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Driving the Agenda of Learning by Design in Science Literacy in Malaysia

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ABSTRACT This article looks at a project that was interested in pedagogical practices in science literacy in secondary schools with a focus on new media technologies and teachers as change agents who will be able to make transformation in schooling and learning in Malaysia. Teachers' views on dominant practices are explored to reveal the difficulties and implications in approaching science literacy in schools. The 'Learning by Design' model is introduced to these teachers, who then set out to design a set of modules that can enhance teaching and learning in schools. The project has encouraged the development of new pedagogical practices and multimodal skills and provided new kinds of relationships to be built among the community of teachers, researchers and students.

Introduction

A new living landscape is emerging where economic, social, and technological transformations are altering every aspect of people's lives. The ever evolving new media technologies and the rising diversities and interests in contemporary societies also transform the practices of literacy and pose tremendous challenges to literacy educators and researchers to rethink their basic tenets, to integrate new media technologies and literacy in creative and productive ways, and to restructure the literacy instruction to respond constructively and progressively to the technological and socio-political changes that we are now experiencing (Kinzer & Leu, 1997; Leu et al, 1999; Kellner, 2003). The new opportunities, risks, and challenges that come into view with each passing year are numerous, and it appears that many of us are still grappling to keep pace with these transformations. The biggest challenge perhaps lies in the domain of literacy, where teachers will have to engage students with extensive knowledge of the world, multimodal skills, and lifelong learning outlooks for this new learning context (Cajas & Gallagher, 2001; Kalantzis et al, 2005).

Like many other countries, Malaysia has experienced turbulent moments and changes in literacy practices which have demanded that teachers rethink the nature of their work and the forms of collaboration and pedagogical practices that will contribute to successful teaching and learning in schools (Sharifah Maimunah, 2003). Malaysia is mindful of the priorities needed to improve the problematic nature of literacy practices (Hodson, 1991, 1992, 2003; Aikenhead, 2003). Highly controversial issues, including whether English should be the medium of instruction in mathematics and science and excessive politicising of schooling matters, have added further setbacks to the pathways of enhancing literacy in Malaysia (Burrows, 2005; Kamisah et al, 2006; Ambigapathy, 2008; Ambigapathy & Shanthi, 2009).

This article presents insights into the endeavour of a community of secondary school science teachers who attempted to transform traditional practices of teaching as they adjusted to changes

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in the turbulent Malaysian educational setting. The first part of the article presents the teachers' current teaching practices in science, and this is followed by a discussion of the intervention strategy taken by the project team to advance the agenda of Learning by Design, and the outcomes of this collaborative inquiry and intervention in enhancing science literacy in secondary schools. This article shares ideas from our project experiences to inspire teachers to embrace a more critical role in better preparing students for living and learning in an increasingly connected and vibrant world in the coming years.

Project Framework and Design

Our first encounter with multiliteracies and the Learning by Design framework began in 2002 and subsequently we became part of the Learning by Design project, which witnessed action research and the designing of modules by teachers in Malaysia and Australia (Kalantzis et al, 2005). In that Learning by Design project, we witnessed a more meaningful approach evolving in the literacy practices in secondary schools, preparing students for twenty-first-century living and learning. Cope & Kalantzis (2000) use the term multiliteracies to focus on the ways in which literacy education will transform and prepare students with skills necessary to be active and informed citizens in present and future societies, and to attend to the disputes created by a changing world in effective ways. They advance that part of the new pedagogy of multiliteracies is the idea that we are designers, and that critical analysis and interpretation of the multiple modes of meaning can lead teachers and students to the 'design of social futures' (Cope & Kalantzis, 2000) in their working lives, public lives, and personal lives.

In February 2008, the project research members, based at the International Literacy Research Unit at the Universiti Sains Malaysia, convened a meeting to discuss what was currently being done in science teaching and learning in secondary schools, and how the Learning by Design agenda could contribute to new methods of teaching and learning science in secondary schools. We linked up with the Ministry of Education and the state education department to generate interest and discussion with teachers in order to understand some of the teaching conventions taking place in science classes. We began the project with a survey to ascertain the realties confronted in science classes. A total of 64 teachers from different parts of Malaysia participated in this study. Capturing the range of activities that were involved in this work raised a number of methodological issues. The research team was more interested in how teachers used the Learning by Design model and the teaching outcomes of this particular project.

We have reported the detailed findings of the survey elsewhere (see Ambigapathy & Shanthi, 2010). In this article, we highlight key findings and the intervention initiatives that we have taken to enhance science literacy in Malaysia.

Teachers' Views on Teaching Practices in Science Classrooms

The findings of the research project on teaching practices in science education revealed the following:

- It was found that 54.7% of the teachers only sometimes and rarely developed resource materials for science lessons, whereas 45.3% always and often developed resource materials.
- On the other hand, 59.4% of the teachers sometimes, rarely and never encouraged peer-to-peer learning, whilst 40.6% said that they often encouraged peer-to-peer learning.
- A large percentage of the teachers (56.2%) pointed out that they always or often did quizzes or tests with their students in class, whereas 23.4% only sometimes did quizzes in class. On the other hand, a small majority of 20.4% revealed that they rarely did quizzes or conducted tests in class.
- In terms of group work, a high percentage (54.7%) of the teachers agreed that they always and often had group work in their class, however 45.3% did not actively participate in group work. In addition, a total percentage of 56.2% of the teachers often allowed students to conduct hands-on laboratory investigations, whereas 43.8% rarely allowed students to conduct investigations in the laboratory.

- More than three-quarters of the teachers (76.6%) were not keen on participating in field trips or having outdoor trips, and only 23.4% actually participated in field trips. In contrast, it was reported that teachers viewed that going to science laboratories and field work increased students' interest and teachers' motivation to teach.
- A total of 64.1% of the teachers agreed that they often used existing social issues faced by the community as examples in their teaching, whereas 35.9% rarely did that.

In short, the teachers used a variety of teaching methods to maintain students' motivation to learn.

