Identifying Chinese Secondary Teachers' Needs for Professional Development Abroad

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Abstract: China is at a crucial point for reforming its education system and seeks professional development abroad for selective secondary teachers. In this study, 13 experienced Chinese physics teachers undertook an intensive four-week professional development program in Australia. Early discussion with the participants and two surveys (i.e., mid-evaluation and end-evaluation surveys) aimed to gather qualitative responses for determining their needs for professional development. Data highlighted the essential nature of school visits for observing teaching practices, accurate translations, and the inclusion of physics-based excursions. Yet, apart from addressing personal and social needs, it was concluded future professional development must focus on delivering advanced content knowledge related specifically to the Chinese Curriculum Standards, and current pedagogical approaches and theories that branch beyond the transmission approach employed in China. The information in this study aims to assist other tertiary institutions conducting professional development programs for Chinese teachers.

Chinese educators are exploring avenues for implementing education reform. For example, the Jiangsu Province is pioneering education reform in China (China Today, 2001) by initiating a Teacher Training Project, in which 1000 selective teacher practitioners per year are sent overseas to Australia, Canada, New Zealand, Singapore, UK, and USA for professional development (Jiangsu Education International Exchange, 2005). China's current education system employs traditional practices (Weng, 2003; Wu, 2001) such as a teacher-centred, transmissive approach (see Fleer & Hardy, 2001), and classroom environments are generally in keeping with these practices. China's traditional practices may have been attributed from the following factors. First, due to the increase enrolment rate, the class size is generally big, and teaching and learning resources are relatively small (Liu, 2002). Second, teachers are culturally the authorities and sources of knowledge. The common social value of education is that students are supposed to respect and learn from teachers, and rarely question teachers (Chan, 2000). Third, China is now implementing mandatory education for nine years. Students after Year 9 will have to compete in a province-based examination for entering senior school, and after Year 12 a national higher education examination for university study. The two examinations are the only assessments to decide the success or failure of students' previous education (Government Information Office, 2002). These factors have exerted pressures on both students and teachers, and contributed to the adoption of a teacher-centred approach as the most effective pedagogical practice.

The American Association for the Advancement of Science (AAAS) claims that a scientifically literate public can enhance a country's technological market place position (Bischoff, Hatch, & Watford, 1999). Indeed, scientific literacy has implications for economic gain and for empowering citizens (Ayala, 2005; Jenkins, 1990). Hence, attaining scientific literacy needs to be central to science education reform (Bybee, 1997; Pattanayak, 2003). Considering China's increased world presence, the development of scientific literacy may further enhance their economic advancement and position in the world market. Education Queensland in Australia is currently undertaking a new physics education reform by

employing a Physics Extended Trial-pilot Syllabus (Queensland Studies Authority, 2004). This initiative aims to engage students "in the acquisition of knowledge and the development of understanding of physical aspects of their world through processes of scientific investigation in real world contexts" (p. 8). This trial syllabus also aims to advance pedagogical practices by guiding teachers' planning for effective physics education.

Science teachers are recognised as key to science educational reform, which requires time, resources, and support for ongoing professional development to promote improved learning outcomes (Goodrum, Hackling, & Rennie, 2001). Elliott (1991, p. 15) states:

> Progression from a beginning, to a competent, to an experienced teacher can be characterised by a continuum of professional development ranging from the development of an overtly analytical approach to understanding and judging situations to a wholistic approach involving an integrated mixture of reflective and intuitive practice.

Professional development is viewed as central to educational reform (Elmore, 1996; Hawley & Valli, 2000; Huey-Por, C., & Chorng-Jee, 2005). Professional development must occur, as there is monetary cost when teachers leave within the first five years of teaching (NewTeacher.com, 2005) and reform cannot occur without providing further teacher education (Danielson, 1999). Professional development activities must meet the needs of teachers who are at different career stages (Ganser, 2000), and teachers should be able to determine their needs for enhancing their own teaching practices (McCarthy & Riley, 2000; National Staff Development Council, NPEAT, 2000).

Researchers (Cobb, 2000; Freeston & Costa, 1998; Ganser, 2000; McCarthy & Riley, 2000; NCES, 2001; NPEAT, 2000; Smith, 2000; Sparks, 2000) have articulated contemporary principles for professional development of teachers. Fundamentally, professional development should: deepen and broaden knowledge of content; provide a strong pedagogical foundation; provide knowledge about teaching and learning processes; be based upon current research and aligned with curriculum standards; and be designed by teachers in cooperation with experts in the field to include sufficient time, support, and resources (American Federation of Teachers, 2002). In addition, professional development should take a variety of forms, and allow sufficient time with colleagues to share ideas and facilitate guided risk-taking through workshops (Bondy & Ross, 2005; Hoewisch, 1998). Most importantly, effective professional development facilitates interactions with teachers who have succeeded in classroom innovation (King & Newmann, 2000).

