Proceeding
The 1st International Seminar on Chemical Education 2015
September, 30th 2015

The Instillation of 21st Century Skills in Teaching and Learning Chemistry

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Abstract

In the pursuit of realising the national education transformation in the National Education Blueprint (PPPM) 2013-2025, the 21st century skills should be applied to all education fields. The progressing education transformation is an effort to escalate our education to international level. The 21st century skills is essential to face challenges that this century and the future have to offer. Chemistry subject is a two-year programme offered in Form 4 and 5 levels. The aim is to instill students with the knowledge, science skills and technology, and also preparing students for problem solving and decision making skills in their daily lifes based on the moral values and scientific attitude. Previous research suggested that students usually have problems understanding Chemistry because of the concepts used which are microscopic and macroscopic and abstracts in nature. This is why the 21st century skills are suitable to be implemented with Chemistry subject. This concept paper will propose a relevant alternative to integrate the 21st century skills in the teaching and learning of Chemistry subject. This concept paper also proposes a few possible ways to improve the 21st century skills. Related reaserch ought to be conducted to see the effectiveness of this alternative to the teaching and learning which are revolving around technological advancement in this 21st century.

Keywords: 21st Century Skills, Chemistry, Teaching and Learning

Introduction

Education transformation is an important agenda for any countries including Malaysia. Malaysia should priotize the continuous development in the education system so that our country can compete globally. Even though Malaysia has achieved triumph in the past 50 years in terms of the educational access and improvement of standards, there are still difference in performance in every states, districts and schools. For that reasons, The National Blueprint of Education (PPPM) 2013-2025 have been engineered to fulfil six students' aspiration where each students should acquired knowledge, thinking skills, leadership skills, bilingual, ethics, and spiritual and national identity. To realise the national education transformation, 21st century skills has been highlighted to ensure students attain the knowledge and skills required to be successful in the 21st century and into the future.

Chemistry is a science discipline that studies matter in microscopic and macroscopic manner, interactions between elements, and the use of elements. According to Meor Ibrahim Kamaruddin and Nurhidayah Ismail (2011), the study of Chemistry concepts are difficult due to the abstract nature of the concept. Moreover, misconceptions in interpretation of new concepts by students differ from the ones defined by scientist. The field of Chemistry is complex due to the requirements of understanding symbols, formulae, and concepts with theory. Chemistry is also called the centre of science because it consist of pure science and applied science such as medicine and engineering (John M. Malin, 2011). Chemistry subjects according to KBSM Curriculum covers three basic aspects; the study of matter, concepts, and the application (Suriati Awang, 1999). It is a big hope that the integration of the 21st century skills in teaching and learning of Chemistry can help to foster student's understanding of the concepts and thus acquiring the knowledge of Chemistry.

21st Century Skills

Education in this country is rapidly changing in the era of 21st century. This caters the effort in producing human resource which will lead our country in the future. 21st century offers an era that highlight the importance of science and technological development. Because of that, a paradigm shift must be made to compete globally. Partnership of 21st Century Skills (2002) stated that students must master core subjects such as English, Arts, Mathematics, Economy, Science, Geography, History and Civic, cross-discipline subjects; finance, global awareness, entrepreneurship and health, creative skills and innovation, career skills and living skills as foundation in creating society which are scientific, progressive, creative, and visionary.

According to enGauge (2003), 21st century skills consist of the digital age literacy, inventive thinking or innovative, effective communication, and high productivity. In order to adust with the 21st century skills with the environment and situations in Malaysia, one more skill have been inculcate to gear the development of human resource which is spiritual values. (Kamisah Osman & Neelavany Marimuthu, 2010).

ISBN: 978-602-73192-0-2

Digital Age Literacy Improve The Understanding Of Abstract Chemistry Concepts.

Digital age literacy is defined as the ability to utilize technology, communication tools, and network to access, manage, evaluate and invent knowledge (NCREL & Metiri Group, 2003). Scientific literacy is a knowledge and understanding of the concept and scientific process needed to make a decision and economic productivity. Technology literacy on the other hand refers to the understanding of certain technology, how it works, the purpose, and how to use it efficiently and effectively to achieve certain goals. Whereby visual literacy refers to the ability to decode, application, sketches, generate images and videos through conventional or 21st century methods.

Chemistry is often refered as the centre of science because it combines physics, mathematics, biology, medicine, pure and environmental science. It is a science discipline that studies matter in microscopic and macroscopic manner, interactions between elements, and creation and the use of elements. (Sukatan Pelajaran Kurikulum Bersepadu Sekolah Menengah Kimia, 2000). Abstract concepts make students think that Chemistry is a difficult subject and weakened their interest to study Chemistry on a higher level. Thus, the application of visual literacy in learning can help to foster students to increase abstract thinking in Chemistry.