We also analysed the frequency of use and the range of multimodal and technology-mediated representations used by the teachers in their science teaching:

- It was found that 61% of the teachers rarely used PowerPoint presentations as a supplement to their science teaching, however 39% said that they used PowerPoint frequently as a form of multimodal representation.
- A total of 43.7% of the teachers used multimodal approaches to show audio-visual presentations – such as videos, CD-ROMs, videodiscs, television programmes, or films – in order to enhance their science teaching. On the other hand, a significant percentage of the teachers (56.3%) rarely used such representations in their classroom.
- More than half of the sample of teachers (54.8%) rarely used word processing, whereas 45.2% of the teachers used word processing in their classroom teaching.
- A majority of the teachers (53.1%) used multimedia learning software packages, such as computer-assisted learning, in their science teaching. On the other hand, 46.9% of the teachers agreed that they rarely used multimedia learning packages.
- In terms of other multimodal representations, such as virtual experiments, a majority of the teachers (67.2%) agreed that they rarely conducted virtual experiments, whereas a small percentage of the teachers (32.8%) did conduct virtual experiments.
- In addition, 70.3% of the teachers agreed that their students only sometimes solved problems using multimedia software, whereas 29.7% of the teachers agreed that they used multimedia software to facilitate their science teaching.

Thus, although students were exposed to multimodal literacy practices, the frequency of their use was rather low.

Intervention: advancing the Learning by Design model

The next part of the project involved locating and encouraging teachers who were interested in initiating change in their pedagogical practices despite the constraints they were facing in their classrooms contexts. The Learning by Design project in science literacy was an especially significant network for locating teachers who were interested in collaborative inquiry and in developing modules for meaningful teaching and learning. The project focused on materials that were part of the Malaysian science curriculum. In this instance, we decided to design modules on environment and conservation issues.

The teachers attended a focus-group discussion prior to the workshop on Learning by Design. The discussion began with an inquiry into teachers' views on initiating change in curriculum matters, as it was deemed important that we map out the structural and attitudinal realities confronted by teachers in schools. We also felt that it was important to appreciate teachers' voices and shared experiences in approaching and transforming science literacy. The main issues that emerged in the discussion were as follows:

Teachers' Work: complex and demanding

The teachers noted that while they were interested in transforming pedagogical practices, much of this work meant additional work and commitment, and not everybody could spare the time and guarantee their presence for the duration of the workshop. The teachers were expected to do parenting work in the school setting, forming relationships with pupils, organising learning and teaching, and managing behaviour in the classroom. The teachers noted that there were intricate difficulties in addressing issues of diversified talents, abilities and competencies in large classrooms

in rural and urban areas. More importantly, much as they were interested in initiating change, they lacked confidence and were very apprehensive about dedicating more time to writing and publishing modules.

Examination-Oriented Curriculum

With time constraints and pressure to produce good results, the teachers resorted to selecting certain conventional topics and paid less attention to other topics such as conservation (which is the final topic in the Form 4 Science curriculum). The teachers further added that the 'exam-oriented education system does not encourage or allow much creativity and innovative in the classrooms'. Furthermore, there was a 'rush to complete the syllabus', thus the 'mass photocopying'. Learning habits of students differ in terms of classes and interest in the subject. The teachers noted that since the curriculum in the schools was examination-oriented, the majority of teachers tended to 'spoon-feed' their students by copying notes on the board and giving them the answers to assignment questions.

Establishing Support Structures

The teachers had mixed views about their abilities to use English to teach science. Many of the senior teachers were trained in the Malay language and had difficulties in delivering the lessons in English. Many of the teachers lacked confidence due to their limited proficiency in the English language and were rather reluctant to present the learning modules and to publish them.

The focus on hearing teachers' voices during the workshop was highly significant and we made a decision to include 10 university English teachers from the School of Languages, Literacies and Translation to do collaborative writing with the teachers so that the learning modules could be published in English. The school teachers worked in pairs and were still in charge of the subject syllabus and content, while the English-language teachers helped to edit the language aspects. This move encouraged the teachers to venture into the module design and publishing activities of the project. When we began working with the project team in designing the modules and in publishing the materials, we forged collaborative interactions and gained insights into the major struggles that the teachers encountered in trying to shape their ideas into the new pedagogical practices as advocated in the Learning by Design model and in publishing the modules.

Transformation: collegiality and collaboration

The voices of the science and English teachers from both the schools and the research university reflected the transformative potential of engaging in literacy research and intervention strategies. We have experienced contestation of ideas, disagreements on pedagogical designs as well as the excitement of having something to say that others value and that can inform the field. We constantly reminded ourselves of the project's concern for improving student learning outcomes. We share the enthusiasm of realising that the process of preparing for and presenting understandings to others transforms and deepens our understandings as well as influences the transformation of others. This potential is one we have personally experienced in our work as researchers and as teacher educators supporting other teachers. Gaining 'voice' with the English and science teachers was critical in securing support for the multiliteracies framework and Learning by Design model in driving the agenda on science literacy. The science teachers who were wary of their English proficiency were not too bothered about the language and grammar aspects as their English teacher counterparts would sit with them and then re-edit the material so that it was worthy of publication and distribution.

Module Design

The next stage witnessed the design of the modules where both the English and science teachers worked in groups and pairs in developing lessons on conservation issues. The science literacy project, after reviewing the responses from both students and teachers on science literacy, found

that the teaching and learning practices of science as a subject in school still adhered to conventional methods of teaching. Teachers were more inclined towards using the chalk-and-board method, the classroom situations were rarely interactive, there was too much dependency on science textbooks, and global science was barely given any attention. Students turned to memorising facts since they could not comprehend them fully, and they could not experience common hands-on science rituals because of time constraints and the emphasis given to completing the syllabus.

With the intention of implementing a more innovative and improved method of teaching and learning science, the idea of creating modules based on the model of Learning by Design was developed. The focus on environmental conservation, a Form 4 topic at secondary school, was selected. This stage of the project aimed to design modules that proposed progressive methods of learning science as well as means of improvising activity-based methods in the classroom. During the workshop, the teachers and project team members explored suggestions for creating more engaging lessons so that students would experience more interest in the subject. The teachers also considered ideas for experiments, field trips, and creative science projects.

There were five states involved in the creation of the modules – namely, Kedah, Penang, Kelantan, Selangor, and Sabah. Each state contributed in coming up with modules based on the topics related to environmental conservation. A total of 48 modules were developed. Each module discusses a specific topic and all these topics come under the umbrella of environmental conservation. The topics include lessons on the rainforest, colonisation, the succession and conservation of mangrove swamps, the conservation of energy, water conservation, the greenhouse effect and global warming, the endangered ecosystem, practising the 3Rs (reduce, reuse, recycle), ozone depletion, environmental pollution, deforestation, 'visit a garden', eutrophication, force and pressure, the methods of controlling industrial waste disposal, air pollution, and the abiotic and biotic components of the environment.