Professional development programs need to be planned to address the learner's needs and should be goal focused (e.g., Bondy & Ross, 2005; Kimble, 1999). Program implementers need to consider how a program addresses the learner's needs. Evaluation of professional development aims to determine a program's effectiveness and improve it. A formative evaluation can be conducted at an interval or intervals to determine a program's progress, while a summative evaluation is conducted at the conclusion of a program. Both formative and summative evaluations aim to gather information for enhancing the program by pinpointing effective aspects and targeting practices for improvement (Cook & Fine, 1997). Data collection and evaluation can alert "participants about whether new ideas are being implemented and, more importantly, can signal whether an activity is having its intended effects on student outcomes" (Freedman, Ascheim, & Devlin-Scherer, 1995). "Although evaluations should be considerate of the time and energy required from participants,

evaluation information should include data on participant outcomes, organizational outcomes, and student outcomes" (National Staff Development Council, 1995, p. 27).

This study aims to identify the professional development needs of experienced Chinese secondary teachers. In particular, this description and analysis considers participants' perceptions of their professional development experiences and needs for advancing physics education in China. Data collected aims to guide the development of future professional development programs held at university abroad for Chinese secondary teachers.

Methods

Thirteen experienced Chinese physics teachers (male=11, female=2) undertook a four-week professional development course at the Queensland University of Technology in Australia (age range: 25 to 44; mean score=39 years). These participants were experienced physics teachers from the Jiangsu Province with no or little English, and English was not a requirement in the program, hence, a translator (interpreter) was employed. The translator was also able to provide participants with information in English for cultural experiences where required. Discussions with these physics teachers indicated they were among the most effective physics teachers in Jiangsu and would be expected to promote and implement physics education reform in their province following their professional development experience.

Participants discussed their needs with university tutors on the first day of the professional development program and were asked to evaluate the program through qualitative surveys (Hittleman & Simon, 2002). The mid evaluation survey aimed to address the Jiangsu teachers' issues and concerns while providing feedback on positive practices that needed to continue. Mid-evaluation topics included: culture and accommodation, tutorials and workshops, and addressing specific needs. The end evaluation survey administered at the end of the last day of the program aimed to determine the success of the program and aspects that may require improvements for future programs. Written responses were coded for frequencies within particular topics (Hittleman & Simon, 2002) after translation from Mandarin to English. Some topics for the end evaluation were taken from mid evaluation responses, for example, micro-skills teaching, social events, translations, action research, and school visits. However, participants were also asked to comment on successful components of the program and suggest ways for improving the program.

The four-week professional development program operated for five hours each weekday on a variety of physics education topics and focused on content knowledge and pedagogical knowledge for secondary physics. The tutorials involved individual and group work on advancing theory and teaching methodology on such topics as teaching and learning about: universal gravitation; energy; states of matter; space; wave phenomena and applications; Quantum Theory, solid state devices, superconductors; radiation; electronics; motion; forces; atoms and molecules; and astrophysics. Authentic materials aimed to provide these participants with further conceptual understandings and valuable information for enhancing content knowledge of physics and their pedagogical practices for teaching physics. The instructional style varied according to the activities. For example, instruction included PowerPoint presentations, overheads, Internet, videos, CDs, tapes, handouts, hands-on experiences (e.g., experiments in workshops), and selected readings within class, groups, and individual contexts.

Workshops involved participants developing and applying micro-skills teaching by presenting lessons to their peers on tutorial topics while addressing the Jiangsu Curriculum Standards. Further discussion followed lesson presentations as part of reflective practices and making connections for advancing teaching practices in China. Participants were also involved in three days of field experiences (i.e., two school visits and one secondary school excursion), which involved observing the teaching of physics to secondary students. As part of caring for participants' welfare and social needs, they were involved in a range of cultural outings and excursions including: a visit to the Gold Coast, Surfers' Paradise, and Pacific Fair; Lone Pine (with koalas and kangaroos); a night at the movies; a night at Southbank arts and craft markets; and a farewell dinner in Chinatown. These Jiangsu physics teachers were accommodated in a hotel as they did not see the need for homestay experiences, particularly as they were all adults and English was not a focus for their professional development.

