REPORT

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Study on the strategy to promote science literacy in Taiwan and the practices of inquiry based science teaching in the mixed ability class

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INTRODUCTION

Science literacy measured in PISA (Program for International Student Assessment) test has become a big issue in some countries, such as Indonesia, which performs in the very low rank. In the opposite, students with the same age in Taiwan have performed better or ranked on 4th among 65 countries. Why there is a big gap between students of both countries?

Taiwan is one of the top countries on science literacy score of PISA 2015, a test to measure the ability of 15-years old students on science, mathematics and reading literacy. Students of Taiwan scored 532 in science or above the average score of OECD countries (493). With this achievement, science education in Taiwan is a good benchmark to some countries. Why Taiwanese students are able to achieve those high scores are might be traced from the structure of Taiwan science curriculum, and how the science classes are delivered by Taiwanese teachers at schools.

As both countries are part of Asia, it might be assumed that Indonesia and Taiwan culturally have some similarities. We also can argue that as the Asian, students of both countries should have intellectual level relatively similar. Then, what actually are the reason of the big gap of science literacy level of students in the both countries?

It might be argued that the quality of science teaching and learning practiced by science teachers since primary level in both countries is the main reason of the gap. Teaching a meaningful science, in which students are being nurtured through a series of inquiry-based activities to eventually have a high level of science literacy, depends on teacher's knowledge and abilities.

Teachers' quality is fundamentally developed through a strong and qualified pre-service and in-service teacher training. How do Taiwan government support trainings for teachers' quality improvement, and how is the professionalism of teachers nurtured are the main queries of this research.

Inquiry-based science teaching (IBST) is the issue emerges since years ago, prior to the PISA' literacy. It have already practiced by John Dewey in his school as the way to teach science contextually, and to train students with a sort of scientist activities, started from posing inquiry question regarding science phenomena, generating

hypothesis, doing an investigation, collecting data, analysing the data, concluding and finally communicating the result. IBST becomes one of the approach of science education in almost all of the developed and developing countries.

However, practicing IBST in the class is not an easy as defined. Prior research show that there are a lot of obstacles found by science teachers to applied IBST in their science class. The problem is not only caused by the lack of Pedagogical Content Knowledge (PCK) skills of teachers, but the problem occurs because of the mixed abilities class of science, where students in one class are not streamed as one level of abilities, but diverse from low to high abilities.

This research will focus on two main activities, 1) to study the strategy of Taiwan on promoting science/scientific literacy, and the policy of science teachers training. 2) to study how do science teachers in the mixed ability class handling the gap of abilities, and overcome with the great science literacy achievement of all students.

The purposes of the research are:

1. To learn successful and failure stories from Taiwan in promoting science literacy and IBST strategies
2. To learn IBST practices at mixed-ability science classes at primary and secondary level
3. Combined developed-developing country learning process: While there are no guarantees that knowledge from developing country can effectively transfer to developed countries, combined developed-developing country learning process can potentially generate alternative solutions for various educational issues

RESEARCH METHODS

Research applied a qualitative method. To answer the first issue, data have been collected through document analysis of the 12-years basic education of science curriculum, and related policies or regulations on teacher training. Interview had also subjected to stakeholders regarding the policies and practices of pre-and in-service teacher training. The subject of interview were lecturers of NTNU, and teachers.

The data for the second issue have been collected by doing a series of observation of science class in the primary and secondary level, analysing teachers' lesson plan and the science textbooks; observation of the science class to learn the practices of IBST; interview with science teachers to elaborate their perspectives and skills on science literacy.

Research was done in 3 (three) months, and the steps of research was as follows:

1. October 9-10, 2018: Collecting data by discussing and interviewing Professor Hsin Kai Wu-NTNU about science curriculum and teacher training program at NTNU
2. October 18, 2018): Observing STEM class at Taipei Municipal Datong High School (Teacher: Mr. Wang)
3. October 29, 2018: Biology class observation at Jingmei Junior High School (Ms. Guo Shu Miao)
4. November 5, 2018: Observing science class at Jingmei Elementary School, Taichung
5. November 14, 2018: Physics class observation at Jingmei Junior High School (Ms. Yang Ji Yin)
6. November 29, 2018: Discussion with Biology and science teachers of Kaohsiung Municipal city
7. December 18, 2018 : Observing marine education class at Elementary School

	November 14, 2018: Physics class observation at Jingmei Junior High School (Ms. Yang Ji Yin)
	November 5, 2018: Observing science class at Jingmei Elementary School, Taichung

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RESULTS

A. Policy on Promoting Scientific Literacy in the Curriculum

Taiwanese curriculum has been reformed in 2010, from 9-years compulsory basic education to the 12-years compulsory basic education curriculum. The new curriculum has been nationally implemented in 2014. The 12-years curriculum representing the strategies of Taiwan on promoting the science/scientific literacy.

