Authentic Learning Approach in Science Education

Pendekatan Pembelajaran Autentik dalam Pendidikan Sains

Vijaya Letchumy Baskaran[1] & **Norazilawati Abdullah[2]**

[1]Pejabat Pendidikan Daerah Manjung, Kementerian Pendidikan Malaysia, Sitiawan, Perak, MALAYSIA
[2]National Child Development Research Centre, Universiti Pendidikan Sultan Idris, Tanjong Malim, Perak, MALAYSIA
[1,2]Faculty of Human Development, Universiti Pendidikan Sultan Idris, Tanjong Malim, Perak, MALAYSIA

**Corresponding author: vijayaletchumy78@gmail.com*

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ABSTRACT

In this paper, the integration of authentic learning approach in science education have been discussed based on Herrington's Authentic Learning approach. The nine elements are authentic tasks, authentic activities, expert views, multiple perspectives, collaboration, coaching and scaffolding, reflection, articulation and authentic assessment. These elements are integrated in the Science education to deliver meaningful lessons. In particular, the author had been able to propose a sample lesson plan for Year 6 Science subject. It consists of authentic context, authentic assignments, easily accessible learning sources that are realistic and tangible and freedom for the students to express their views and interpretations. The sample lesson plan is a practical implementation based on the Nine Elements of Authentic Learning Approach by Herrington & Herrington (2006). Together with proposed activities, teachers are able to plan and carry out their Science lessons more effectively with their students in order to produce more meaningful learning process. Authenticity in learning helps students to be more responsible and provide students a learning environment that they can be active learners, since the learning is altered to their profile.

Keywords: Authentic learning, Authentic Assessment, Science Education, Teaching Approach

ABSTRAK

Pengintegrasian pendekatan pembelajaran bermakna dalam pendidikan sains berdasarkan Pembelajaran Autentik Herrington telah dibincangkan di dalam artikel ini. Sembilan elemen dalam Pembelajaran Autentik ialah tugasan autentik, aktiviti autentik, melibatkan pandangan dari pakar, pembelajaran dilihat dari pelbagai perspektif, kolaborasi, bimbingan, refleksi, artikulasi dan pentaksiran autentik. Elemen-elemen ini disepadukan dalam pendidikan Sains untuk menyampaikan pengajaran yang bermakna. Secara khususnya, penulis telah dapat mencadangkan contoh rancangan pengajaran mata pelajaran Sains Tahun 6. Ia terdiri daripada konteks autentik, tugasan autentik, sumber pembelajaran mudah diakses yang realistik dan ketara serta kebebasan pelajar untuk menyatakan pandangan dan tafsiran mereka. Contoh rancangan pengajaran adalah pelaksanaan praktikal berdasarkan Sembilan Elemen Pendekatan Pembelajaran Autentik oleh Herrington & Herrington (2006). Bersama-sama dengan aktiviti yang dicadangkan, guru dapat merancang dan melaksanakan pelajaran Sains mereka dengan lebih berkesan bersama pelajarnya bagi menghasilkan proses pembelajaran yang lebih bermakna.

Kata Kunci: *Pembelajaran Autentik, Pentaksiran Autentik, Pendidikan Sains, Kaedah Pengajaran*

INTRODUCTION

The most significant change that is happening in the world of education is the defined curriculum and the technology used. The paradigm shift that occurs had caused education to be no longer defined in terms of what a teacher will be able to teach but rather conforming to what a student will be able to demonstrate, which it explains that instructional strategies chosen must conform to the students rather than the teachers.

Malaysia is now trying hard to modernize its education system to compete with other industrialized countries. It aspires to develop students who will be able to compete in the global marketplace (Baskaran & Abdullah, 2021). Thus, for it to become a reality, teachers, as the primary implementers of education, carry a significant amount of responsibility for achieving that aim.

In response to rising international education standards and the desire to better prepare Malaysia's children for the needs of the twenty-first century, the Malaysian government has developed the Malaysia Education Blueprint 2013-2025 (Kementerian Pendidikan Malaysia, 2012), which incorporates 11 strategic and operational shifts. The Blueprint aspires to achieve five outcomes for the Malaysian education system as a whole: access (i.e., 100 percent enrolment across all levels from preschool to upper secondary by 2020), quality (i.e., top third of countries in international assessments such as PISA and TIMSS in 15 years), equity (i.e., 50 percent reduction in achievement gaps: urban-rural, socioeconomic, and gender, by 2020), and unity (i.e., an education system that gives children shared values and experiences by embracing diversity), and efficiency (i.e., a system which maximises student outcomes within current budget).