For example, simulation and computer animation can provide clear descriptions on how the collisions and movement between particles in certain reactions which are affected by temperature, size of reactant, pressure, concentration, and catalyst as indicated in the Rate of Reactions topic. Other than that, computer simulations can describe electron transfer that happened in the chemical bonding in the topic of Chemical Bonding. Visual literacy in the 21st century skills is an effective approach to explain teaching and learning of difficult abstract science concept. This will boost students interest towards Chemistry and science.

Practical Chemistry Caters Inventive Thinking.

Inventive thinking consist of the ability to adapt and manage complexity, self-direction, curiosity, creativity, risk taking, high order thinking and reasoning (Tuan Mastura Tuan Soh, Kamisah Osman & Nurazidawati Mohamad Arsad, 2012). The ability to adapt and manage complexity refers to individual ability to tackle various goals, tasks, input and at the same time abiding the dateline, resources, and corresponding system. Self-direction refers to the individual's ability to set goals of learning, planning for the goals, freedom of time and effort,

evaluation of education quality and the results of that experiences. On the other hand, curiosity has something to do with the feeling of knowing something or thinking that would lead to inquiry. Creativity is an action that will lead to something new and genuine. Risk taking is the will of doing things wrongly in certain issues or circumstances. While high order thinking and reasoning are cognitive process analysis, comparison, evaluation and academic domain, and solutions (enGauge, 2003)

Chemistry practical is an activity conducted to learn Chemistry subject and it is important in acquiring science process skills and manipulative skills. Chemistry practical activity have been identified as effective in increasing inventive thinking which are important component in the 21st century skills. When students conduct experiments in labs, they have to adapt and manage problems throughout the experiment. They also have to set their aims so that experiment can be conducted within desired period of time. For example, a group of students conducting an experiment to study the reactions of elements; litium, sodium and potassium with water. Curiosity will take place when they study what will happen if a small piece of litium is placed on the water. During the experiment, students are inculcated with the risk taking skills where they will have to follow experiment procedures while facing mistakes if the desired results is not achieved. Students then discuss, evaluate, analyze and discover the reasons on why the results is not correct. At this point, high order thinking is inculcated to the students.

Ethics Issues And Environmental Through Effective Communication Skills.

Effective communication skill is important to the knowledgeable society in this century. Important communication consist of the elements of teamwork and collaboration, interpersonal skill, self responsibility, social and civic responsibility, and interactive communication. Teamwork and collaboration is an interaction between two or more individual who cooperate to solve or to conduct a project.

Interpersonal skill is defined as an individual's ability to work cooperatively in a group in verbal or non-verbal manner, can compare individual emotions, attitudes, motivation, and intention, having empathy which is sensitivity to other people's emotion in their surroundings (Ivy Deirdre Mangkau, 2012). Social and civic responsibility is the ability of an individual to manage technology and utilise them for the betterment of society and environment. Self responsibility is

the ability to manage and utilize teachnology to attain balance to the ethical issues, integrity, and life quality as a family member, society, students or even employee. Students who are self responsible will practice sense of responsibilty in using technology, information, and technological equipment system.

Effective communication teaches students who are learning Chemisty to be sensitive towards environmental issues and the available ethics within our country or at global level. For instance, students can conduct forums to discuss the importance of having a good waste management system in the electrochemistry industry, safely and effectively. With that, it can promote awareness and responsiblity while coordinating chemical from electrochemistry industry. Other than that, students can have group discussions on decomposition organic substances that produce methane and how it can start a fire at waste disposing centre and mangroves. Besides, a debate could be organized to discuss the use of biodegradable synthetic polimer and the effects to daily lives. With this, paradigm shift that are instilled can develop students to be a self-concious and aware of the environment.

Manipulative Chemistry Skills Promote High Productivity

High productivity could not be seen while the students are still in school. But the skills involved in the school level will determine whether someone will strive or otherwise in their future career. According to Siti Faizzatul Aqmal Mohamad Mohsin dan Razali Hassan (2011), high productivity is also known as attitude skills, values, and work ethics. These skills cover priority, planning, and management in achieving certain objectives, effectiveness in using real apparatus and the ability to create products that are relevant and high in quality.

According to enGauge (2003), the use of real instruments means the ability to use real tools such as hardware, software, network, and the devices used by the technician of information technology (IT) to achieved the goal of 21st century which are communication, collaboration, problem solving, and task completion. In Chemistry context, apparatus that can be applied are for instance the apparatus used to conduct an experiment; burettes, pipettes, electronic scales, fume hood, and other apparatus. Skills in handling apparatus and materials in the laboratory known as the manipulative skills are the skills that are essential for preparing students for the working world based on research.