The analysis of the curriculum was focused on: what the core literacy, the design of the conceptual progression of life science, and the inquiry skills to be nurtured in promoting the SL.

The core literacy is focusing on three points, i.e. inquiry ability, cultivating scientific thinking, scientific attitude, and learning core concepts of scientific knowledge. In the broad sentences are, first, providing students with the opportunity to do inquiry learning, and problem solving develop the "inquiry ability" of relevant knowledge. Second, assisting students in understanding the ways in which scientific

knowledge is generated and the cultivation scientific thinking and exploring the "scientific attitude". Third, guiding the students to learn the "core concept" of scientific knowledge.

To implement the core literacy, the interdisciplinary concepts approach have been adopted as the strategy to promote SL practiced in each grade. There are seven interdisciplinary concepts, i.e. matter and energy (INa), construction and function (INb), system and scale (INc), Change and stability (INd), Interaction (INe), Science and Life (INf), and Resources and Sustainability (INg). Those seven concepts are covered in three main concepts in science: 1) the composition and characteristic of nature, 2) the phenomena, laws, and effects of nature, and 3) the sustainable development in nature.

Science learning performances are promoted in two aspects of inquiry abilities, which are thinking ability and problem-solving skills. While the science attitude is promoting two aspects, i.e. scientific thinking habit and nature of science.

Under the guidance of the above basic concepts, the 12-year Natural Science Curriculum is based on the following objectives:

1. Encourage the enthusiasm and potential of scientific inquiry: enable students to have curiosity and imagination in the natural sciences, express rational thinking, and develop their potential.
2. Construct basic scientific literacy: enable students to possess basic scientific knowledge, inquiry and practical ability, effectively communicate and participate in decision-making and problem solving ability on civil society issues in real life, understand and reflect on the scientific related content reported by the media, and also cultivate the spirit of seeking truth
3. Lay the foundation for continuous learning of science and the use of technology: develop students' positive attitude towards science, interest in learning science, and lay a good foundation for adapting to the life of science and technology
4. Cultivate social care and protect the values and actions of nature: enable students to appreciate and cherish the beauty of nature, deepen the caring and action of loving nature, cherishing life, and cherishing resources, and then commit to construct a rational society and sustainable environment
5. Preparing for career development: Make students work harder to improve their scientific knowledge, whether they are interested, living or working, and prepare for the next stage of career development through this stage of study.

Time allocation of science course in each grade is shown in Table 1. In the early stage of education or in the elementary school, students in Taiwan are introduced with Natural Science or Life Science at the third grade for 3 credits. Whiles, for the grade

1-2, they learn science to the Life skills course. At the grade 5-6, and grade 7-9, the same amount of science class are also assigned. However, the number of science class increase at the high school level. There six subjects, i.e. physics, chemistry, biology, earth science, natural science exploration and practices 1 and 2.

Table 1. Time Allocation

Education Stage	**ES**			**JHS**	**Ordinary secondary school**	**Advanced**
Learning Phase	**1**	**2**	**3**	**4**	**5**	
Grade	1-2	3-4	5-6	7-9	10-12	
					Ordinary	Advanced
Number of learning sessions	Life Skills (6)	Natural Science (3)	Natural Science (3)	Natural Science (3)	Physics (2 credits) Chemistry (2 credits) Biology (2 credits) Earth Science (2 credits) Natural Science Exploration and Implementation (1) (2 credits) Natural Science Exploration and Implementation (2) (2 credits)	Deepen, broaden, elective

In detailing the core literacy, the curriculum state three main literacy, i.e. autonomous action (A), communication (B), and social participation (C) (Table 2). Each literacy have been elaborated to each grade of school, for instead, the autonomous action in the elementary school means students are able to use five senses, strong curiosity on their surrounding science phenomena, keenly observe the nature, and continuously explore the nature. Moreover for the junior high school students, they are

expected to apply scientific knowledge, methods and attitudes in the daily life. While, for the senior high school students, they should understand the progress of science and its contribution to and restrictions on human society, and finally chose science as their future career.

