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Policy perspectives of challenges and factors in promoting science literacy in Thailand

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Abstract

Scientific literacy is not only a key indicator of national competitiveness. It is also an attribute of a quality citizens for national well-being. However, many countries, including Thailand, still struggle to find ways to ensure that their citizens become scientifically literate. This paper explores opinions from eleven policy level experts through in-depth interviews about public science literacy in Thailand. This includes its situation, the challenges of the ecosystem to promote public science literacy and possible key areas for improvement. The study revealed that science is well-received as an important discipline, especially in formal education, but less considered as providing tools for quality living. The major challenges in enhancing public science literacy include outdated curricula, diverse student assessment standards, lack of long-term national policy, quality of science teachers, low involvement of scientists and public attitude toward lifelong learning. Key success factors suggested are: (1) promoting long-term government policy in public science literacy; (2) integrating work between various education systems; (3) engaging the private sector and scientists in promoting science literacy; and (4) cultivating lifelong learning attitude. Other proposed ideas include creating a science learning platform, providing customized learning and knowledge management, promoting local community involvement in science education, and distributing more science museums throughout the region.

Introduction

Promoting scientific literacy has been a continuous focus in most countries with the expectation that this would contribute to individual decision making and well-being, as well as to national growth, particularly in economic and social development (Office of the National Education Commission, 2003). Thailand is in a transition period from being considered under-developed to developing while aiming to catch up to more developed countries with a national policy goal to raise the standard income above that of middle-income countries through science,

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technology and innovation (National Science Technology and Innovation Policy Office, 2011). Thailand devotes about three percent of its national budget to education (Bureau of the Budget, 2016). Science schools and science-gifted programs have been implemented with scholarships for higher education. Also, Thai students spend longer hours in school than other students in the world. Unfortunately, even with these positive efforts of budget, scholarships and time, science literacy scores for Thai students (PISA) show reverse results (Punyasavatsut, 2015). In 2015, Thai PISA science literacy ranked only 54 among 72 countries, a decline from the previous year and considered the below global standard (Institute for the Promotion of Teaching Science and Technology [IPST], 2006, 2018). In terms of national research achievement and science and technology manpower to support future economy growth, the number of Thai scientists, science publications and scientific research has increased slightly, but is still low compared to other countries in Asia and the number of people entering science and engineering careers has not improved (Office of National Higher Education, Science, Research and Innovation Policy Council, 2019). Therefore, it would be beneficial to identify possible barriers to such progress. Since this study aims at public science literacy, this discussion covers not only one type of education, but the ecosystem of learning that includes formal, non-formal and informal education. The term "lifelong education" was used to guide interviewees to reflect their thoughts holistically. It is important to note that in 2019 only 20 percent of the Thai population aged 7–60 years were in the formal education system (Office of National Statistics, 2019). Therefore, promoting public science literacy also needs to seriously consider the role of non-formal and informal education in this effort. Gaining the perspectives of experts in these areas can help identify important gaps in this overall integration so that future implementation of policy directives can be more effective.

Literature Review

Public science literacy is regarded as the social foundation for sound global governance that allows citizens the ability to participate and share responsibilities in social and economic development, cultivate innovative talents and better meet complex global challenges (Miller, 1996). Shen (1975) proposed three types of science literacy, namely, practical, civic and cultural. This became an influential definition in the measurement of science literacy. DeBoer (2000) extended the definition to be "a broad and functional understanding of science for general education purposes and not a preparation for specific or technical careers". The UK policy report, "Beyond 2000: Science Education for the Future" suggests that science curriculum should be provided to enhance "scientific literacy" which mainly enables students to express opinions on important social and ethical issues with which they will increasingly be confronted (Millar & Osborne, 1988). PISA treats science literacy as a competency of an ability to engage with science-related issues, and with ideas of sciences, as a reflective citizen. Such competency includes the ability to: (1) explain phenomena scientifically; (2) evaluate and design scientific enquiry; and (3) interpret data and evidence scientifically (Organization for Economic Co-operation and Development [OECD], 2013).

The importance of science literacy can be perceived in four different aspects. (1) personal: it helps people to respond to issues and challenges which emerge in their personal and community contexts such as health; (2) democratic: it is the foundation for understanding the impact of science on society and helps in making informed civic decisions (3) economic: an advanced economy requires a scientifically and technologically skilled population; and (4) cultural: sciences are important cultural activities and offer powerful ways to understand and change views of the world. Therefore, it should be part of liberal education (National Academies of Sciences, Engineering and Medicine [NAS], 2016).