As presumed by Ong et. al (2017) when youngsters participate in projects in which they do studies and/or participate in creation or innovation related to their particular questions, their intellectual talents are more likely to be stimulated and used as agreed by Helm & Katz (2001), Katz (2010) and Katz & Chard (2000). Furthermore, participation in projects places children in an active and interactive role in which they take responsibility and initiative in inquiring by generating questions to the one they want answers; exploring by collecting relevant data or information culminating in a suitable design or procedures; investigating based on the procedures or inventing based on the design; and showcasing or reporting their work and it will be more worthwhile if it is relevant to their daily life experiences.

Teachers now carries a huge responsibility of knowing what students know prior to incorporating new knowledge and how it can best to mirror the situation that is related to their daily lives. When students can take on the role of professionals and generate new scenarios that improve knowledge transferability, the education system is revolutionized (Baskaran & Abdullah, 2021). Therefore, enters Authentic Learning approach. Authentic learning approach is a strategy that mirrors the challenges and situation that will be faced by the students in their future workplace during their learning sessions at schools. According to Herrington et al. (2010), the more teaching and learning activities that engage students to real-life circumstances, the better their knowledge and abilities will be and the more relevant their learning will be.

AUTHENTIC LEARNING

Authentic learning approach originated from a constructivist approach where it is based on some common assumptions like complex, challenging learning environments, authentic tasks, multiple representations of the content delivered and an understanding that knowledge is constructed while learning is carried out via student-centered instruction (Latham & Carr, 2012). According to Herrington et al. (2014), authentic learning is an approach where it aligns classroom learning with the real-world environments. It is created by researching qualities that focus on real-world applicability over a lengthy period.

Har (2013) had indicated that authentic learning is an educational strategy that pushes students to address real-world issues in order to improve student motivation, give greater learning chances, and prepare them for an unpredictable future. The design of authentic learning is to facilitate the comprehension of complex concepts and blending theories and learning to make it more meaningful.

The authentic learning approach is not as straightforward and easily comprehended by teachers and students as normal standard of learning. Authentic learning approach employs high-level learning in complex problem-solving situation where it enables students to incorporate their experiences and knowledge, beliefs and interests in the classroom. This situation will help students to structure their knowledge rather than routine rote-based information. This learning environment enables students to apply concepts and theoretical information obtained in school to real-life situations. Students are not only trained, but they may also immediately link their theoretical knowledge with real-life duties, resulting in a one-of-a-kind experience, although in an unexpected way. The more students are exposed to real-life situations in authentic learning, the more likely they are to feel that their knowledge and abilities will increase and that every problem will be handled using multiple techniques. Lombardi (2007).

According to Lombardi (2007), in a classroom that incorporates an authentic learning approach, students are more exposed to real-life environments, where they behave more responsibly and believe that their knowledge and skills can be used to improve and solve any problem that their teachers have presented to them. There are certain attributes that must be adhered to when authentic learning is applied in the teaching and learning strategies. Here in this article, authentic learning design that is being discussed followed Herrington's Authentic Learning Principles (Herrington, J., Parker, J. & Boase-Jelinek, D. 2014) that consist of 9 main principles that must be adhered to:

a) Provide authentic contexts to ensure knowledge can be applied in the actual contexts.
b) Creates authentic learning activities that are relevant to the real world and complex assignments that need to be completed based on a prescribed duration.
c) Exposing students to the expert performances
d) Encouraging students to explore multiple perspectives and diverse roles.
e) Collaborate with another to help develop knowledge.
f) Reflect on the problems and their solution
g) Articulating discussions among students
h) Coaching and scaffolding
i) Carrying out the authentic assessment.

In a learning environment that executes authentic learning approach, students are required to resolve real-life tasks, develop interdisciplinary perspectives, produce various solutions to issues that can be researched with various methods, collaborating with peers and improving self-awareness about learning levels while reflecting on the outcomes. Authentic learning approach will allow students to resolve real-life problems that is related to the topics being taught. This will help in retaining the knowledge and skills learnt during the learning process and allowing them to identify ways to connect to the real world surrounding them. Only through authentic context and task, the new approach of integrating authenticity in the teaching and learning strategies can be achieved.

According to Yahaya et al. (2017), although authentic learning was originally presented in the 1980s, it was not completely implemented since it was difficult to bridge the theoretical foundation and practical instruction. This is also agreed upon by Herrington, Reeves, and Oliver (2006); Rule (2006); Stein, Isaacs, and Andrews (2004), since there is a significant gap between classroom learning and real-life learning. The gap can only be bridged by providing students with an authentic learning environment, which will allow them to associate with real-life activities and traditional schooling.