Table 2. Design of core literacy

General core literacy	**Mastering program of core literacy project**	**Description of General outline of core literacy project**	**The core connotation of natural sciences**		
			Elementary School	National Secondary Junior High School	General High School
A Autonomous action	A1 Physical and mental quality versus Self-advancement	Have the quality of physical and mental development, have a proper view of human nature and self-view, and at the same time, through the selection, analysis and application of new knowledge, effectively plan career development, explore the meaning of life, and constantly	自-E-A1 Able to use the five senses, keenly observe the surrounding environment, keep curiosity and imagination to continuously explore the nature.	自 -J-A1 Apply scientific knowledge, methods and attitudes to everyday life.	自-S-U-A1 understands the progress of science and its contribution to and restrictions on human society, made science a career choice for future career developmen t.

		improve themselves, pursue the best			
	A2 System thinking vs problem solving	Systematic thinking and post-construction literacy with problem understanding, speculative analysis, and reasoning criticism, and action and reflection to effectively deal with and solve life and life problems.	自 E-A2 Able to use curiosity and imagination to present questions or explanations suitable for scientific inquiry from observations, readings, and thoughts, and to rely on known scientific knowledge, scientific concepts, and exploration science. The way to imagine what might happen and to understand scientific facts will have different arguments, evidence or explanations.	自 -J-A2 Able to link the acquired scientific knowledge to the natural phenomena and experimental data that it observes, learn self or group to explore evidence, respond to multiple perspectives, and be able to credibility of problems, methods, information or data. Hold reasonable skepticism or conduct checks to explain causal relationships or possible solutions to problems.	自 S-U-A2 It is possible to obtain natural science data from a series of observations and experiments, and to compare and judge the rationality of scientific data in methods and procedures based on scientific theories and mathematical calculus formulas, and then to check the truth of the data with critical arguments. Sex and credibility, proposing

					innovative and forward-thinking to solve problems.
	A3 Planning execution and innovation	Have the ability to plan and execute projects, and explore and develop diverse professional knowledge, enrich life experiences, and develop innovative spirits to respond to social changes and enhance individual resilience.	自-E-A3 With the ability to explore scientific issues through on-the-spot inquiry activities, and to initially plan simple steps based on factors such as question characteristics and resources, operate equipment, technology equipment and resources suitable for the learning phase, and conduct natural science experiments.	自-J-A3 Students have the ability to identify problems from their daily life experience and plan natural science research activities based on factors such as problem characteristics and resources, and make good use of the objects, equipment, scientific equipment and resources around us.	自 S-U-A3 Have the ability to identify problems from the journal research or research, and independently plan the complete implementation of the inquiry activities based on the characteristics of the problem, the learning resources, the expected results, and the impact on the social environment, using instruments and technology equipment

					suitable for the learning phase. Then, based on the experimental results, the experimental model is revised, or the innovation breakthrough limit.
B. Communication	B1 Symbol use and communication expression	Ability to understand, use, and communicate with language, mathematics, body, and art to understand, communicate, and interact with others, and to apply to everyday life and work.	自-E-B1 Ability to analyze and compare, make charts, use simple mathematics, etc., organize existing natural science information or data, and use simpler forms of spoken language, words, images, drawings or objects, scientific nouns, mathematical formulas,	自-J-B1 Ability to analyze induction, charting, use information and mathematical operations, organize natural science information or data, and use slightly more colloquial, images, texts and patterns, drawings or objects, scientific terms, mathematical formulas,	自 S-U-B1 Reasonable use of thinking intelligence, making charts, using information and mathematical operations, etc., effectively collating natural science information or data, and using spoken language, images, words and patterns,