In Thailand, the definition of scientific and technological literacy has been influenced by international organizations, such as UNESCO, ICASE, SEAMEO and OECD (Yuenyong & Narjaikaew, 2009). However, at present, due to the PISA initiative, the definition of science literacy defined by OECD is mostly used through the Institute for Promotion of Science Teaching. According to IPST, people who possess scientific literacy are able to: (1) perceive questions and problems that could be verified through scientific method; (2) identify evidence or data for inquiry; (3) give reasonable explanations related to empirical data or evidence; (4) communicate or explain to others the conclusions of issues related to science; and (5) understand scientific principles and concepts (IPST, 2006).

Thailand is not an OECD country, but it has adopted the PISA test as a way to identify its competitiveness in the global arena. Since 2000, the country has continuously participated in the test for students aged fifteen to judge their performance in reading, science and mathematics. Figure 1 demonstrates that the mean score for scientific literacy stayed about the same between 2000 and 2015.

It is interesting to note that in many countries, promoting public science literacy requires an integrated effort of education systems, including formal, non-formal

and informal education. In China, for example, the China Academy of Science reported a significant improvement in scientific literacy when comparing data from 2005 to 2015 (Gao, He, Zhang, & Ren, 2016). This contributed to an action plan for a Chinese science popularization program that included a Sci-tech Week, National Science Popularization Day, and other informal science activities on social publicity platforms. For this reason, this research included views on lifelong education.

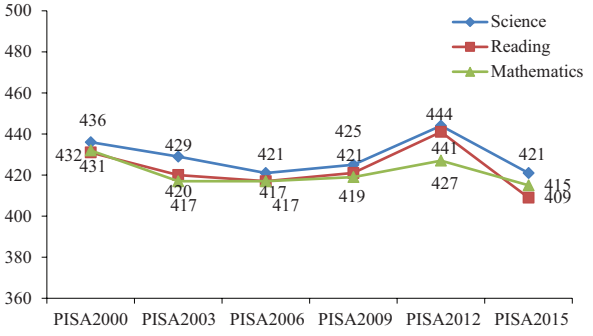

Figure 1 PISA Science Score of Thai students from 2000–2015 (in Blue line)
Source: IPST (2016)

Methodology

This qualitative research was conducted though in-depth interviews of eleven experts working at policy level in organizations involved in science research or education. The interviews were conducted from June to August 2017 as part of research on developing a survey in public science literacy. The interview was semi-structured with an average interview time of 1–1.5 hours. The experts were asked to reflect on the following points based on their views from observation and experience: (1) public science literacy situation in Thailand; (2) challenges and pitfalls of promoting science literacy from the perspective of lifelong education; (3) key success factors in promoting public science literacy through lifelong science education; and (4) suggestion for lifelong education to promote science literacy. The experts were selected from organizations in science or education with at least five years of experience in administrative roles. The organizations include the Office of the Basic Education Commission, Office of the Higher Education Commission, Office of the Vocational Education Commission, Office of the Non-formal and Informal Education, Office of the Education Council, The Science Society of Thailand, Office of Knowledge Management and Development, The Institute of the Promotion of Teaching Science and Technology, and National Science Technology Development Agency. The interviews were recorded, transcribed and summarized. The conclusion is a summary based on the data that more than five of the eleven experts agreed upon. Other interesting remarks are also here presented for further discussion.

Results

Current Status of Science Literacy of Youth in Thailand

Most experts agreed that although many people acknowledge that science is an important subject, they feel it is difficult and do not have much interest in it. Most people do not think that science is relevant to life after school. Since parents and teachers do not recognize its value, they cannot convince their children to be interested in it or to pursue science careers. "Thai people seem to not pursue learning because our lives are too easy, but now we might be more pressed by fast moving technology to understand more about science." "People are still away from science. Although parents send their kids to science camps, it is with the aim of their kids getting a good score and then getting into a good university. After that, science is no longer relevant to them."

Challenges and Pitfalls in Promoting Public Science Literacy in Thailand

The experts identified the following major challenges that act as barriers to promoting science literacy in Thailand:

1. Standards and contents of the science curriculum are outdated and not relevant. "The big barrier is that the curriculum is too boring and long. This blocks students from choosing science." "We need a modern and contemporary curriculum." The outcome of learning is still measured mainly by test scores. Schools and parents see education as a tool to bring students to higher education and, therefore, the learning goal is to do well in examinations rather than to gain personal qualities in terms of skills, attitudes and the ability to apply knowledge gained to daily life. The consequence is the discontinuation of youth development, especially in skills attainment and perception.