Results and discussion

Early discussions indicated a need to change the initial program design. Participants identified from the draft program a need to re-sequence particular topics, for example, two requested "motion" to be placed earlier in the program and "atoms and particles" and "nuclear physics" placed together later in the program. They claimed this would allow them to build upon the complexities of theories and content. Apart from sequencing the proposed content knowledge for the program, all participants agreed to proceed through the first two weeks and then re-assess their needs. The mid evaluation aimed to determine the Chinese physics teachers' perceptions of various components of this professional development program. These participants generally agreed that the tutoring at university and field experiences with secondary physics students provided insight for their own practices. Two participants commented on the current teaching practices in physics education in Australia with considerable interest in the senior physics trial-pilot curriculum. For example, one participant commented there was value in, "knowing about the successful experience of senior physics trial-pilot curriculum since 2002 including the teaching and learning style, and student assessment in Queensland." Another stated that it was interesting to learn about the "extended trial-pilot syllabus and assessment methods." In addition, new ideas were brought forward for the physics teachers to consider for improving practices. One participant stated, "In contrast to China's traditional teaching, Australia's teaching and learning styles and methods are worth to compare and adopt." Another participant commented that a strong element for teaching physics in Australia was the "use of body language in teaching and focus on students' active learning are valuable."

The tutors and translator were provided with the mid evaluation responses so program changes may be made to address the participants' needs. Their comments focused on culture and accommodation, tutorials and workshops, and addressing further developmental needs.

Culture and accommodation

Although the physics teachers easily adapted to the weather and climate, some were not as adaptive to the culture (e.g., food or language). Several agreed that English was a barrier for various cultural activities; however it appeared not to be so with the tutorials and workshops at the university. Two participants commented, "English is not a problem at all. We can ask [the translator or interpreter] to help or we can use a dictionary and body language", and "the interpreter helped solved this [language] problem." Another claimed that the "translation was a great help for both learning and living. It was impressive to me." When asked if the program could be improved with an English language component, about half the participants commented that, because of their very low level of English, a short-term

English course may have little effect, especially as the focus will still be on teaching physics with an interpreter. The other half suggested that a small amount of English may assist with their cultural communications.

Even though language may be considered a barrier for cultural activities (e.g., attending a movie, shopping, excursions to places of interest), the social events in the program were generally considered by the participants to be worthwhile activities. Comments such as, social events were "very worthwhile because we want to learn more about Australia both in culture and custom", and "Social events help [us to] understand the people, area, and culture, and we can relax from the weekday program." Only one participant was negative about one aspect of the social program but his colleagues did not share this viewpoint. He pointed out that Australian social and cultural events would not assist his development as a physics teacher.

Several participants commented on the cultural experiences as it broadened their "knowledge by understanding Australia's culture and meeting local people and places." They were also positive about the environment and the "public order and security" and accommodation arrangements. Even though two stated that the accommodation was "not as good as imagined", most agreed that hotel or apartment accommodation would be more suitable than homestay. Two participants claimed that possibly a one or two-week homestay may benefit their understanding of Australian culture, however, most claimed that for a four-week program it was better for them to get to know each other as physics teachers. Therefore, apartment accommodation appeared more suitable, as they were able to cook for themselves, interact on similar levels of understanding, and had freedom to shop and discover the culture without relying on homestay arrangements.

Tutorials and workshops

The physics teachers were asked to comment on the value of the tutorials and workshops for their teaching of physics. They perceived greatest value at this mid-way point to be knowledge about student-centred learning, teacher dedication and various methods and techniques for assessment and teaching, including concept mapping. To illustrate, the following comments were recorded:

- We strongly perceived that we should focus more on students' active learning and motivation and interest rather than just emphasising traditional teaching methods.
- We are inspired by some new thoughts, methods and techniques.
- Especially the concept mapping and other ways to guide students.
- Traditionally we teach physics from systematic physics topics, and then try to link the physics knowledge to students' real-world experience. However, many students lost their interests in physics in this way. The Queensland Trial-Pilot starts the teaching and learning from students' real-world contexts and allows students to discover and investigate the physics knowledge within the real-world contexts. Students seem to be more motivated and interested in this way.
- Unlike the assessment of students' learning, which depends only on one final pen and paper examination in China, we agree that the Queensland's methods of assessment such as the extended experimental investigation (EEI) and extended response task (ERT) are effective ways to assess students' learning.

The value of the tutorials and workshops for developing physics teaching skills and knowledge is also noted as a way for educational reform. To illustrate: "China is in a critical point of time for educational reform. This interchange and impact between eastern and

western cultures will certainly cause sparks of educational reform." The learning of new assessment strategies became a focal point at this mid evaluation. For example, one participant stated, "we would like to know more about the educational system and assessment. Particularly the real experiences in the physics classroom and more teaching and learning resources."