			models, etc. Process, discovery or outcome.	models or other new media Form, expressing the process of inquiry, discovery and results, values and limitations.	drawings or objects, scientific terms, mathematical formulas, models, etc., or Try to present a relatively rigorous process of inquiry, discovery or achievement in the form of new media.
	B2 Technology Information and Media Literacy	Have the ability to make good use of technology, information and various media, cultivate relevant ethics and media literacy, and analyze, think and criticize the relationship between people and technology, information and media.	自-E-B2 Learn about the ways in which technology and media are used, and learn about problems or gain useful information from learning activities, daily experiences and technology applications, the natural environment, books and	自-J-B2 Ability to operate technology equipment and resources suitable for the learning phase, and to distinguish the credibility of information and various planned observations from learning activities, daily	自 S-U-B2 From the daily experience, the use of technology, science-related issues in society, learning activities, the natural environment, books and online media, moderately use information that is helpful for

			online media.	experience and technology applications, natural environment , books and online media to obtain Information that helps in inquiry and problem solving.	inquiry, problem solving and prediction, and then can detect problems or reflect on media reports. Science-related content to cultivate the spirit of seeking truth and truth.
	B3 Art conservation versus Aesthetic literacy	With the ability to perceive, create and appreciate art, and to appreciate the beauty of art culture, through the reflection of life aesthetics, enrich the aesthetic experience, cultivate the attitudes and abilities of appreciation, construction and sharing	自-E-B3 Through the primitive feelings of the five senses, observe the flora and fauna and natural phenomena in the surrounding environment and know how to appreciate beautiful things.	自-J-B3 Experience the beauty of nature by admiring the mountains, the clouds, the rain, the oceans, the sun and the moon.	自 S-U-B3 Learn to appreciate the beauty of science by understanding the simplicity of scientific theory, the rigor of scientific thinking, and the laws behind complex natural phenomena.

		of good things.			
C. Social participation	C1 Moral practice versus Citizenship	Have the literacy of moral practice, from personal ego to social citizen, step by step, develop social responsibility and civic awareness, take the initiative to pay attention to public issues and actively participate in social activities, care for the natural ecology and sustainable development of human beings, and show the good character.	自-E-C1 Cultivate the caring and action of loving nature, cherishing life, and cherishing resources.	自-J-C1 From daily learning, students have to concern about the public issues related to the natural environment and respect the importance of life.	自 S-U-C1 Develop a sense of social responsibility and citizenship that actively cares about natural issues and build a sense of self-awareness that cares about the natural ecology and sustainable human development.
	C2 Interpersonal relationship and teamwork	Have a friendly interpersonal relationship and establish	自-E-C2 By exploring scientific collaborative	自-J-C2 Through collaborative learning,	自 S-U-C2 From the group inquiry

		good interactions with others, and develop teamwork with people to communicate and coordinate, tolerate dissidents, social participation and service.	learning, students develop the ability to communicate with peers, teamwork in harmony.	development and peer communication, joint participation, joint implementation and joint exploration of scientific knowledge	discussion, students can actively build the ability to think and coordinate, communicate and tolerate dissent, and then be willing to share the results of the inquiry or assist others to solve the scientific problem.
	C3 Multiculturalism and international understanding	With the belief of self-cultural identity, and respecting and admiring multiculturalism, we are actively concerned with global issues and international situations, and are able to adapt to the pulse of the times and the needs of society, and	自-E-C3 Learn about the current state and nature of the global natural environment through environmentally relevant topics.	自-J-C3 Through the study of environmental related issues, students can understand that the global natural environment is different and interactive, and can develop the value of the	自 S-U-C3 Being able to take the initiative to care about global environmental issues while recognizing that it is the responsibility of the global citizen to maintain the global environment, through

		develop international understanding, multicultural values and world peace.		world as a citizen.	the practice of individuals, to build a world view of multiple values.

Learning Focus

Based on the basic concepts and curriculum objectives of cultivating scientific literacy, the focus of this field is on the three core areas of scientific core concepts, inquiry capabilities, and scientific attitudes and nature. The courses at each stage of learning should integrate the three in a proper way according to the physical and mental development of the students, the needs of society and life. The two dimensions of "exploration ability" and "scientific attitude and essence" are the "learning performance" of students at each stage, while the "scientific core concept" presents the specific scientific "learning content" of each stage of learning.

In the course of the field, the relationship between "learning performance" and "learning content" is closely related and mutually exclusive. The former is the learning performance of scientific inquiry ability and scientific attitude when students are expected to face science-related issues at various stages of learning. The latter shows students at this stage, knowing the current systematic scientific knowledge accumulated by human beings in the exploration of the natural world, and also as a solution to the problem.

