International Society of the Learning Sciences

Responses of rural Chinese teachers to workshops on culturally relevant constructivist pedagogy

Weiying Li, Marcia C. Linn
weiyingli@berkeley.edu, mclinn@berkeley.edu
Graduate School of Education, University of California, Berkeley

Abstract: We analyzed the impact of two workshops that introduce Knowledge Integration and Culturally Relevant Pedagogy to rural Chinese science teachers. The workshops emphasized connecting science lessons to local, culturally-relevant contexts. Teachers developed written lesson plans to localize their instruction and implemented their plans in classrooms. We used inductive coding to identify five levels of localization in the lesson plans. We captured the creative plans that teachers generated in three classroom case studies. The workshops revealed ways to support rural Chinese teachers to connect complex science topics to culturally-relevant local examples and identified areas for improvement.

Introduction

Science education researchers and practitioners have long emphasized constructivist perspectives, including eliciting students' prior knowledge and related experiences to scaffold learning (Vygotsky, 1978; Linn & Eylon, 2011). In 2001, the Ministry of Education (MOE) in China embarked on a series of education reforms to shift from an exam-oriented to a student-centric and constructivist education system (MOE, 2001). Consistent with this shift we studied how teachers in a middle school in central rural China responded to two constructivist workshops. We investigated how teachers planned and enacted their lesson plans.

In China, rural areas include villages where people mainly engage in agricultural activities and rural towns that evolved from villages and function as educational, cultural, and economic centers (National Bureau of Statistics, 2008). Rural areas often preserve more traditional cultural practices, compared to urban areas (Oakes, 2013). Rural teachers in China rarely adopt constructivist teaching (Sang et al., 2009; Zhang & Liu, 2014) because they are socialized into norms of science teaching that reinforce exam results (Wu, 2016). And, teachers lack constructivist teaching professional development compatible with rural contexts (Rao & Ye, 2016).

Rural contexts offer a rich environment for learning science as students make scientific inquiries in family settings, community events, natural surroundings, and the agricultural activities in their lives (Avery & Kassam, 2011). Although social constructivists demonstrate that science is impacted by cultural values (Bingle & Gaskell, 1994), in school science classrooms where western science dominates, local practices and knowledge are seldom acknowledged. Researchers have begun to bridge the gap between local experiences and school science (Bang & Medin, 2010), and place-based education approaches (Bartholomaeus, 2006).

We investigated rural teachers' lesson plans and implementation of localized science learning contexts to answer the following research questions: 1) What kinds of localized learning contexts do rural Chinese teachers create? 2) What are the challenges of building localized contexts into science lessons?

Methods

Workshops and Participants

The two-day workshops were held in January 2021 and June 2021. The first workshop introduced the concepts of constructivist teaching and Knowledge Integration (KI) pedagogy. The KI pedagogy emphasizes that students develop multiple, varied ideas about the same scientific phenomena across their many experiences at school, at home, and when interacting with the natural world. By eliciting students' ideas, providing opportunities for students to discover more ideas, encouraging students to distinguish among these ideas, and asking students to reflect on their ideas, teachers help students develop a coherent account of the phenomena (Linn & Eylon, 2011). The second workshop introduced Culturally Relevant Pedagogy (CRP). By supporting learners to draw on their cultural identities and reflect on social inequalities, teachers can build identity as a science learner (Ladson-Billings, 1995). At the end of the second workshop teachers drew on KI and CRP to write a lesson plan that created a learning context to introduce a new concept to their students.

Participants were 20 science teachers who attended both workshops: 8 physics, 8 chemistry, and 4 biology teachers. All 20 teachers are rural residents who grew up in the area and have taught grade 7, 8, or 9 at the school for 4 to 40 years (M = 22.2 years, SD = 8.58). Three case studies involved teachers who consented to classroom observations and interviews. After observing each 45-min class, the first author interviewed the teacher and two to three students, asking, "How do you feel about this class?"

Data sources and analysis

The 20 teachers' written lesson plans, written in Mandarin, were analyzed. The first author used inductive coding (Thomas, 2006) to create categories for the localized contexts. The lesson plans were then translated into English. The case study observations were in Mandarin Chinese and the interviews were in local rural dialect Chinese. They were translated into Mandarin, coded, and translated into English.

Results

Each teacher made a detailed lesson plan and 18 of the 20 teachers included creative and relevant local contexts. Teachers were eager to incorporate local contexts in science teaching. Using inductive coding, 5 levels of localizations emerged in the teacher's written lesson plans (see Table 1).