2. Lack of national policy to promote public science literacy. In past years, there have been various directions and measures regarding the national science education policy which has shifted from government to government, thereby creating a lack of clear and consistent goals. Relevant comments from the experts include: "In the past, human resource development planning was scattered and lacked focus." "It is important to simplify the policy and make it clear how the policy will be supported. This should be communicated throughout the country."

The absence of a clear and sustainable policy also causes the lack of integration and unity among various players in science education. With no common focus, each agency establishes its own goals, approaches and standards with minimal effort to integrate and communicate with other players. "We have a lack of collaboration and center of coordination among different agencies." "Without coordination and sharing, the standard of practice becomes varied from one place to another."

3. Lack of qualified science teachers. Many teachers take an education degree because they prefer arts to science. In many primary schools, it is common that teachers have to teach subjects they are not trained for, most notably, science. "Many schools do not have teachers for all levels. Teachers do not always teach what their major specialty is. …..we found that teachers who teach other subjects (i.e. other than science) can have a big impact on student learning as they do not know how to motivate enquiry skills." "In the classroom context, teachers usually do not have enough time to finish what is required in the curriculum. Sometimes they do not understand the subject well."

4. The quality of science content is not good enough to catch the attention of the public and support lifelong learning. Very often, science curriculum is outdated and presented in a traditional manner. "Science content available to the public is still not up to date and therefore it is not interesting enough and does not meet the expectations or curiosity of the public." "Science contents that are available to the public are not available to everyone since there are some schools in the province that have limited digital technology." "There is a lack of quality and useful content creators that could provide up-to-date relevant science that meets the needs of the public." In general science is usually communicated in a manner too complicated and too difficult to understand.

5. Low involvement of scientists in science engagement. To make science relevant and interesting, the public needs to see how science has contributed to their well-being, how scientists work and come up with new important knowledge. The need to hear from real-life scientists and get responses to scientific news was also mentioned by the experts. The ego of scientists was mentioned as a challenge to promoting science learning, as well as gaining their active involvement and participation. There seems to be a general feeling that scientists like to stand on the top of the mountain looking down on the public,a situation that needs to be improved. At present, there is no clear attempt ensure that the scientific community will take responsibility for providing scientific information to answer society's need in a time of crisis.

6. Lack of value and habit in lifelong learning. Lifelong learning is still not very common for most people. Self-learning outside the classroom, such as from reading and accessing the library, is limited. People expect to only learn in school by having teachers teach. This is problematic as it does not encourage people to keep learning once they are no longer in school.

Key Success Factors in Promoting Public Science Literacy for Thailand

The experts identified the following various factors that would be key areas to support promoting public science literacy, especially in a lifelong learning context, which is summarized in Figure 2.

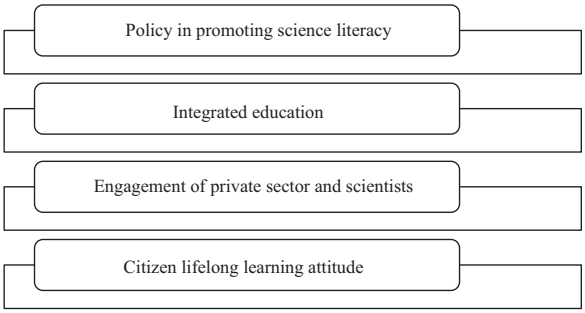

Figure 2 Key success factors in promoting public science literacy in Thailand

1. The government should have a strong policy for promoting public science literacy and make sure that it is implemented and integrated in all education systems. "There should be a long-term plan with strategies about how we are going to achieve it. We should find factors why people are not interested in science and erase those factors." "Government policy should be clear, consistent and continuous, especially in promoting lifelong learning." "The policy must be continuous. This government tends to support science to promote the economy. We have to design laws that support science and technology to accommodate upcoming situations, such as drone technology."

2. An integration of formal, non-formal and informal education "We need to integrate various education systems for formal, non-formal and informal education to ensure that we can improve the quality of life throughout their lifetime. In this way, people can choose which mode suits them and appreciate learning" "We need to invest in multipliers of knowledge not only for formal education but also informal education"

3. Engagement of private sector and scientists. There

should be incentives to the private sector to help strengthen science literacy, and to scientists who are the main content contributors. Education inequality needs to be overcome and the private sector could play more of a part in quality education. "The private sector should have more incentives to work in this area (of promoting public science literacy)." "At this moment there are some organizations such as the National Science Museum, Science Centers for Education, and the National Science and Technology Development Agency who work on public science literacy promotion, but it seems like it is not enough."