The necessary starting point for the problem process means the course of natural science should guide students to acquire scientific inquiry ability and develop scientific attitude through multiple methods such as inquiry, reading and practice, in order to gain the understanding and application ability of scientific knowledge content.

The core concepts in the field of science cover three main topics, including "The composition and characteristics of nature", "Phenomenon, law and role of nature" and "sustainable development of nature" (Table 3).

The "exploration ability" is divided into two parts: thinking intelligence and problem solving. "Scientific attitude and essence" mainly include three aspects, namely, "cultivating interest in scientific inquiry" and "developing the habit of applying scientific thinking and inquiry" and "to understand the nature of science". The focus of learning in the field of natural sciences is based on the characteristics of the students'

physical and mental development. The 12-year longitudinal coherence plan is carried out.

In addition, the “Research Center for Key Learning and Core Literacy Response References in the Natural Science Field” is to enable learning priorities and core literacy to respond to each other, and to implement core literacy in the field through learning priorities, and to guide cross-disciplinary/cross-border. The curriculum design of the subject enhances the rigor of the curriculum development. The "Introduction to the syllabus of the topic of integration into the natural sciences" is to enrich the learning of the field and promote the cultivation of core literacy so that the topics can be properly integrated with the learning focus of the natural sciences.

Table 3 Learning Content Architecture in the Field of "Natural Science"

Subject	**Interdisciplinary concept (IN)**	**Theme/Topic**	**Subtopic**
1. The composition and characteristics of nature	Matter and energy (INa)	Composition and characteristics of matter (A)	Material composition and periodicity of elements (Aa) Form, nature and classification of substances (Ab)
		Form and flow of energy (B)	Energy Morphology and Transformation (Ba) Temperature and Heat (Bb) Energy and Metabolism in the Living (Bc) Energy Flow and Transformation in the Ecosystem (Bd)
	Construction and function (INb)	Material structure and function (C)	Separation and identification of substances (Ca) Structure and function of substances (Cb)
		Biological structure and function (D)	Cell Structure and Function (Da) Structure and Function of Animals and Plants (Db) Constancy and Regulation in the Body (Dc)
	System and scale (INc)	Material system (E)	Nature's Scale and Unit (Ea) Force and Movement (Eb) Gas (Ec) Universe and celestial bodies (Ed)

		Earth environment (F)	Composition of Earth (Fa) Composition of Earth and Space (Fb) Biosphere (Fc)
2. The phenomena, laws and effects of nature	Change and stability (INd)	Evolution and continuation (G)	Reproduction and inheritance (Ga) Evolution (Gb) Biodiversity (Gc)
		History of the Earth (H)	Origin and Evolution of the Earth (Ha) Stratigraphy and Fossils (Hb)
		Changing Earth (I)	Changes in surface and crust (Ia) Weather and climate change (Ib) Movement of seawater (Ic) Day and night and season (Id)
	Interaction (INe)	Material reaction, balance and manufacturing (J)	Substance reaction law (Ja) Change in aqueous solution (Jb) Oxidation and reduction reaction (Jc) Acid-base reaction (Jd) Chemical reaction rate and equilibrium (Je) Properties, preparation and reaction of organic compounds (Jf)
		Phenomena and interactions in nature (K)	Fluctuation, Light and Sound (Ka) Gravity (Kb) Electromagnetic phenomenon (Kc) quantum phenomenon (Kd) basic interaction (Ke)
		Biology and Environment (L)	Interaction between organisms (La) Interaction between organisms and the environment (Lb)
3. Sustainable development in nature	Science and Life (INf)	Science, Technology,	The interaction of science, technology and society (Ma)

		Society and Humanities (M)	The history of scientific development (Mb) The application of science in life (Mc) Natural disasters and prevention (Md) Environmental pollution and prevention (Me)
	Resources and sustainability (INg)	Resources and sustainable development (N)	Sustainable development and resource utilization (Na) Impact and Adaptation of Climate Change (Nb) Energy Development and Utilization (Nc)