Table 1
Levels of Localized Context Examples Generated by the Teachers

Score	Levels and Criteria	Examples
1	No context building	● I don't think giving examples is helpful in my classroom. It will weaken my teaching efficiency.
2	Irrelevant: Building contexts that are irrelevant to learning objectives	● I will play some music, videos, or pictures that are relevant to learning content to help students get into the learning status. ● When I teach *infectious diseases*, I will introduce a story about a Pacific Island in our biology history.
3	Partial Link: Teachers build contexts that have one of the characteristics: 1) relevant to learning objectives; 2) familiar to students; 3) shared within community culture; 4) have critique of inequities.	● When I teach *salt metathesis reactions*, I don't want students to just memorize the equation. I often introduce it with changing dancing partners while dancing in a ballroom. [In rural China, ballroom dancing is not common, especially among students.] ● I often use our real life events as my example. While I introduce the concept of solutions, I will ask students to predict the reason why the water in swimming pools is blue. [In rural China, swimming pools are not common]
4	Full Link: Students included **one link** between two characteristics listed above.	● When I teach *buoyancy*, there is a very widely used experiment in the textbook: we will ask students to wear plastic disposable gloves and then put their hands into a water tank. Many teachers will just describe to students about how they might feel, but I will ask students to share their feelings (e.g. the gloves will cling to their hands), and predict the reason. ● When I teach *voltage*, the concept is very difficult to understand. The textbook says that "electric current is the result of electric charges moving in a certain direction", but I think students are often confused by "Why charges move in a certain direction?", then I will show them a video about the formation of stream/water flow, and make analogies among flows, current, water pressure, and voltage.
5	Complex Link: Teachers provided **two links**	● When teaching *levers in simple machines*, I will prepare some really hard pieces of chalk and invite two male students to squash them. I can imagine that they will use all their strength to squash the chalk. After that, I will take my pliers, and ask them to try this tool which will easily squash the chalk. ● When I teach *purify*, I will introduce the concept with our Chinese slang "A speck of mouse dung spoils a whole pot of porridge". ● When I teach *Metamorphosis in amphibians*, I will use the story in our traditional fairytale 'The Tadpoles Look For Their Mommy' and ask students to predict the reason why tadpoles cannot recognize their mom.

The level of implementation of localization did not depend on the science course taught or years of teaching experience. Two of the three CRP features were detected: creating contexts relevant to learning objectives and creating contexts that are interactive, familiar to students, and shared by the community. The lesson plans did not include critiques.

The teachers of each case study reported that their students became excited and engaged when they realized that they were using local knowledge in science. The cases were scored from Level 3 to Level 5.

Case 1 Combustion and Spring Lantern Festival (Level 5)

Teacher Ku is a chemistry teacher with 20 years of experience who was teaching 48 9th grade students about combustion. Ku showed a photo of the Spring Lantern Festival and asked students to rank the most important part of the lantern to keep it lit without burning. Students discussed in groups for 10 minutes and then shared their predictions. Many students raised their hands. Student A mentioned that the vent at the top of the lantern is important because otherwise the light will go out really fast. Student B shared making lanterns by using a special coating inside the paper to concentrate the heat to the center and reduce the chances of the paper burning. Student C's group believed that the material of the candle wick is crucial. After the whole class shared, Ku played a video introducing the functions of different parts in a lantern and asked students to revise their thinking based on the video. During the interview, Ku reported the lesson was a success because "everyone was participating and they also analyzed the combustion conditions by themselves". Student C was surprised that the creative lantern designs aligned with science ideas and described feeling like a "practitioner scientist". Student D didn't speak to the whole class, but drew on prior knowledge during group discussion, saying, "They are discussing the purpose of the vent. Some say it's left for our hand to light the candle, but I remembered that I covered the vent one time because I didn't want the wind to blow it off, but the fire went out immediately. I shared the story with them, and we started to talk about how this vent can be useful."

Teacher Ku's lesson followed the localized KI pattern: eliciting students' prior knowledge; helping students discover new ideas by comparing their experiences and by watching the video. Students spontaneously engaged in distinguishing ideas by comparing their first-hand experiences. Teacher Ku added a distinguishing activity where students ranked the elements of the lantern that controlled combustion. Students then reflected by reconsidering their rankings and explaining their reasoning.

Case 2 Phase Change and Laundry (Level 5)

Teacher Zeng, a physics teacher with 10 years' experience, was teaching 49 8th grade students about phase change. Teacher Zeng introduced the topic by lecturing about the heat transfer process and the changes of states for 20 minutes. Then Zeng showed a picture of laundry hanging in the rural courtyard in the summer (dryers are not common in rural areas) and asked students to predict the phase changes. Several students quickly answered loudly "evaporate!". Then Zeng discovered new ideas by asking if they ever used special methods to make the clothes dry faster. After 10 seconds, Student E said, "Yes, they usually dry faster on sunny days than on cloudy days." Zeng distinguished ideas by asking, "Based on what you've learned so far, can you predict the reasons why they dry faster on sunny days?" Student E then said, "Because of sunlight." Student F said, "Because it's warmer when the sun comes out." Zeng then asked, "What has this to do with the phase change?" Student E answered, "They need heat when they evaporate. The warm sunlight hastens this process." Zeng nodded his head and then asked for more answers. Student G raised hand and said, "They will dry faster if hung in the open courtyard than in the balcony, than indoors." Teacher asked for her reasoning. She said, "Because there is more wind in the open spaces. They can take away moisture." Student H said, "Expand the clothes instead of squeezing them together." Zeng tried to help her reflect on ideas and predict the reasons why her way is faster. Student H said with hesitation, "Maybe because I expose more moisture?" Teacher Zeng agreed with her and added more details, "you increase the surface contacting air, so the water can evaporate faster."