Addressing further developmental needs

The mid evaluation survey asked participants to write about their further needs for developing their physics teaching knowledge and skills. Several wanted more field experiences in the physic classrooms, particularly visits to those schools involved in the Queensland trial-pilot curriculum for physics education. One participant suggested "a detailed case study on any physics topics or context, from concept mapping to assessment tasks, students' activities, resources". Other comments for further development of their practices included:

- Detailed teaching and learning material based on context study in senior physics.
- Teaching material, lesson plan, experiments, computer animations and other resources developed by local teachers.
- Detailed educational system from primary to tertiary (university).
- Assessment data and information, teaching resources and classroom videos.
- More new advanced educational theories from university professors.

Finally, the mid evaluation asked for further comments about the overall program organisation. Although one participant wanted the content condensed in the final week, many indicated a need to have more visits into school classrooms with more interaction with local teachers. After a two-week involvement in the program, a very experienced Jiangsu physics teacher suggested, "For understanding about educational and pedagogical theories and researching about Australia's education evolution, I suggest this training program to be extended to half year or one year." The mid evaluation feedback was analysed by organisers and tutors towards addressing participants' professional development needs for the following two weeks.

As a result of addressing mid evaluation needs, participants recorded mostly positive comments about the overall program on the end evaluation. The tutorials and workshops proved to be successful with participants generally praising the tutors for their planning, dedication, and initiative. Nevertheless, four participants commented that there wanted more advanced theoretical knowledge and teaching designs for physics education. Individuals also commented that some improvements could be made, that is, that there needs to be more school visits and the last day of the program should be free in order to arrange for the following day's departure.

Social events

Comments about the social events varied considerably. Some wanted more social events, others said the number of events were "satisfactory", and yet one person claimed that social events are "important but don't need too many". As a consequence of these comments, future programs may keep the same number of events but change one or two locations as suggested by three physics teachers and ensure much tighter organisation so the participants are constantly active. For example, participants had a field excursion to a botanical lookout which they felt was not stimulating, consequently, social activities that focus more on physics may aid in enhancing their interests.

Micro-skills teaching

The program consisted of a micro-skills teaching component that allowed participants to act as tutors for their peers. This involved each participant receiving a physics topic (e.g., light, motors and generators, wave motion), in which they needed to consider the tutorial advice for presenting the lesson to their peer group. Two participants claimed they were not interested in micro-skills teaching, however, the others stated that this technique assisted their teaching development, as represented by the following responses: "It is a good approach for our training so we can actively participate" and "Helpful for most topics in designing lesson plans and integrating skills." Four participants added they required more detail in order to adequately plan for the micro-skills teaching sessions. One commented, "It is necessary to practice teaching in order to understand teaching style. But it is not necessary to have too many micro-skilled teaching." In light of these responses, future programs need to consider more detailed explanations of implementing micro-skills teaching, and ensure there is a greater balance between micro-skills teaching episodes and advanced theories for teaching physics education. In addition, lesson presentations by the Chinese teachers should be selective and conducted only to emphasise particular teaching strategies in relation to specific content knowledge.

Translations

As participants had minimal English skills, the program relied heavily upon translations from English to Mandarin. Indeed, the translator was not required to have a physics background but needed to provide an accurate translation. However, the translator had a strong primary mathematics and science background and there was unanimous approval of the high-quality translations throughout the program with comments such as:

- Outstanding performance. In this program, the translator is very important.
- It improves our understanding in the tutorials.
- Worked very hard and took this job seriously. He spent a lot of extra time to help us settle down and adapt to living in Australia.

These comments highlighted the essential nature of a competent translator who has an understanding of the topics.

School visits

Responses indicated that increasing school visits was a high priority and would better assist Chinese physics teachers to understand the implementation of physics education in Australia. The school visits provided very positive experiences and nearly all participants suggested increasing the number of school visits for future programs. For example, "Good, very good, please add more of this type of activity." Even though these experiences were positive, classroom visitations were met with some surprise, as few expected the type of interaction experienced. These unexpected experiences may be a result of cultural and educational differences. For example, "Only two school visits but the form of the visits is good. However, we didn't get what we expect from the schools. Maybe it is because the practice in classroom here differs too much from ours in China." These physics teachers expected to see more traditional classroom teaching similar to teaching practices in China; instead they observed hands-on activities with secondary students involved in designing, implementing and evaluating physics experiments, which aided in their understanding of non-transmissive teaching.