Remarks: Learning content encoding method

1. the first code: the national primary education stage is based on the Interdisciplinary Concept, which contains seven concepts. The code is presented in INa - INg. The middle school education stage and the general high school education stage are presented in thematic and sub-theme styles due to the specialization of the sub-division. The 14 themes are represented by capital letters A to N. In the general advanced secondary school education stage, the code of the capitalized English characters B, P, C, and E is added before the subject to represent Biology, Physics, Chemistry, Earth (Earth Sciences) The content of the four subjects.
2. the second code: the second and third stages of learning (national primary education stage 3-4, 5-6 grade) are represented by II, III; the fourth stage of learning (grades 7-9, national secondary education stage) to IV Representation; the fifth stage of study (grades 10-12, advanced secondary school education) uses Vc to indicate the compulsory content of ordinary high-level secondary schools, and Va to express the generalized advanced secondary schools to deepen the elective content.
3. the third code: the Arabic number is the serial number.

B. Teacher Training Policy and Scientific literacy practices in the classroom

Based on the classroom observations and interview to the teachers, it can be concluded that teachers quality in Taiwan is successfully developed through the well-managed pre-service teacher training program conducted by the teacher training college at the qualified national university. There are three prominent teacher training college in Taiwan, i.e. National Taiwan Normal University, National Changhua University of Education, and National Kaohsiung Normal University.

Those institutions which provided college of education are the center for preparing secondary teacher candidate. While, primary school teachers are trained at teachers' college. In the pre-service training, all teachers have to take classes in their specialize area, and are granted a Pre-Service Teacher Education Completion Certificate once they successfully complete teacher education coursework. This certificate enable them to take the Teacher Qualification Examination to earn a Qualified Teacher's Certificate

specific to their teaching area. For four years of bachelor's degree seekers, there is a required teacher practicum, where they have to follow a six-month internship in schools to observe, learn and teach.

The scheme of teacher training conducted at NTNU is shown in Figure 1 and Figure 2. NTNU students who admit to Teacher Education Program (TEP) have to accomplish 26 credits of TEP, and 30-40 credits for their major. After accomplishment of the minimum 56 credits, one is able to proceed to 6-months teaching practicum, and take the teacher qualification exam.

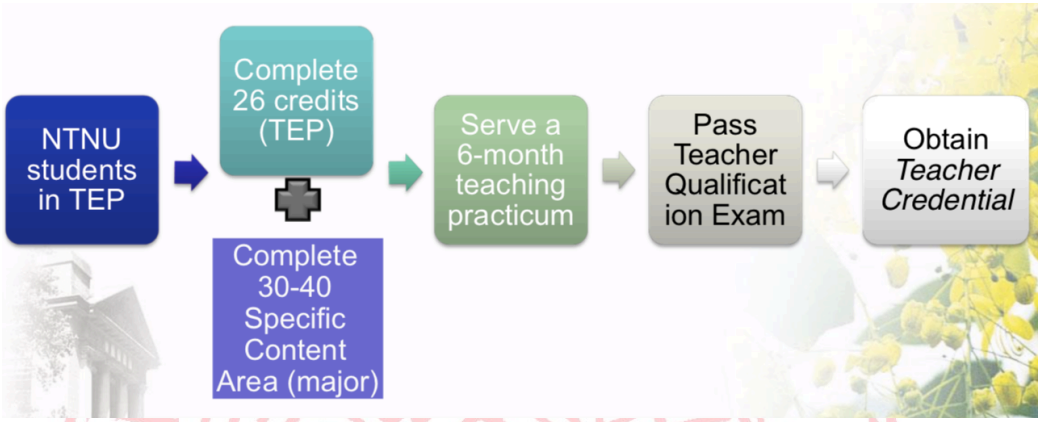

Figure 1. The step of TEP at NTNU (Source: Yeh, Fi Yen, NTNU)