A four-day workshop on multiliteracies and the Learning by Design model was conducted in each of the states: in March 2008 in Penang, May 2008 in Selangor, March 2009 in Sabah, March 2009 in Kedah, and August 2008 and March 2009 in Kelantan. There were trained facilitators present to guide and aid the participants in their discussions on creating 'Sense about Science' modules. When the modules had been completed, they were tested for accuracy and reliability in real classroom situations. Students were then asked to give feedback on whether the modules were useful as well as interesting, and whether the lesson on environmental conservation was found to be interesting and effective.

The modules created are intended as resource materials for teachers and students in the teaching and learning process of science and in improving science literacy. The modules were circulated among selected schools. By doing this, 'knowledge sharing' was encouraged, where schools could share information online or through other means of communication on academic issues, and go forward together hand in hand in the creation of a learned society.

In the following section, we present a sample of selected activities from the collaborative work of the teachers in this project.

In the Learning Element entitled 'Understanding Water Pollution' (see Figure 1), the teachers focus on developing students' scientific inquiry skills through stating the importance of water and identifying the substances that can be found in polluted water. Students are also encouraged to share their knowledge about water from books, the mass media, and their personal experience. In a Learning Element, teachers document learning objectives, the learning activities designed to meet these objectives under the headings of the knowledge processes, and assessment of the knowledge objectives. As seen in Figure 2, the different planned activities are clearly outlined at the beginning of the module to enable teachers and learners to connect teaching and learning to issues on water pollution in imaginative and useful ways.

As seen in Figures 3-6, the learning objective here is to enable students to explain the importance of water to living things and to identify substances that might be present in water. The learning activities include field trips, watching video clips, collecting and testing water samples in the school compound, and identifying substances in the water, as well as delivering talks and speeches and designing brochures on water conservation as part of an awareness campaign in the school.

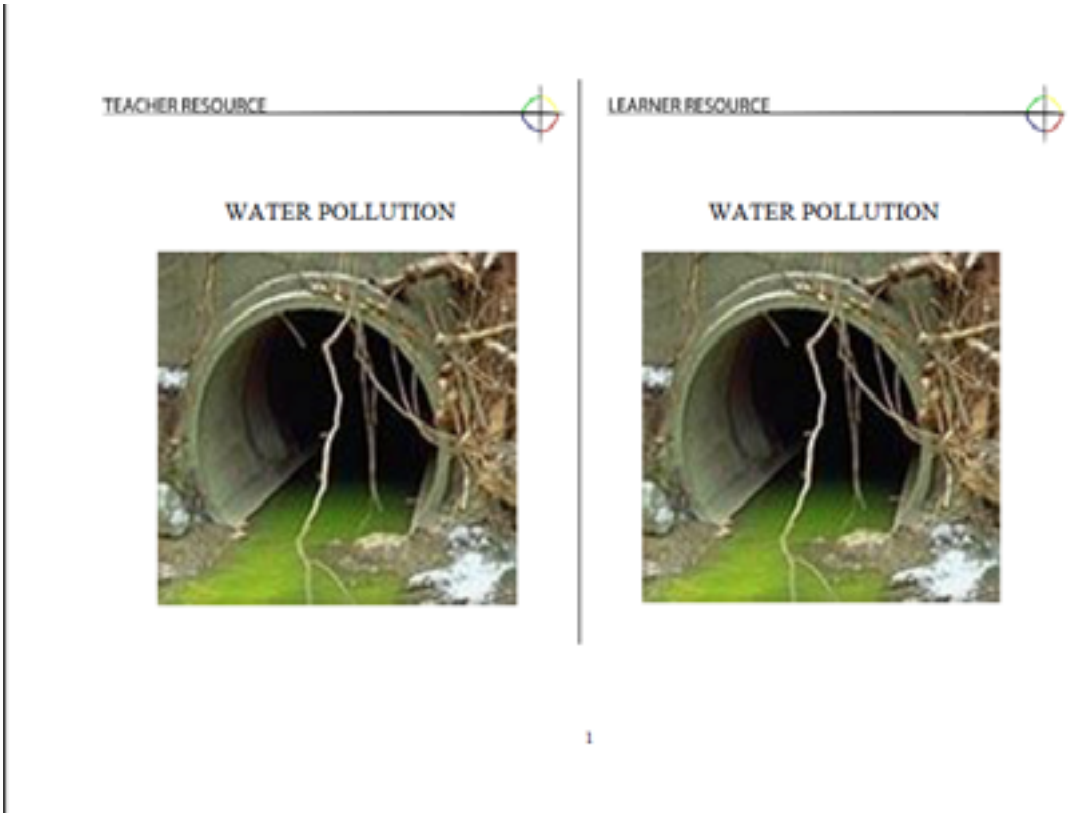


Figure 1. Title page of module: 'Understanding Water Pollution'.