Action research

Participants were interested in learning about action research with the following responses: "It is an advanced theory. Will try to implement and popularise in China" and

"Easily understandable. Useful and operable". Two participants commented they wanted more action research stating: "One day is not enough for action research" and "Didn't understand much in one-day tutorial. I am not clear about the detailed procedures about action research." Nevertheless, further involvement with action research during a four-week period would mean deleting other components from the program that participants also considered valuable. It may be possible to integrate action research with other aspects of the program if the action research was presented earlier in the program rather than on the last day.

Successful components of the program

When asked to list the most valuable components of this four-week program, eight participants stated the tutorials (particularly assessment methods associated with various physics topics), seven stated the school visits, and two participants claimed the interactive Science Centre, scientists, action research, and the video on forces. It was interesting to note that the Science Centre provided new insight into physics applications. For example, one participant stated, "All activities in Science Centre are hands-on activity. This is very different from the one in China." Conversely, when asked to state the least valuable part of this program, three participants claimed one particular Saturday excursion not far from Brisbane.

On an international diplomatic level, it was also important the physics teachers were positive about their involvement in this program, which all had claimed they would want other Jiangsu physics teachers to have this professional development experience. Many responded that this program would assist their teaching of physics in China by focusing on students' interests and using different pedagogical designs, including assessment techniques. For example, "You have broadened our ideas on pedagogical design in classroom. The assessment strategies are also of great value for us to reference." Learning about teaching physics in another country provided practical applications for physics teaching in China. To illustrate, "We can apply the concepts of teaching, learning and assessment in our physics teaching and learning activities" and "Improve our understanding about curriculum reform. Reference the new trial-pilot and classroom model in Australia to guide our teaching practice". Two participants wanted this program to be extended for at least half a year. Further responses about the use of this program for potential physics teaching in China were as follows:

- Focus on students' interest in physics and active learning.
- Advance our knowledge about student's assessment and learning and teaching style.
- I learnt a lot on how to motivate students' interests and hands-on activities.
- Improve teacher and students' interaction. Increase students' interest in physics. And to measure students' real ability by using new assessment methods.

Although participants had not provided input into the construction of this professional development program before arriving, they had provided input on day one and as the program progressed, particularly at the mid evaluation. Suggestions for improving this program included "increasing the number of school visits" in order to "to improve and guide education reform" for future Jiangsu physics teachers. Two participants claimed the program could be improved with "more teaching and learning and assessment details" and "discussion on pedagogical designs, experimental activities". Two participants suggested organising social events particular to their professional development, for example, "meet with international students here [at the university] from China and Hong Kong" and organising "senior school contacts and interactions". In addition, one physics teacher suggested "allowing the tutors to understand the context of China's teaching and learning style, so they can aim at our needs."

These and other responses indicated previously suggested that increasing school visits was a high priority and would better assist Chinese physics teachers to understand the implementation of physics education in Australia, which may assist in promoting educational reform in China.

Conclusion

In accordance with professional development principles (e.g., American Federation of Teachers, 2002), this program was noted by participants as providing sound pedagogical directions with further knowledge on teaching and learning processes in physics education and in line with curriculum standards. However, as these experienced teachers were already deemed knowledgeable physics teachers in Jiangsu, this professional development may not have deepened and broadened their content knowledge even though this was one of the program objectives. Yet, they found this professional development intellectually engaging by addressing the complexities of teaching for the pedagogical knowledge (e.g., classroom management techniques, assessment strategies, problem-based learning) rather than the content knowledge. They also learnt from expert teachers within another education system and through the involvement of various types of activities not previously experienced (e.g., interaction with scientists, field experiences, science-based excursions with a focus on pedagogical knowledge). Nevertheless, further investigation would be required to determine if these physics teachers employed reform measures in Jiangsu and whether this professional development can be measured in terms of student achievement. The impact of this program for the participants is at the re-conceptualisation level. Some indicated they will try to form action-research groups and others thought assessment methods may be implemented in China. Even so, they suggested that changing their assessment methods cannot be achieved without altering their teaching and learning styles, and societal demands (e.g., Chinese students, teachers, and parents' views). Considerations of the components conducted in this study may aid other educational institutions abroad for devising their own professional development programs.

In conclusion, determining the Chinese secondary teachers' needs early in the program (preferably before the program commences) and re-assessing these needs at various points throughout the program can lead to effective changes that promote more intensive professional development. Importantly, these secondary teachers had first-hand experiences with Australian educational reform, which may lead towards considerations for China's educational reform in physics education. Of course, other benefits were derived from the program, which included the promotion of "friendship and culture interchange between two countries" and the "broadening of outlooks". Further interchanges between countries may assist in global development of secondary education, particularly as countries continue to learn from each other. As one participant said, "We can increase the interaction and interchange about education, and advance both countries by drawing on each other's merits and raise the level together."

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