity and relationships in communications but overlooks rationality (b.2), as expressed in various Vietnamese proverbs, i.e. *A bit of humanity outweighs a lot of rationality [Một bồ cái lý không bằng một tí cái tình].* Consequently, moral-related lessons of ritual behaviours rather than critical and rational thinking with the emphasis on argumentation have been traditionally used as subjects to educate individuals in Confucian heritage culture. This has led to overlooking inquiry activities and led to the absence of hands-on tasks in science education.

To a certain extent, the stability preference and the humanity value of Confucian traditions could be a cultural factor that is not in line with social constructivism.

c. The virtue focus

Finding 4.1, *students' personal aspects were discounted*, can be influenced by the Confucian cultural feature of virtue focus. Confucianism encourages individuals to *learn civility first and foremost and then learn literacy [Tiên học lễ, hậu học văn]* (Đạm 1994, p.395). This has become an active slogan for teaching and learning in primary schools in Vietnam, in which ritualistic behaviour is (over-)stressed (c.1). In this way, students are encouraged to become obedient and sensible rather than intellectual and critical in their communications. According to Đạm (1994), the overemphasis on civility and ritualistic behaviours of Confucianism hinders individuals in proving themselves and binds the personal ego (the personal interest of the *I*; c.2). The feature of virtue focus hinders students to argue with each other and with the teacher in science lessons. Therefore, the virtue focus diverges from a social constructivist approach in primary science education in Confucian heritage culture.

d. The support of hierarchical order

Finding 2.2 (*teaching and learning was teacher-centred*), finding 3.1 (*reproduction of knowledge directly taught by the teacher*), finding 4.1 (*students' personal aspects were discounted*), and finding 5.2 (*hierarchical interactions remained in science classroom practices*), can be influenced by the support of hierarchical order of Confucian heritage culture. Confucianism regards the teacher as the parent (d.1), as expressed in the statement *A teacher for a day, a father for life [Thày dạy một ngày là cha cả đời]*, and affirms that *in the world no parent is wrong [Thiên hạ vô bất thị để phụ mẫu]* (Đạm 1994, p.182), meaning that whatever the parent says or does is always right. This is consistent with many Vietnamese folk sayings which also highlight the significance of the teacher, for instance, *No teacher, no success [Không thầy đố mày làm nên]* and *To cross a river, build up a bridge/To become knowledgeable, tie to the teacher [Muốn sang thì bắc cầu kiều/Muốn con hay chữ* thì *yêu lấy thầy].* As an inferior, students are traditionally encouraged to be trustful, grateful and respectful to the teacher. They remain modest and humble in communicating with their teacher. This could drive students to depend on and defer to the teacher and could make them avoid arguing with and opposing the teacher, as a way to avoid "a sin of sacrilege". The support of Confucian heritage culture for hierarchical order could be a cultural factor that *diverges* from a social constructivist approach, which encourages an equitable interaction between the teacher and students.

e. The family value

Finding 5.1, *families were included to support school science*, can be explained by the family value of Confucian heritage culture. According to Confucianism, family is an initial learning cradle for individuals (e.1) and parents need to teach and educate their children

from early ages with various subjects and also support their learning. This aligns with the Confucian norms in which the teacher is regarded as the parent and vice versa (e.2). In addition, in old Chinese, the word *sư phụ [master]* was combined with the word *sư [teacher]* and the word *phụ [parent]*. This word combination manifests the closeness between the parent and the teacher in Confucian heritage culture. In Vietnamese, the word *thầy*, which is used to call those who are male teachers, has been used for father. This form of address was especially popular in use in areas of the Northern part of Vietnam in the past. The value of family therefore is in alignment with a social constructivist approach for primary science education.

f. The emphasis on theoretical knowledge

Finding 2.1 (*teaching and learning was textbook-based*), finding 2.3 (*lessons were focused on factual knowledge*), finding 3.1 (*reproduction of knowledge directly taught by the teacher*), and finding 3.2 (*hands-on complex tasks were absent*), can be explained by the emphasis on theoretical knowledge of Confucian heritage culture. According to Quang Đạm (1994), Confucianism turned from *being fond of the old [hiếu cổ]* to *revering the old [sùng cổ]*, to *sticking stubbornly to the old [nệ cổ]*, and to *restoring of the old [phục cổ],* as partly expressed in Confucius's sayings *Reproducing person is not inventing [thuật nhi bất tác]* and *Revise the old to make sense of the new [Ôn cố nhi tri tân]* (Lê 1992, p.37). In Vietnam, the idiom *what formers said is never wrong [người xưa nói chẳng sai]* has been popular in use in everyday life. This drove three learning methods: *reviewing [ôn]*, *practicing [tập]*, and *reproducing [thuật]*, are valued in Confucian heritage culture (*Đạm 1994). The methods of reviewing and reproducing of the old have promoted rote learning: learning by memorising and by repeating old stereotypes over and over (Đạm 1994). This has created dogmatic and conservative learners who can give simple explanations about the world, life, and human beings but stay limited in abilities of invention, creation, and improvement to science education and human life (Đạm 1994).*