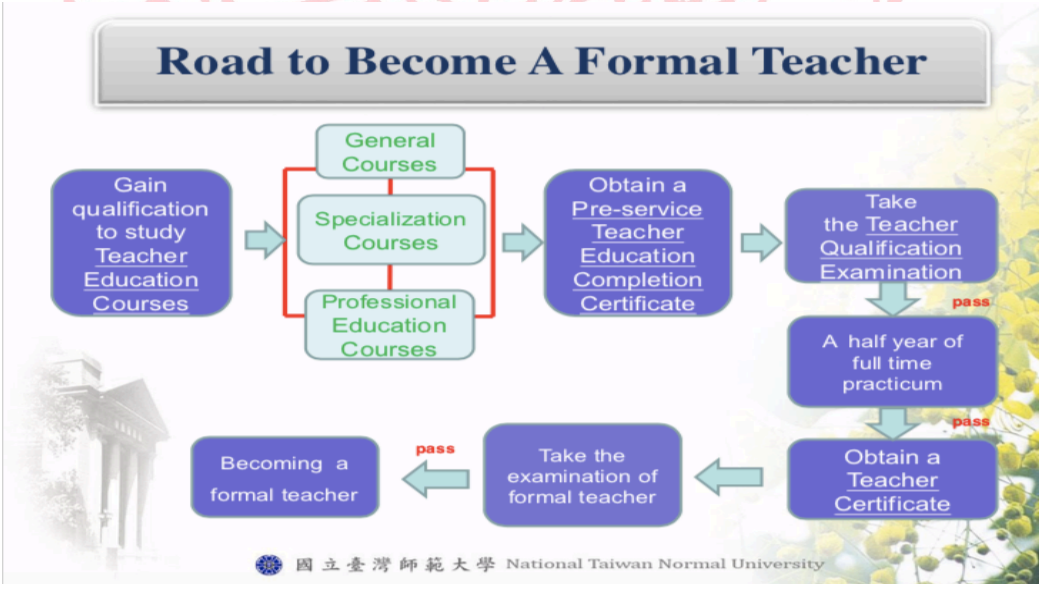

Figure 2. Process to be a regular teacher (Source: Yeh, Fi Yen, NTNU)

According to NTNU data, about 84.62% students of TEP NTNU passed the qualification exam, which was higher than nationwide (54.59%), and about 20.60% of nationwide teachers are recruited from the NTNU alumnae.

Taiwan is also a country with a strong systems on reviewing, assessing, and accrediting teacher education providers. Thus, Taiwan also has strong mechanism for ensuring that graduates meet high standards of performance before gaining the certificate or teacher licence.

Based on classroom observation, we identified that some teachers have practiced a strategy to tackle the mix ability students. For example, science teacher at Jingmei Elementary School, Taichung city, applied a different type activities for students who have a fast achievement. She provided an extra tasks or activities for students who have finished the given work faster than other peers. Moreover, she also did a field survey, such as going to the traditional Asian market in Taichung to find some natural colourful food additive as the material for learning acid and base, as well as introducing students with the natural colouring or dying. During her lesson, students also practically applied an inquiry steps or a scientific approach, which makes her class was truly meaningful.

The teacher that I observed at Jingmei JHS in Taipei performed the similar things. Beside the abilities of teacher, the science learning process was also supported by the adequate facilities, practicum tools and equipment which enable students to learn contextually.

All respondents teachers that participated in this research actively join the teacher association, and also attend regular training conducted by the ministry, and university level. They also have regular meeting with teachers from the same municipal city to discuss the science classroom activities. During the FGD with biology teachers and science teachers of Kaohsiung municipal city, we got the impression on how teachers at regional level being passion on adopting the new curriculum, which is according to teachers, more science activities added, and more focus on scientific inquiry process.

DISCUSSIONS

The strategy of Taiwan on promoting science literacy or scientific literacy is mostly started by the reformation of the curriculum, which is implemented to the all level of schooling in the country. In the curriculum, scientific literacy have been translated into what they called as core literacy. The core literacy is a basis for breaking down the science core concepts, science process skills or inquiry skills, and the science attitude that have to be set up in each subject.

The second strategy of promoting SL is to develop an interdisciplinary concepts which enable students learn integrative, and comprehensively. Teachers in this framework are also called to develop a cooperative work with their peer.

The third strategy is by structuring and levelling the skills of inquiry or scientific literacy abilities based on the level or grade. Deciding what abilities should be able to achieved by the students in each grade will guide the teachers to focusing the core of learning specifically.

Scientific literacy is also promoted through the well and strong system and mechanism of teacher training and education. The quailed institution on producing teachers candidates is the must requirement for guarantee the high level of achievement on SL. Besides the pre service training, effort on continuing the learning habit and process of teachers in Taiwan are also backed borne by the ministry and teacher colleges or university. It means, there is a strong connection between teachers, schools, government, and universities, in continuously promoting teacher professionalism.

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