Authentic Learning in Science Education

Science taught in an isolated context will create a situation where the feeling of irrelevant, impractical, not close, and different from their lives among the students. Therefore, the love towards Science education will be hindered. It will then have a huge impact towards students' learning and interest. This statement is supported by Sabudin et al., (2020) that discussed the situation when the students do not feel a part of Science, therefore Science will not become a part of their identity and later become disengaged from learning Science altogether.

Science education is important for prior knowledge, abilities, interests, and competencies of the students because the process of understanding science as a part of their daily lives could provide a significant foundation for their achievements in real life (OECD, 2012). Meanwhile, in Malaysia, science curriculums are constantly changing, and these changes are necessary because Malaysia is a growing country that must keep up with the world economy's rapid developments. Science education has received special attention in Malaysia since it is seen as an area of the curriculum that is most likely to generate a supply of scientific and technical workers for the country's economic growth (Halim and Meerah, 2016).

When Malaysia initially participated in TIMSS in 1999, the average score of its pupils in both Mathematics and Science was higher than the international average score. However, in 2011, the system's performance fell below the international average score in both Mathematics and Science, resulting in a corresponding decline in ranking. In 2011, 35% to 38% of Malaysian pupils failed to attain the minimal competency levels in Mathematics and Science (MOE 2013). These kids were found to have a weak understanding of basic Mathematical and Scientific concepts. PISA 2009 results were likewise dismal. Malaysia was ranked 55th out of 74 participating nations, much behind the worldwide and Organization for Economic Cooperation and Development (OECD) averages. Almost 60% of Malaysian 15-year-old pupils who took PISA did not exceed the required competency level in Mathematics. Malaysian pupils struggle with higher-order thinking skills, as evidenced by the TIMSS and PISA international assessments.

Nonetheless, despite a lower overall worldwide average, Malaysia improved greatly in all three PISA literacies in the most recent PISA 2018 findings. Malaysia's performance based on mean scores demonstrates that our education system is on the right track, since the results are approximating the Organisation for Economic Co-operation and Development (OECD) average.

According to OECD (2012), when students are included in the process of understanding that science is a part of their daily life, it can provide a significant foundation for their achievements in real life. The science curriculum must be able to integrate higher-order thinking skills and allow students to invest in their competencies that can help them to tackle scientific issues and ideas needed by them to reflect, participate in active learning, associate prior knowledge and later explore novel knowledge that is being taught by their teachers.

Due to scientific and technological breakthroughs, Malaysia's science curricula have been updated several times. Various strategies and approaches have been integrated in the new curricula in order to allow meaningful and authentic learning in a student-centred learning environment. Many of the changes implemented by the MOE are aimed at improving the quality of STEM education through improved curricula and retraining of scientific educators. This has been stated in the latest Malaysia Education Blueprint 2013-2025 (MOE 2013).

Malaysia, which is on its way to becoming a developed country, should construct a scientific, progressive, imaginative, and prescient community, not only as a beneficiary of cutting-edge technology, but also as a contributor to the future creation of scientific and technological civilisation. To attain this goal, we must cultivate a critical, creative, and knowledgeable citizenry that values science and technology. Implementing authentic learning method as an instructional approach will facilitate the process of introducing real-world experiences in the classroom (Banas & York, 2014;

Lombardi, 2007; Semerci & Yelken, 2010) that is vital in preparing students to become a knowledgeable citizen that can contribute to the future of scientific and technological civilisation.

Globe (2021) and Johnson et al. (2012) had emphasised that students must be well prepared to investigate the problems that arise in their lives by familiarising themselves with authentic tasks given to them based on the science curriculum. Only through authentic learning approach, students are able to understand the real world and real-life problems. Authentic learning needs authentic context, since to experience authenticity in scientific research process, Roth (2012) had suggested five approaches that student must go through.

These approaches have been derived to mimic the processes that a scientist must go through in their days while handling and understanding the scientific concepts. The steps are:

i. Students will learn about real-life problems in their current environment.
ii. Students experience the nature of scientific work and knowledge with uncertainty and doubt in their minds
iii. Students will be learning in compliance with the curriculum based on the current and prior knowledge level of students and will determine the activities that they would develop.
iv. Students will be able to consider themselves as part of research groups where knowledge, applications, resources and discourse are shared.
v. The research group that they are involved will allow them to draw on the expertise of other more knowledgeable individuals, including peers, mentors or teachers.