4. Motivation for the public to pursue lifelong learning. Learners' motivation can be enhanced through good learning environments, and promoting the attitude and skills of self-learning. This is important to cultivate from childhood as it is an important factor for further learning throughout life. "Once the public has science learning in their habit then we no longer need to force (further learning)." "We need to encourage people to have motivation to learn, which means people should set goals for which direction they want; then they will have passion and satisfaction in learning." "It is a responsibility of the government to be the conductor to inspire learning."

Other Suggestions for Lifelong Education to Promote Public Science Literacy

Experts were asked to provide additional suggestions on how to promote science literacy through lifelong education. Areas that were strongly mentioned include:

1. There should be new channels or platforms for science learning which provide real experience both on-line and on-site.

2. Learning should be customized according to learners' needs which could be individual, interest group, etc. People will choose to learn only what they are interested in. Therefore, learning centers will have to provide a variety of contents in order to accommodate individual needs.

3. There is a need to develop a knowledge manager or content creator who has skills in science communication and can integrate art and marketing concepts into the science content. It is important to engage more scientists in science communication and science education. Perhaps scientists and artists could work more together to ensure science becomes more interesting and meaningful.

4. Encourage local communities and organizations to be involved in science education.

5. Increase more science learning centers by working with universities and research agencies. The issues of accessibility and distribution were also important factors noted by the experts. The government will have to invest more effort and resources to ensure that learning facilities such as science museums, science knowledge sharing platforms and science media are more available and accessible to the public, not only in central Thailand but country-wide.

These key suggestions are summarized in Figure 3.

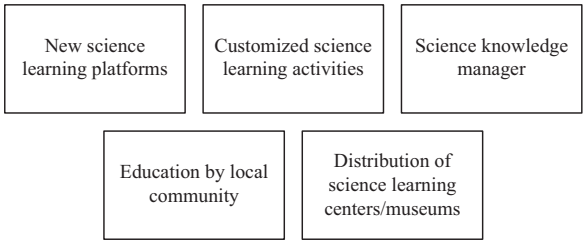

Figure 3 Suggestions for lifelong education to promoting public science literacy

Discussion

The results from this study reveal that from the perspectives of policy level experts in science or education, science literacy in Thailand is not high although the public tends to have a positive attitude about the importance of science. In other countries such as Indonesia or USA, similar results have been observed (NAS, 2016). The issue of public science literacy perception could arise from various challenges such as the quality of science teaching, changing government policy, availability of good learning resources, lack of involvement of the scientific community and attitude toward lifelong learning. Since this study was conducted in 2017, this situation might have changed due to the implementation of the STEM education policy, but it still identifies important factors that could help to strengthen public science literacy in Thailand. Regarding policy in public science literacy, a good example is China, which has seen achievement in technology and innovation in the past years after having set its nation-wide and long term goals and plans in public science literacy since 2006. China also engaged in intensive research and monitoring of public science literacy resulting in an increase in public science literacy level up to 4.7 percent in 10 years (Gao et al., 2016). This could be something Thailand can learn from and adopt if it would like to move the nation forward in science and technology. The view from the experts also suggested that education in science should not be limited to classroom learning but all education systems should be important parts of this effort. In many

other countries such as China, Korea, Japan, the importance of science museums, learning centers or community learning spaces in science were mentioned. Public media and learning centers that provide scientific and technological knowledge customized to various target groups would benefit the society by creating the complete learning ecosystem to support lifelong learning. Good science content needs the involvement of scientists as the source of information and also needs people with skills in communication to make science more digestible for the public. Scientists should contribute more by sharing with the public their work and lives in order to open up the unknown world of science to attract the young generation.

Identifying a need for a knowledge manager is probably the most important and innovative idea to come out of this research. Such a manager would help science become more relevant for youth and the general public. Once the resources and platforms to promote lifelong education in science have been developed, it will be important to make sure it is accessible for the majority of the population. This can be referred to as the availability of learning environments for people of all ages.

It is important to note that "self-motivation in learning" is a key success factor. Therefore, to promote science literacy, it is necessary for individuals to become self-learners or lifelong learners. Therefore, the education system should encourage nurturing the habit and attitude of self-learning rather than focusing on simply providing content. In order to motivate self-learning, the most interesting and meaningful science content should be available and easily accessed. Activities to promote science should be organized continuously by various organizations all year round. Relevant agencies should work to integrate such efforts. This would help the youth and public to see science in the real world and in a more concrete form.

Conflict of Interest

There is no conflict of interst.

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