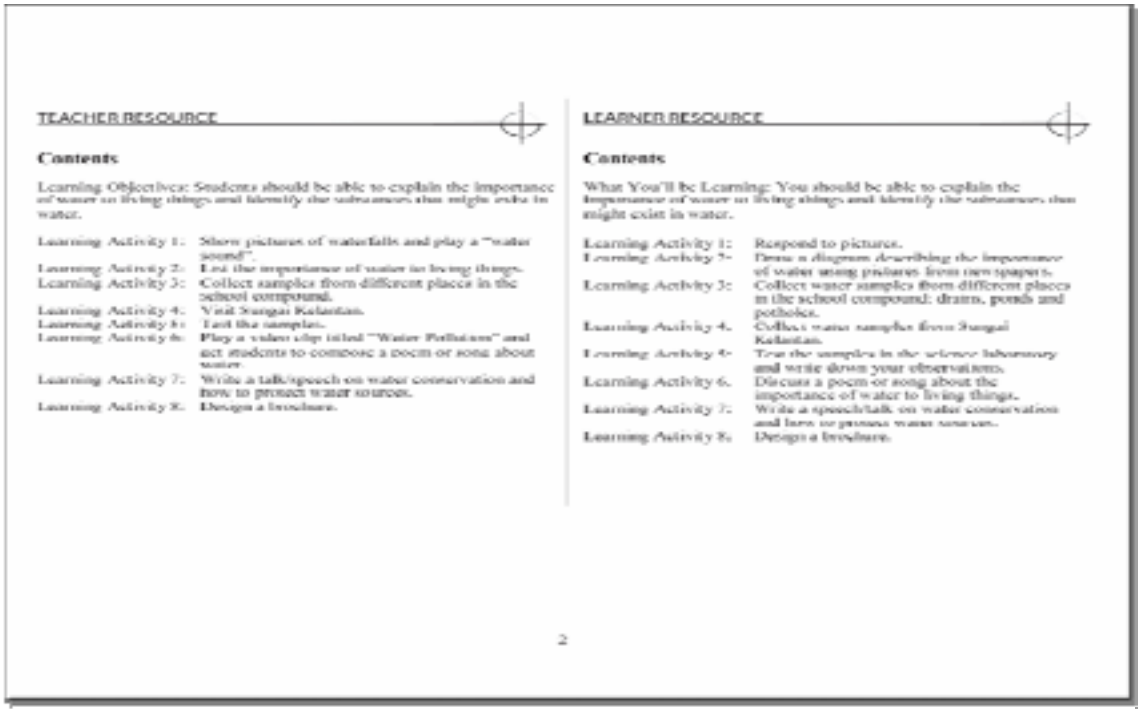
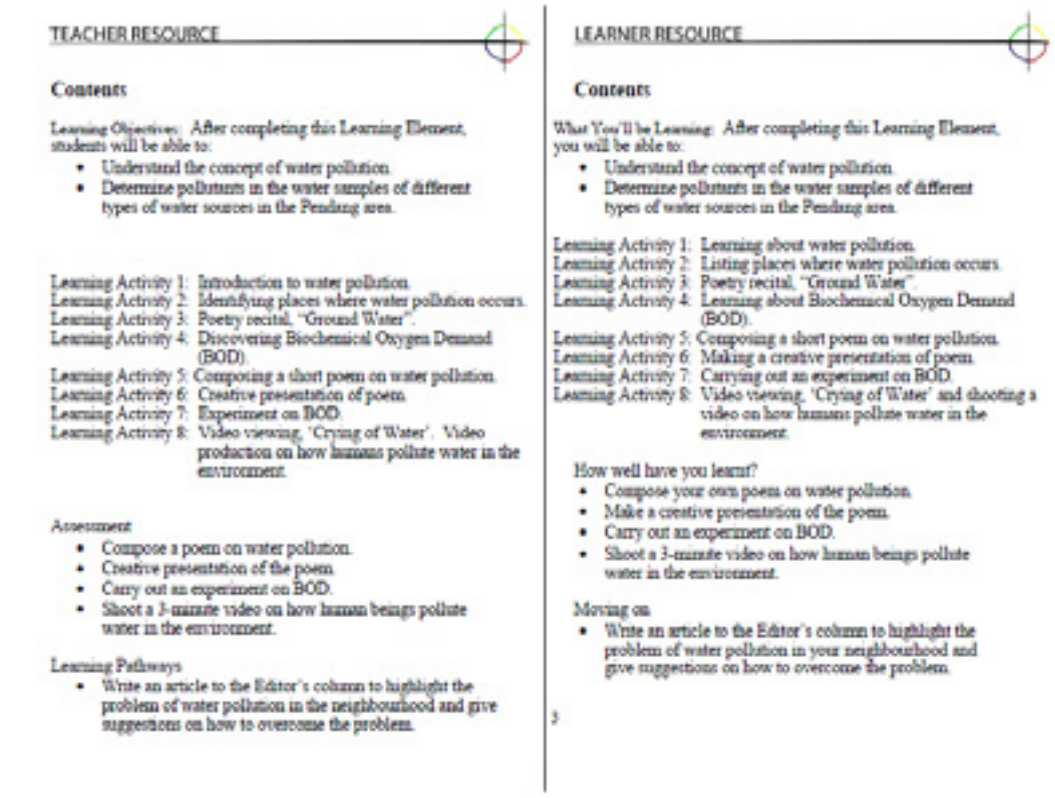


Figure 2. Contents page of teacher and learner resource.



TEACHER RESOURCE

Contents

Learning Objectives: After completing this Learning Element, students will be able to:

- Understand the concept of water pollution.
- Determine pollutants in the water samples of different types of water sources in the Pendang area.

Learning Activity 1: Introduction to water pollution.
Learning Activity 2: Identifying places where water pollution occurs.
Learning Activity 3: Poetry recital, "Ground Water".
Learning Activity 4: Discovering Biochemical Oxygen Demand (BOD).
Learning Activity 5: Composing a short poem on water pollution.
Learning Activity 6: Creative presentation of poem.
Learning Activity 7: Experiment on BOD.
Learning Activity 8: Video viewing, 'Crying of Water'. Video production on how humans pollute water in the environment.

Assessment

- Compose a poem on water pollution.
- Creative presentation of the poem.
- Carry out an experiment on BOD.
- Shoot a 3-minute video on how human beings pollute water in the environment.

Learning Pathways

- Write an article to the Editor's column to highlight the problem of water pollution in the neighbourhood and give suggestions on how to overcome the problem.

LEARNER RESOURCE

Contents

What You'll be Learning: After completing this Learning Element, you will be able to:

- Understand the concept of water pollution.
- Determine pollutants in the water samples of different types of water sources in the Pendang area.

Learning Activity 1: Learning about water pollution.
Learning Activity 2: Listing places where water pollution occurs.
Learning Activity 3: Poetry recital, "Ground Water".
Learning Activity 4: Learning about Biochemical Oxygen Demand (BOD).
Learning Activity 5: Composing a short poem on water pollution.
Learning Activity 6: Making a creative presentation of poem.
Learning Activity 7: Carrying out an experiment on BOD.
Learning Activity 8: Video viewing, 'Crying of Water' and shooting a video on how humans pollute water in the environment.

How well have you learnt?

- Compose your own poem on water pollution.
- Make a creative presentation of the poem.
- Carry out an experiment on BOD.
- Shoot a 3-minute video on how human beings pollute water in the environment.

Moving on

- Write an article to the Editor's column to highlight the problem of water pollution in your neighbourhood and give suggestions on how to overcome the problem.