The Confucian cultural emphasis on theoretical knowledge therefore is a cultural factor that *hinders* the implementation of a social constructivist approach which emphasises inquiry activities and empirical knowledge.

The compatibility of Confucianism with a social constructivist approach in primary science education in Vietnam is generalised and presented in Table 5.

Conclusions and discussion

A social constructivist approach so far has not been well implemented in primary science education in Vietnam. This is because of the following:

- Teaching and learning was textbook-based (Finding 2.1) and teacher-centred (Finding 2.2);
- Lessons were focused on factual knowledge (Finding 2.3);
- Reproduction of knowledge directly taught by the teacher (Finding 3.1);
- Hands-on complex tasks were absent (Finding 3.2);
- Students' personal aspects were discounted (Finding 4.1); and
- Hierarchical interactions remained in science classroom practices (Finding 5.2).

In addition, the dominance of whole class grouping (Finding 1.1) and short-term pair grouping for group learning (Finding 1.2) could also be the aspects that demonstrate that

initial constructive ideas about changes in teaching and learning have not been implemented in primary science education.

Nevertheless, the findings reveal that there is alignment between a social constructivist approaches and Confucian culture in primary science education. They are the appreciation to learn in small groups (Finding 1.3), the expectation of cooperative experimental tasks (Finding 4.2), and the inclusion of families and fieldwork (Finding 5.2) for primary science education.

The implementation of the several features a social constructivist approach in primary science education in Vietnam has been considerably influenced by Confucian heritage culture. Accordingly, Confucian heritage culture shows both alignment and divergences with a social constructivist approach.

The alignment concerns the cultural root of collectivism that bolsters the tradition of learning together, peer learning, and the value of family, which supports the inclusion of families for primary science education. In this way, it is consistent with the notion that there exists cooperative and group work in learning environments of Confucian heritage culture, and Confucian heritage culture students prefer a collaborative learning environment (Biggs 1996). Also, it reinforces the assertion that Asian students want to explore knowledge themselves and do this together with their peers in an atmosphere which is friendly and supportive (Littlewood 2000).

The divergences concern the root of collectivism, which supports the appreciation and the application of pair grouping for learning. In addition, the stability preference, the virtue focus, the hierarchical order, and the emphasis on theoretical knowledge nurture and stimulate static teaching and rote learning of science that focuses on theoretical knowledge and overlooks inquiry activities and personal aspects of learners that is characteristic for social constructivist approaches.

This study used Vietnam as a case due to its relevance to Confucian heritage culture and the recent reform of primary school curricula. Though Vietnam is considered as a country that has been deeply influenced by Confucianism, it might contain differences in its Confucian heritage culture in comparison to other Confucian heritage countries, i.e. Japan, Korea, and China. However, in this study, differences in Confucian heritage culture among these countries were not taken into account. In addition, the study surveys were carried out in three provinces of Vietnam; however, all of them were located in the Northern Vietnam (note that the country is officially divided into three main parts: the North, the Middle, and the South). It is assumed that there are certain differences and influences in Confucian heritage culture among these three regions.

In attempting to provide cultural explanations for the implementation of a social constructivist approach in primary science education in Vietnam, the study often referred to folklore. Applying the model of uniqueness levels in mental programming, which is called for patterns of thinking, feeling, and acting that were learned throughout the person's lifetime, including (a) universal level—human nature, (b) cultural level—specific to group/culture, and (c) personal level—specific to individual (Hofstede et al. 2010), it is assumed that the folklore utilized in the study takes the cultural level. It means that the values expressed in the utilized folk saying may exist elsewhere in other cultures due to human nature, however, they are more important and emphasized in Confucian heritage culture and have been inherited and learned by Confucian heritage individuals.

The findings of this study showed that implementation of social constructivist ideas in science education in Confucian heritage culture remains challenging. These findings are also consistent with cross-cultural studies which revealed that lessons in Asian countries were traditionally dominated by a teacher-centred, book-centred method and an emphasis

on rote memory (Liu and Littlewood 1997) with little emphasis on critical thinking (Couchman 1997); teaching influenced by Confucian heritage culture is primarily one-sided in an one-way process: what the teacher announces is right and the students are not entitled to ask about sense and purpose, to require reasons or to question the content (Chan 1999).