Allowing students to experience these five processes to conduct research in groups and create permanent learning environments with activities that have been designed with authentic learning approach will enable them to master skills such as identifying the problems around them and alter will create solutions to overcome it. During the process itself, they will be able to experiment with their ideas. Students will be able to design their own operational steps and come out with suitable data analysis methods. Based on the problems that they have been presented with and prior knowledge, they will be able to formulate new questions. Authentic learning will allow students to associate their experiences with various activities, scientific concepts along with other scientists. Sharing and discussing the operational steps, their own research findings and solutions will help in empowering the students to be responsible in their learning sessions.

Creating authentic learning situations while teaching Science, requires teachers to play an important role in managing the authentic learning environment and in the development of authentic activities associated with the science course topics. These teachers have a huge responsibility in designing, implementing and guiding authentic learning environments, and in in-depth reflection, emphasizing other dimensions and providing feedback to the students (Bhagat & Huang, 2018). Authentic learning will encourage students to solve problems and express themselves based on their knowledge and social skills.

Several authors have presented a few principles for applying an authentic learning model, including the model established by Zemelman et al. (2005), Lombardi (2007), Donovan, Bransford, and Pellegrino (1999), and the model used in this work, Herrington and Herrington (2007). They incorporate various essential ideas, such as authentic tasks (learning material), authentic learning sources, the relevance of the community role, authentic activities, flexibility in forming interpretations, and the kind of assignments.

Learning materials must be authentic, real, and relevant to contemporary situations, as well as suited for students' learning styles and best goes with students; family, or local leaders. Interviews, observation, and fieldwork can all be used to gather information for the students. The communal component is critical, as students are encouraged and permitted to make comments, make plans, and undertake evaluations regarding concerns affecting the community. Students will be able to exhibit their works or assignments to the public and build goods that may be shared with the community if

they have a good relationship with the community. Connecting with the community will assist students in gaining actual, relevant information that will assist them in completing their tasks.

Authentic activities will highlight inquiry-based activities that may help students develop their knowledge and abilities, as well as the utilisation of suitable scaffolding of learning activities. Students will have more opportunity to employ their interpretations in accomplishing their tasks if they are given real projects to complete. It also requires students to engage in higher order thinking abilities, challenging activities that require students to solve within a specific time frame, and to be more prepared to complete authentic assessments.

Nine Elements of Authentic Learning Approach by Herrington & Herrington (2006) and the proposed authentic teaching and learning activities in science education.

Table 1: Nine Elements of Authentic Learning Approach by Herrington & Herrington (2006) and the proposed authentic teaching and learning activities in science education

No	Item	Guidelines for designing and implementation of learning environment	Example of Learning Materials
1	Authentic Context	▪ In real life, a physical setting that represents the information should be employed. ▪ A learning environment that mirrors how the information will be used in the end. ▪ Students will be given a challenging scenario. ▪ Real-world problem and students' actual surroundings ▪ A huge amount of materials to allow for extended analysis from a variety of perspectives.	Presenting a situation where a person is choking (digestive tract) and the connection with the person's breathing (respiratory system). *(Science Year 5)* Students will be asked to observe and conceptualise the sample modelling challenge or problem to the level appropriate the need to acquire more (theoretical) information to get acquainted with the topic at hand.
2	Authentic Activities	▪ Activities with a real-world application ▪ Ill-defined activities ▪ A continuous period of research ▪ Tasks that can be combined across topic areas ▪ A chance for students to define the tasks needed to accomplish the activity. ▪ A period of research that lasts for a long time ▪ The possibility of collaborating together.	Analysing the electricity usage at home by calculating monthly electric bills. *(Science Year 5)* Students will be required to analyse the approach used in actual practise in response to reported queries or difficulties, so that they are aware of the what, why, and how experts operate, as well as the types of answers they seek.
3	Expert Performances	▪ Availability of expert thinking and modelling methods ▪ Access to learners at varied levels of skill ▪ Possibility of exchanging	Presenting a situation where broken bones will swell because of disruptions in the blood circulation *(Science Year 5)*