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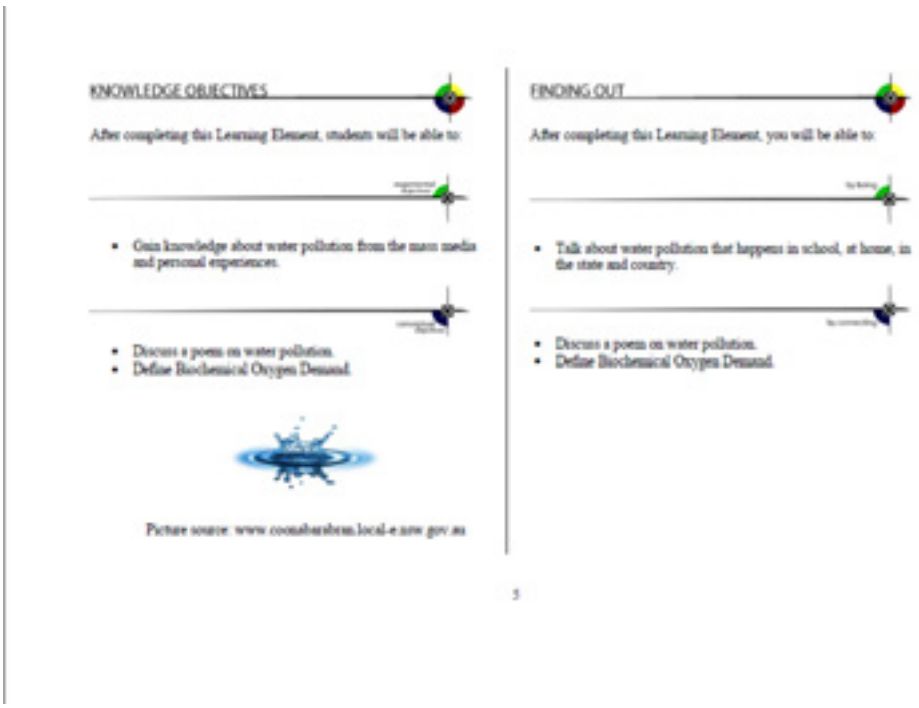
Figure 3a. Contents of teacher and learner resource.



KNOWLEDGE OBJECTIVES

After completing this Learning Element, students will be able to:

- Gain knowledge about water pollution from the mass media and personal experiences.
- Discuss a poem on water pollution.
- Define Biochemical Oxygen Demand.

Picture source: www.coombarabram.local-e.nsw.gov.au

FINDING OUT

After completing this Learning Element, you will be able to:

- Talk about water pollution that happens in school, at home, in the state and country.
- Discuss a poem on water pollution.
- Define Biochemical Oxygen Demand.

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Figure 3b. Designing knowledge objectives (experiential objectives and conceptual objectives).

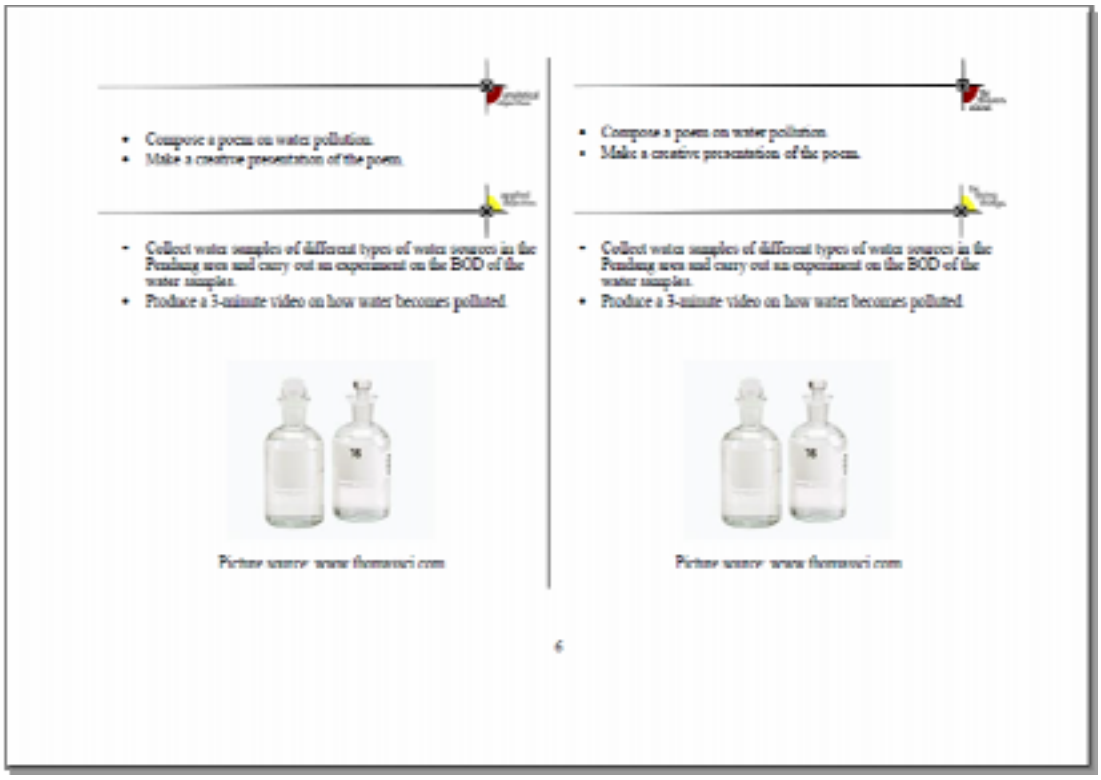

Figure 4. Learning activity.

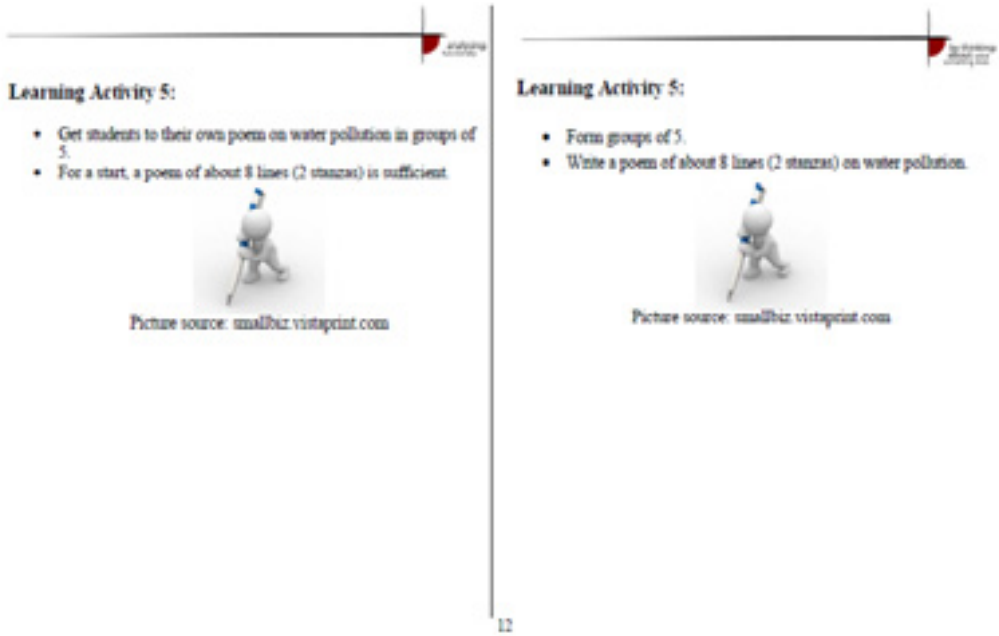

Figure 5. Learning activity 5.