Chemical manipulative skill outlined elements of cleaning equipment and apparatus in the right way after use. For example, the measuring cylinder used to measure the organic compound must be washed with soap because the organic compound are insoluble in water. In addition, instruments and apparatus which has been used should be stored in a correctly and safely after the experiment. For example, a burette must be placed upside down on its rack while bunsen burner must be kept in a closed cupboard. Solid skills of handling equipment and apparatus will facilitate communication, collaboration, problem solving and task completion will result in higher productivity.

Learning Chemistry Is A Means Of Being Grateful To God

Nowadays, spiritual values are seems to dwindling among Malaysians of different races and ethnics. Discipline problems in schools are worsening including social problems which are getting more serious becoming more serious shows collapse of the spirituality in our society. Since then, spirituality values are inculcated in the 21st century skills of Malaysian based on our surroundings and local culture. According to Kamisah Osman & Neelavany Marimuthu (2010), the spirituality include elements such as accepting and respecting the Creator, realisation of the fact that the use of technology improve our ability to use natural resources efficiently, Creator bless and encourage new creation that benefits humans, accepting mankind effort to understand the interaction between people and nature, and religion as a way of life in peace and harmony.

Elements in the spirituality values are wide and easy to be applied in Chemistry subject. The teacher's role is very important in inculcating spiritual elements to students by linking reactions, concepts and theories of Chemistry to the Creator. For example, in the title of the Periodic Table, in order to achieve the objective existence of elements and compounds, students are encouraged to discuss in forum about the state of life without the various elements and compounds on earth. This will bring a sense of gratitude for the gift of Allah that have no limits. In addition, students are also exposed to the arrangement of the elements in the Periodic Table with the increasing proton numbers which will make them realise that Allah is all-powerful in compiling elements systematically and can be explained by science. Thus, the paradigm shift of gratification towards God, can strengthen the spiritual belief and faith towards the Creator.

ISBN: 978-602-73192-0-2

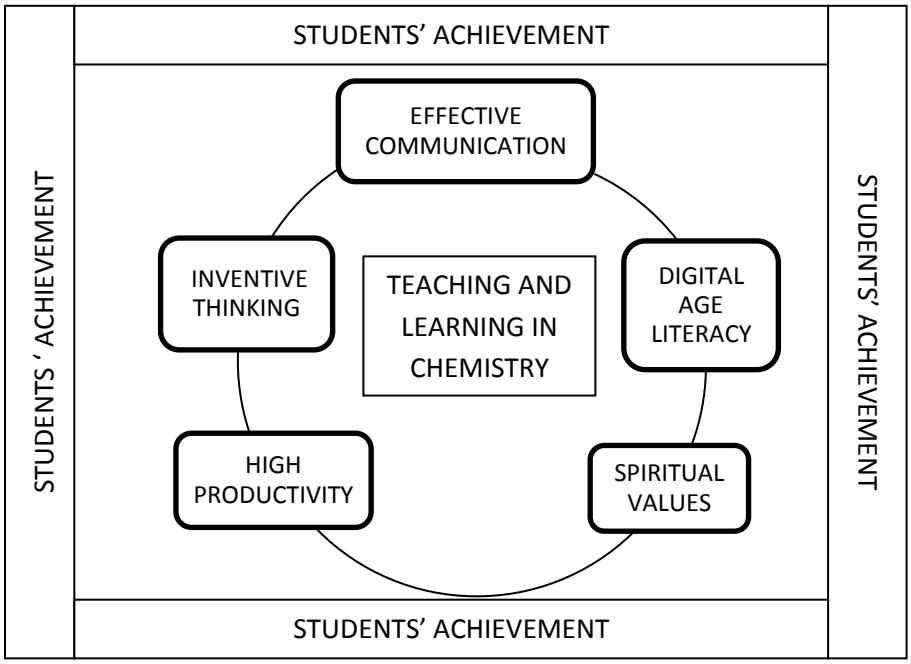

Figure 1 Elements in the 21st Century Skills

Conclusion

The integration of 21st century skills into teaching and learning Chemistry is seen as a suitable alternative to inculcate the elements of 21st-century skills thus improving students' achievement in Chemistry subject. Among 21st century skills that have been adapted to the environment in Malaysia is the digital age literacy skills, inventive thinking, communication skills, high productivity and spiritual values. Each of these skills can be applied in the teaching and learning of Chemistry as the center of science. Some proposals can be put forward to improve the implementation of which are to strengthen the practical skills of Chemistry, the use of computer simulation and the emphasis on STEM education. Therefore, every parties should give their full commitment to realize the implementation of 21st century skills in the teaching and learning of Chemistry to prepare the young generation as the guardian of the nation in the future.

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