In a culture-approach on teaching and learning of science, Ying Tao, Mary Oliver and Grady Venville (2013) acknowledged the profound influences of Confucian philosophy on science teaching and learning in China wherein Chinese primary teachers were described to avoid utilizing the recommended group work and memorizing science facts was a frequent activity for Chinese primary students, who participated more frequently in passive and closed activities. However, Tao et al. (2013) overlooked the existence of cultural divergence between Confucian philosophy and Western philosophy about nature of science and social constructivism. Cultural divergence between Confucian philosophy and Western philosophy on science education are revealed in this study.

Implications for designing culturally appropriate science education in Confucian heritage culture

There are three striking cultural divergences between Confucian heritage culture and Western educational philosophy that emerged from this study, which need to be addressed when designing science education. These are presented below.

1. Confucian heritage culture emphasises stability and harmony among its human values, whereas Western educational philosophy emphasises rationality (Totten et al. 1991) that supports argumentation and conflict in discussion and helps students be prepared for citizenship (Kolstø 2001). In the "nature of science" education (Dekkers 2006), conflicts and argumentation are preferred over harmony.
   By recognizing this cultural divergence, this study can reinforce the claim asserted in other studies that cooperative learning has been applied both in Western culture and Confucian heritage culture (Mai 2008) but the way of applying is different: Cooperative learning in Confucian heritage culture is in harmony (Xiao 2009) rather than in argumentation or in conflicts. This leads to the proposition that though in Confucian heritage culture cooperative learning exists by the visible form of student learning together, but in essence, student learning is more individualistic, or separate. This can be supported by the notion that the Chinese approach to group work is cognitive-centred in contrast with the Western approach that tends to be more skill-centred (Watkins 2000).
2. Confucian heritage culture emphasises theoretical knowledge, considering "classical" knowledge and theory as universally correct, whereas Western educational philosophy emphasises empirical knowledge and well-substantiated scientific claims, believing that there is no complete truth and that every aspect of theoretical knowledge is changeable (Dekkers 2006).
3. Confucian heritage culture emphasises hierarchical order in which the teacher is considered superior and the transmitter of the body of knowledge to students, whereas Western educational philosophy emphasises equitability: the teacher is considered a more advanced learner (Vygotsky 1978) who facilitates students to learn in order to achieve not only knowledge but also the skills and attitudes used to study science (Bybee et al. 2009).

With the cultural divergences between Confucian heritage culture and Western educational philosophy emerged from this study, the study advocates the claim that curriculum development needs to be built upon careful evaluation of past local experience (Coll and Taylor 2012) and to take cultural resources (Neuman and Bekerman 2000) into consideration to avoid a false universalism (Nguyen et al. 2009) and to reduce practical difficulties (Serpell 2007).

Several features of a social constructivist approach, which were not well implemented, reveal that primary science education in Confucian heritage culture requires a need for a culturally appropriate design of the curriculum aimed to improve primary science education in Confucian heritage culture to address the urgent task of fostering industrialisation and modernisation in Vietnam. For such science curriculum development, a design-based approach (Bulte et al. 2006) is recommended to provide theoretical and empirical curriculum guidelines that can address problems found in primary science education in Confucian heritage culture. A culturally appropriate designed curriculum based on a social constructivist perspective can be promising for primary science education in Confucian heritage culture because despite being culture-bound, teaching and learning is highly contextual and learners are highly adaptive (Biggs 1996). For an example, it is reported that the longer the students study in Australia the more likely they adapt to and adopt the style of Australian teaching and learning (Wong 2004). Social constructivism can be a passionate approach which can inform the intended and beneficial education, because it involves the whole person: thought, emotion, and action, and "encourages all members of a learning community to present their ideas strongly, while remaining open to the ideas of others" (Beck and Kosnik 2006, p.8). Then, a social constructivism-based science curriculum which is designed appropriately for Confucian heritage culture cannot only be an educational transaction between Western culture and Confucian heritage culture but also it shows a heritage and development of social constructivism in education.

By providing holistic research on the current implementation of a social constructivist approach in primary science education in Confucian heritage culture through a case study of Vietnam, this study fills in the lack of educational research regarding the implementation of a social constructivist approach in primary science education in Confucian heritage culture. In this way, the study provides grounds for further research to adapt primary science education in Confucian heritage culture and consequently contributes to the knowledge base about a social constructivism in science education programmes in general and in Confucian heritage culture in particular.