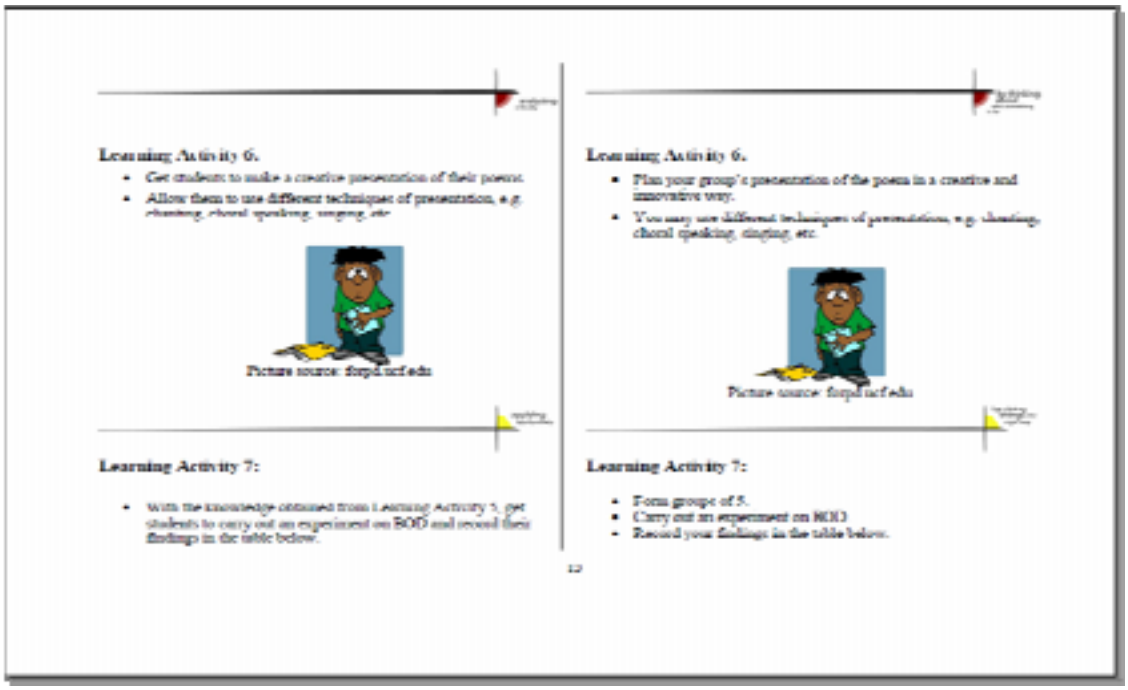

Figure 6. Learning activities 6 and 7.

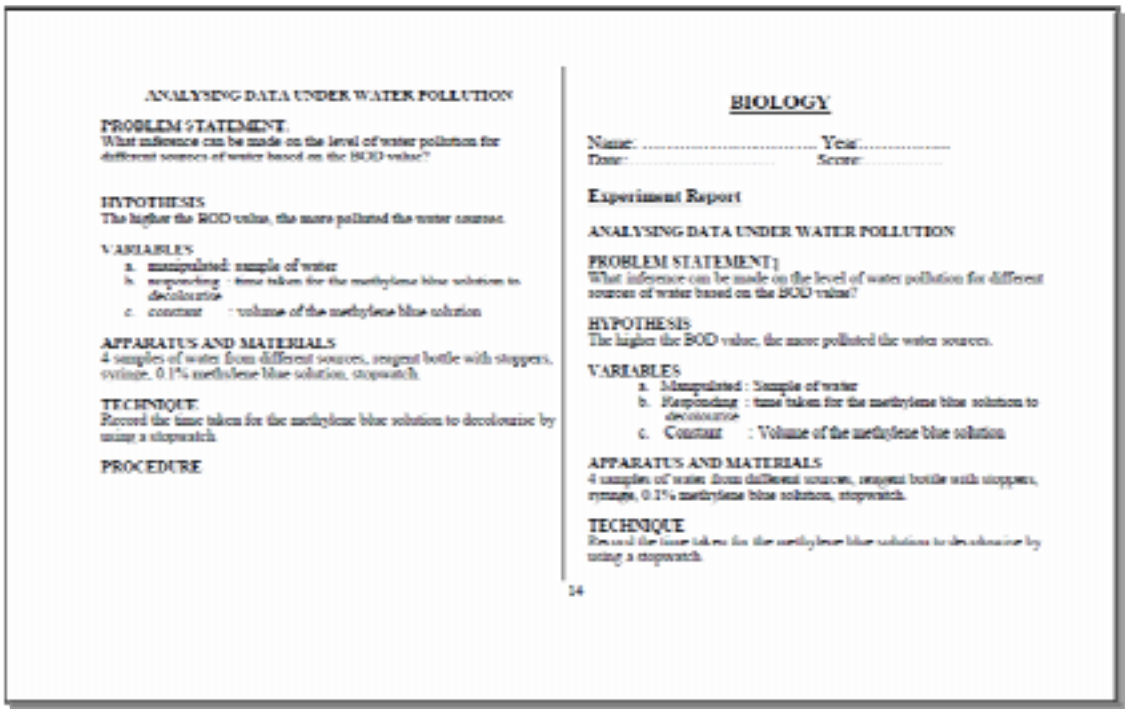

Figure 7. The activity of doing experiments and analysing data.

The activity of doing experiments and analysing data (Figure 7) and the worksheets for the student activity (Figure 8) allow the teachers and students to bring together their knowledge on water pollution in critical and creative ways. Their personal experiences and images from books and the mass media of consuming water for drinking, bathing, washing, and watering many living things, which students can link with sources of water, such as waterfalls, rives, and lakes, allows students

to engage with new ways of connecting to environmental aspects such as survival, nature, and conservation. By undertaking field trips to rivers and collecting samples of river water, they gain a deep understanding of both the harmful and harmless substances in the water. The students then continue by looking at their school compound, collecting water samples in order to examine the substances present in this water. The students provide their perspectives on the causes of pollution and analyse critically what they can do to reduce water pollution in their compound.