Teacher Zeng implemented the KI pattern while drawing on the students' local knowledge. During the interview, Zeng reported that students were engaged, especially the female students, remarking that in rural families, laundry is always the "women's business." Student G reported already knowing about phase change and learning the names of the phases and the mechanism of heat transfer. Student H reported that laundry methods that seemed like tricks, actually followed real science. Teacher Zeng selected relevant local experiences and was able to recognize female students for their scientific observations.

Case 3 Force and Pressure and Walking/Skiing in Snow (Level 3)

Teacher Zhang, a physics teacher with 28 years of experience, was teaching 46 8th grade students about "force and pressure." Zhang asked students to think about the differences between walking in the snow and walking in the snow with skis. When asked to share ideas, no student raised their hand. Teacher Zhang showed a picture of a kid skiing and one kid walking in snow. He asked for observations. After 5 minutes there were no hands raised so the lecture continued. During the interview, Zhang said that the example achieved some level of success because students had time to think about the real-life example. However, Student I showed a slight disagreement: "I don't understand why the boy uses skis. How could he move?" Student J was also confused by the details in the picture, "I saw that the ski in the TV is a very large single board, why does this boy use two separate narrow boards? Does this have any difference with the single board?"

Although Teacher Zhang incorporated an example, since the school is located in central-southern China, few rural students have used skis. Students might have seen skiers on TV or the Internet but they didn't have first-hand experiences and were not able to take advantage of the example.

Conclusion and Discussion

These results illustrate the effectiveness of two workshops using KI and CRP to support rural teachers to localize their science instruction. In spite of years of experience with teacher-centered, western science dominated, exam-oriented instruction, many teachers were able to identify relevant local cultural practices and empower students to connect them to scientific phenomena. Some teachers selected textbook examples that were not familiar to their students and gained insight into the limitations of this approach. A few interpreted their students inability to interpret the examples as a weakness or underestimated the ability of their students to come up with examples. The workshops can be improved by increasing opportunities for teachers to collaboratively connect science to local examples. By enabling teachers to report on the successes in the case studies, teachers can enable others to recognize the strengths of rural students.

References

Avery, L., & Kassam, K.-A. (2011). Phronesis: Children's Local Rural Knowledge of Science and Engineering. *Journal of Research in Rural Education*, *26*.

Bang, M., & Medin, D. (2010). Cultural processes in science education: Supporting the navigation of multiple epistemologies. *Science Education*, *94*(6), 1008–1026.

Bartholomaeus, P. (2006). Some Rural Examples of Place-Based Education. *International Education Journal*, *7*(4), 480–489.

Bingle, W. H., & Gaskell, P. J. (1994). Scientific literacy for decisionmaking and the social construction of scientific knowledge. *Science Education*, *78*(2), 185–201.

Ladson-Billings, G. (1995). Toward a Theory of Culturally Relevant Pedagogy. *American Educational Research Journal*, *32*(3), 465–491.

Linn, M. C., & Eylon, B. S. (2011). *Science Learning and Instruction: Taking Advantage of Technology to Promote Knowledge Integration*. Routledge.

Ministry of Education. (2001). 基础教育课程改革纲要（试行）[Guidelines for Curriculum Reform of Primary Education (pilot ed.)]. http://www.moe.gov.cn/srcsite/A26/jcj_kcjcgh/200106/t20010608_167343.html

National Bureau of Statistics. (2008). 关于统计上划分城乡的规定（试行）[The rule of dividing rural and urban areas statistically (pilot ed.)]. http://www.stats.gov.cn/tjsj/pcsj/rkpc/5rp/html/append7.htm

Oakes, T. (2013). Heritage as Improvement: Cultural Display and Contested Governance in Rural China. *Modern China*, *39*(4), 380–407.

Rao, J., & Ye, J. (2016). From a virtuous cycle of rural-urban education to urban-oriented rural basic education in China: An explanation of the failure of China's Rural School Mapping Adjustment policy. *Journal of Rural Studies*, *47*, 601–611.

Sang, G., Valcke, M., van Braak, J., & Tondeur, J. (2009). Investigating teachers' educational beliefs in Chinese primary schools: Socioeconomic and geographical perspectives. *Asia-Pacific Journal of Teacher Education*, *37*(4), 363–377.

Thomas, D. R. (2006). A General Inductive Approach for Analyzing Qualitative Evaluation Data. *American Journal of Evaluation*, *27*(2), 237–246.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes, (M. Cole, V. John-Steiner, S. Scribner & E. Souberman, Eds. and trans.). Cambridge, MA: Harvard University Press.

Wu, J. (2016). Educational discipline, ritual governing, and Chinese exemplary society: Why China's curriculum reform remains a difficult task. *Policy Futures in Education*, *14*(6), 721–740.

Zhang, F., & Liu, Y. (2014). A study of secondary school English teachers' beliefs in the context of curriculum reform in China. *Language Teaching Research*, *18*(2), 187–204.