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Appendix 1: Teacher questionnaires

A. Personal information

A1. Name (optional): ……..

A2. School: …….....

A3. Province

1. Hanoi 2. Bacninh 3.Namdinh 4. Other

A4. Gender: 1. Male 2. Female

A5. Age: …….....

A6. Teaching grade:

1. Grade 1 2. Grade 2 3. Grade 3

4. Grade 4 5. Grade 5 6. None

A7. Years of teaching experience: ……

A8. Educational academic level:

1. Intermediate 2. College graduation

3. University graduation 4. Master

B. Answer the following questions about the primary science curriculum

1. To what extent do you think that the following learning goals are emphasized in the primary science curriculum? Please circle one number for each question.

i. Scientific knowledge	*Not at all*					*Very much*
	1	*2*	*3*	*4*	*5*	
ii. Skills	*Not at all*					*Very much*
	1	*2*	*3*	*4*	*5*	
iii. Attitudes	*Not at all*					*Very much*
	1	*2*	*3*	*4*	*5*	

2. How often do you apply the learning and teaching method below in your science classes? Please circle one number for each question.

i. Question asking	*Never*				*Very often*
	1	*2*	*3*	*4*	*5*
ii. Lecturing	*Never*				*Very often*
	1	*2*	*3*	*4*	*5*
iii. Student exercises	*Never*				*Very often*
	1	*2*	*3*	*4*	*5*
iv. Visual modelling	*Never*				*Very often*
	1	*2*	*3*	*4*	*5*
v. Game playing	*Never*				*Very often*
	1	*2*	*3*	*4*	*5*
vi. Problem solving	*Never*				*Very often*
	1	*2*	*3*	*4*	*5*
vii. Inquiring	*Never*				*Very often*
	1	*2*	*3*	*4*	*5*
viii. Dictating	*Never*				*Very often*
	1	*2*	*3*	*4*	*5*
ix. Brain storming	*Never*				*Very often*
	1	*2*	*3*	*4*	*5*
x. Play-acting	*Never*				*Very often*
	1	*2*	*3*	*4*	*5*
xi. Experimenting	*Never*				*Very often*
	1	*2*	*3*	*4*	*5*
xii. Other:	*Never*				*Very often*
…….	*1*	*2*	*3*	*4*	*5*

3. Circle three numbers corresponding to science teacher roles that you think are most important

i. Introduce lesson
ii. Give lectures
iii. Set up student groups

iv. Ask questions
v. Direct student learning
vi. Answer students' questions
vii. Deliver learning tasks
viii. Supervise student learning
ix. Maintain active learning atmosphere
x. Set up tight control of the classroom
xi. Solve student-learning conflicts
xii. Facilitate students when necessary
xiii. Assess student learning
xiv. Other: ……

4. How often do you apply learning-in-groups for your science classroom practices? Please circle only one.

i. For all of the science lessons
ii. For majority of the science lessons
iii. For half of the science lessons
iv. For some of the science lessons
v. For one or very few of the science lesson(s)
vi. Never
vii. No idea/I don't know

5. Which learning form is most applied in your science classroom practices? Please circle only one.

i. Individually
ii. Pair grouping
iii. Grouping with more than two participant students
iv. Whole class grouping
v. Other (please specify: …….)
vi. No idea/I don't know

6. Which learning form do you appreciate for students to learn science? Please circle only one.

i. Individually
ii. Pair grouping
iii. Grouping with more than two participant students
iv. Whole class grouping
v. Other (please specify: …….)
vi. No idea/I don't know

7. What do you think about the current primary science curriculum?

8. Which factors influence, foster or hinder your application of group learning for science lessons?

Appendix 2: Student questionnaires

A. Personal information

1. Name (optional): ……

2. School: …….....

3. Province

i. Hanoi ii. Bacninh iii. Namdinh iv. Other

4. Gender: i. Male ii. Female

5. Grade:…….

B. Answer the following questions about the primary science curriculum

1. Which learning form do you like most to learn science?

i. Individually

ii. Pair grouping

iii. Grouping with more than two participant students

iv. Whole class grouping

v. Other (please specify: ……)

vi. No idea/I don't know

2. Please describe an ideal science lesson for you.

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toàn diện giáo dục và đào tạo, đáp ứng yêu cầu công nghiệp hóa, hiện đại hóa trong điều kiện kinh tế thị trường định hướng xã hội chủ nghĩa và hội nhập quốc tế. Kết luận số 51-KL/TW].

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