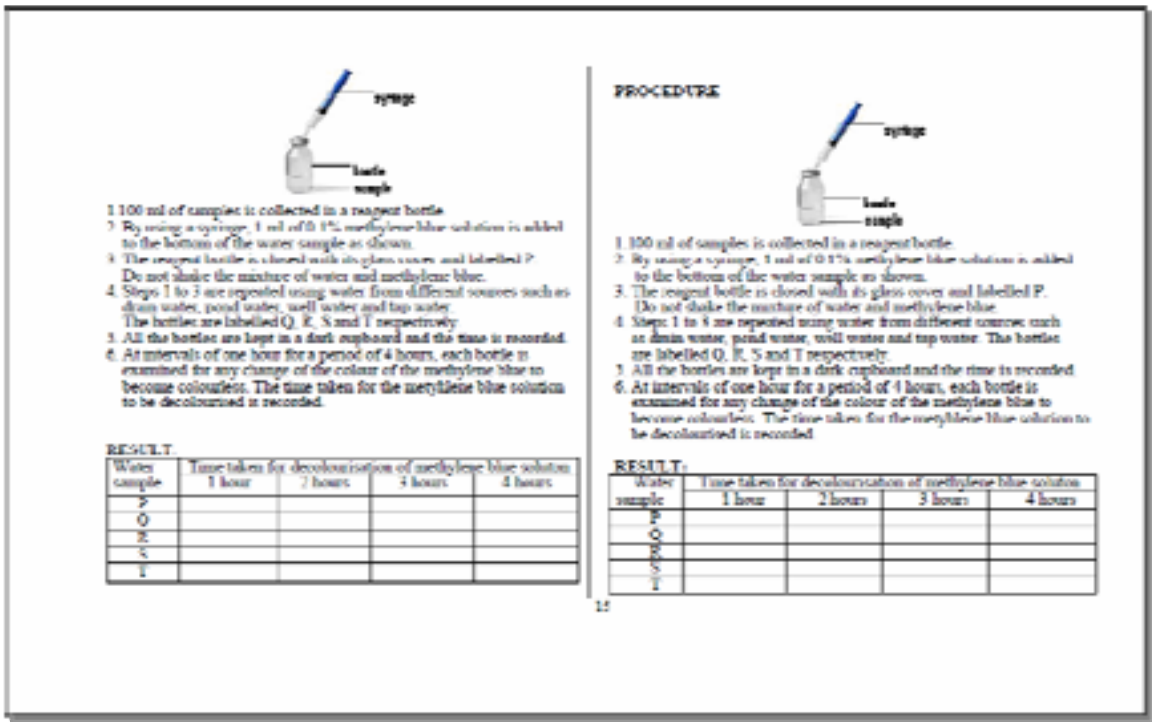

Figure 8. Worksheets for the student activity.

Key Learning Outcomes

The science literacy project witnessed the opening of spaces and the development of opportunities for creative teaching and learning in Malaysian secondary schools. There was a lot of experimentation and risk taking, as there was the possibility of objections from school teachers and parents of students since several of the activities were not seen as 'helpful' in answering examination questions. The teachers and researchers in the project were also not sure if the anticipated activities in science lessons would produce the desired impact on teaching and learning in the classrooms. Some of the key learning outcomes of the project that are noteworthy are outlined below.

Promoting Inquiry and the Writing Process Using Multimodal Tools

Compared to traditional classroom writing practices that use paper-based media, writing and producing screen images, visuals and graphics requires a whole new set of skills that involve inquiry, reading, speaking and writing abilities in new ways. Throughout the project, the Internet, computers, still and video cameras, field trips, craft and design work, and even drama were inserted into classroom lessons through a variety of instructional strategies. The teachers managed to get their students to create video clips, PowerPoint presentations, reports, posters, plays, and placards, and to present their findings in creative ways. More attention was paid to the visual elements, where the creation of slides involved resizing elements, incorporating multiple images on a single slide, changing the font and background colour, and applying animation. This can be seen in

Figures 9, 10 and 11 where the students have used various visuals and graphics in projecting their ideas on their learning experiences.

Figure 9. Students' work: PowerPoint slides on students' reflection on their project experience.

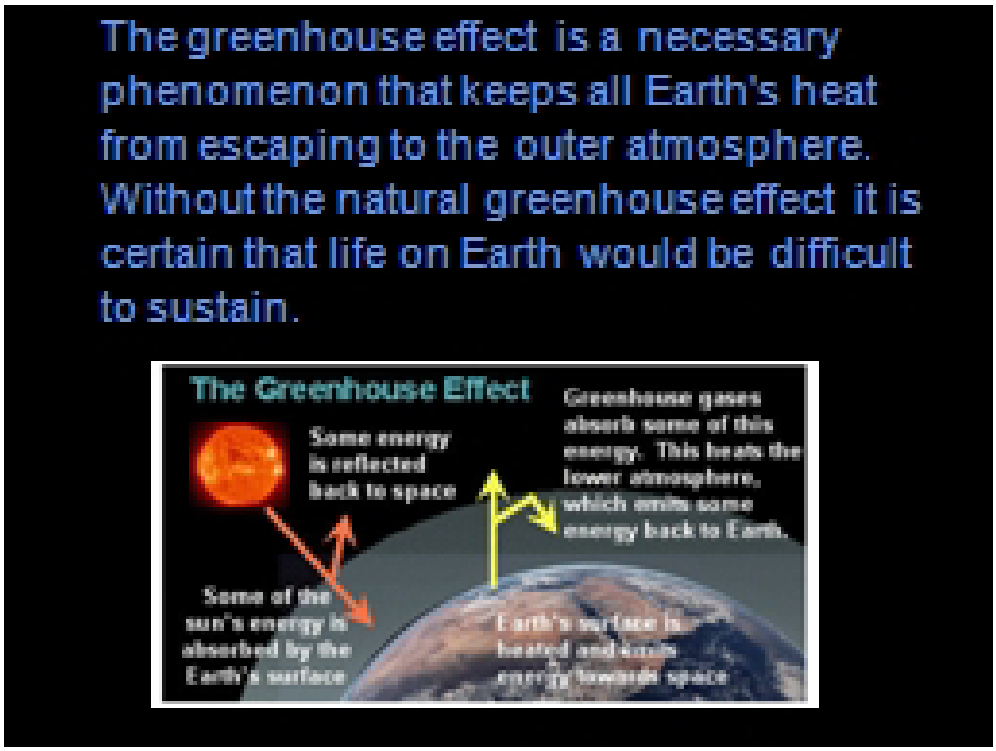

Figure 10. Students' work: using visual elements in their presentation.

Figure 11. Students' work: using visual elements to build narratives on littering.

Class time was spent reporting on research, information collection, and creative work experiences. Fourteen video clips of public service announcements that carried messages about the environment were uploaded onto YouTube and other websites. The students drew their ideas from books, the library, the Internet, and other cultural resources to express their learning. Following the completion of their projects, the students shared, discussed, and exhibited their projects on student talk and social networking sites. The project found that the students mostly noted their ability to present information in ways that made the most sense to them.

The use of diverse media technologies to demonstrate methodical study promoted exploration in science lessons. This approach also encouraged students to generate knowledge in numerous ways that best suited their learning styles. This not only meant a lot of work after school hours, but it also offered opportunities for students to engage in skills involving teamwork, presentation, communication, project management and creative production. More importantly, the Learning by Design model brought a sense of accomplishment and pride to the students as they were able to publish their work on the Internet. In addition, the teachers continued to learn new ways of engaging children in science through exemplary strategies and tools, and noted that some of the students' work really surprised them as it offered new perspectives on students' talent and learning practices.

Creative and Meaningful Learning

For many years in school, the students had been accustomed to the chalk-and-board method of learning and print materials were the dominant form of texts used. They rarely or hardly ever undertook science excursions or field trips. As a consequence, the students lacked exposure to how

science works in the real world. They did not perform experiments and investigations outside the scope of the science syllabus and their reading habits were almost non-existent.

The experience of field trips, doing hands-on investigations, and laboratory work proved to be meaningful as the students were able to use their five senses and connect to their natural surroundings. They were also offered new environments for learning and opportunities for teamwork in the development of skills and understanding. These alternative learning settings were also breaking down the hierarchies between the teachers and students.

The students also noted in their presentations that the learning experiences crossed boundaries, where they were doing science, drama and civics In one project in their biology lesson, and they enjoyed this convergence in their literacy practices (see Figure 12).

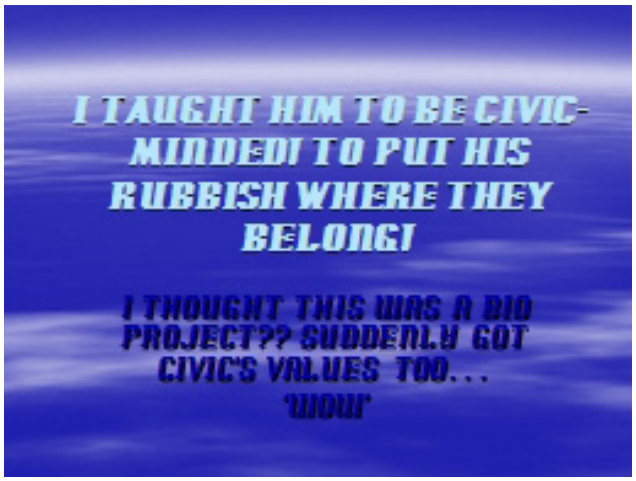

Figure 12. Students' work: crossing subject boundaries.

Bank of Resource Materials and Sharing of Teaching Strategies

Photos documenting field trips to mangrove swamps, rubbish dumps and museums, teachers' and students' PowerPoint presentations, picture galleries and video clips generated a bank of materials that could be used as resources for teachers in subsequent years. Some of these assignments were exhibited in school libraries and halls. The schools also screened the video clips at special functions. Teachers from different schools worked together in organising field trips and contributing teaching strategies that could be used by others. Figures 13 and 14 show some of the materials and resources created in the project that can be shared and used for exhibition and other awareness-raising activities on environmental issues in the schools.

Figure 13. Photo 1: students' work.

Figure 14. Photo 2: student poster presentation.

Developing Critical Inquiry and Thinking Skills

The project teachers employed learning strategies that required students to collaborate, gather data, and propose solutions using scientific and communication tools. By completing these assignments, the students were able to analyse samples from rivers and swamps, and apply the knowledge to building various plant and animal habitats in their local area. The students selected materials for their presentation and making meaning that were appropriate to the science subject matter.

Increased Awareness of Literacy Skills

Most of the teachers and students agreed that the Learning by Design model improved their reading, speaking, observation, and writing skills. They agreed that the model developed their knowledge-seeking and knowledge-making capacities. In addition, the students were also applying multimodal skills by using visuals, graphics, comics, symbols, and YouTube videos in their assignments. The teachers noted that there was a lot of peer discussion and sharing of knowledge among students as they also learned about diverse learning styles and the abilities of their friends in their teams as well as of other communities from different geographical locations and cultures in Malaysia.

Conclusion

This study was interested in pedagogical practices in science literacy in secondary schools with a focus on the integration of new media technologies and teachers as change agents who would be able to make transformations in schooling and learning in Malaysia. The nature of science literacy is a very exciting and evolving one given the changes experienced in the diverse movements in local and global contexts. This study has provided insights into some of the teaching practices that dominate schools and learning, and points to the need for appropriate literacy practices that are relevant to the lifeworlds of young people today.

With collaborating secondary school and university teachers, we designed a project that would enable us to explore some of the ways in which the agenda of Learning by Design as promoted by Kalantzis and Cope might transform science literacy practices in the classroom. Our analysis shows that teachers are instrumental to any pedagogical change and that they are ever willing to improve themselves and enhance science literacy so that student learning outcomes can be advanced.

The project found that the Learning by Design model enabled the teachers to handle science literacy better in several ways. The teachers designed their Learning Elements according to the knowledge processes, and incorporated multimodal texts and experiences that could enrich students' understanding of science topics. As for the students, the learning outcomes were very encouraging as the students engaged in critical and analytical inquiry as well as diverse ways of writing and knowledge-making processes. They demonstrated a high level of motivation in exploring the subject matter and in developing their presentation, project management, and language skills. Both the teachers and students responded to the new literacy practices with keen interest to challenge conservative methods of teaching.

This work suggests that collaborative inquiry and the designing of modules which involved both science and English teachers from secondary schools and the university were worthwhile to the professional development and empowerment of teachers to initiate transformation in school settings. The study also illustrates the significant hurdles to change, as there were issues about teachers' time and role in administrative matters, school politics, and risk taking, and competing perspectives on literacy matters, which posed difficulties for the project team and teachers in initiating changes in science literacy. Continuous and close ties between the project team and the teachers from the participating schools are essential to ensure that the new practices in literacy are maintained.

Nevertheless, this project did not only encourage the development of new pedagogical practices and multimodal skills for approaching literacy in a meaningful context, it also provided the new kinds of relationships and new forms of communication and learning to pave the way for an attainable goal of transformation of literacy practices.

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