		narratives and stories.	A medical practitioner will be invited to listen to the explanation by the students. A small project by the students evaluated by an expert in the field.
4	Multiple Perspectives and differential views	▪ Different perspectives on the themes from various points of view, as well as the possibility to voice different points of view through collaboration. ▪ The opportunity to express different points of view through collaboration	Explaining on advantages and disadvantages of technology usage in their daily life. *(Science Year 6)* Students must determine for themselves which main difficulties or problems exist in authentic practise with the above-mentioned subject, so that they get engaged.
5	Collaboration	▪ Tasks that are directed towards a group rather than an individual. ▪ Appropriate incentive structure for overall group success ▪ Classroom structure ranges from partnerships to small groups. ▪ Appropriate incentive structure for overall group success.	Solving issues that they may face in the daily lives: blocked sink. (Knowledge on air pressure) *(Science Year 6)* Students will be required to analyse the approach used in actual practise in response to reported queries or difficulties, so that students understand what, why, and how professionals operate, as well as the kind of answers they strive for.
6	Reflection	▪ Students will have the opportunity to think about, reflect on, and discuss their options. ▪ Students will be able to compare themselves to other students at various stages of achievement. ▪ Opportunity to reflect on online journal books and materials read or listened to ▪ The ability for learners to compare themselves to other learners at various stages of achievement. ▪ Collaborative groups of pupils to allow for reflective awareness.	Explaining their observation on friction through sketching, writing or verbally creatively. Students will be asked to come up with ways to reduce or increase friction in daily use. *(Science Year 6)* Students will define and schematize the topic at hand in order to activate their pre-existing knowledge base.
7	Articulation	▪ A chance for students to write and talk on their grasp of a subject or issue.	Generating ideas about impact on maintaining and Conserving animals and plants

		▪ Students defend their views in a general presentation. ▪ Using a social media platform to share their thoughts ▪ Argument presentation in public to facilitate for articulation and defence of learning.	that are under threat of extinction. (Science Year 6) Using social media to raise awareness. Students must be able to speak creatively and innovatively about the work involved in preserving and improving and preserving the environment for long-term environmental sustainability
8	Training and Scaffolding	▪ Knowledge transmission is not the primary problem in an open-ended learning environment. ▪ Teachers would concentrate not just on teaching but also on assisting pupils in creating knowledge and correcting errors. ▪ Partners can help with scaffolding and coaching in collaborative learning. ▪ Recommends that the instructor administering the programme be available for coaching and scaffolding support for a significant portion of the time the programme is in use.	Observations on the application of air pressure through activities such as: (i) A cup containing water covered with hard cardboard (ii) A bottle containing water tightly closed and punched a hole in the bottom of the bottle. Students will observe and conceptualise the sample modelling topic or problem to the point where they feel the need to get more (theoretical) information in order to become acquainted with the subject at hand with the guidance of the teacher.
9	Authentic assessment	▪ Complex, ill-structured issues that need judgement and a wide range of activities ▪ Assessment that integrates effortlessly with the activity ▪ Multiple learning criteria. The ability for pupils to be competent performers with acquired information to construct polished performances or outcomes. ▪ Validity and dependability, as well as adequate criteria for assessing various items.	Generalizing that food can be preserved by combining more than one method of preservation. (Science Year 6) Assessment will be carried by looking into the product of food preservation. Students will discover for themselves whatever key difficulties or challenges exist in actual practise concerning the above-mentioned area, which captivates their attention.

Therefore, it was observed that authentic learning requires students to solve real life problems together with their peers. Providing authentic task will help students to benefit from and implement the acquired knowledge in a different field. Having exposed to authentic task will allow them to associate their academic and personal lives. Authenticity in learning will help in bridging the knowledge acquired in the classroom and the employment of this knowledge in real world.

The table below shows the sample of Science Year 6 lesson plan based on the Authentic Learning approach by Herrington & Herrington (2007). The lesson plan had been drafted using the latest Science Curriculum Standard Document for Year 6 (2021 Edition)

Table 2: Sample Lesson Plan

Year	6			
Subject	Science			
Title	Force			
Content Standard	6.2: Force			
Learning Standard	6.2.3: Experimenting to determine the factors that affect friction			
Learning Objectives	Students will be able to identify 2 factors that contributes to friction Factors affecting friction: (i) The mass of the object. (ii) Type of surface			
SBA School Based Assessment Indicator	Performance Level (Tahap Penguasaan): 5 Solving problems by applying knowledge in appropriate ways to increase and decrease frictional forces			
Steps	**Learning content**	**Authentic Element**	**Activity**	**Note**
Set Induction	Rate of accidents are at alarming rate.	Authentic context	Students will be given few newspaper cuttings on major accidents	Brainstorming session on how does accident happens.
Step 1	Discussion in depth on how an accident happens	Expert views	Students will be communicating or listening to briefing by policeman and fire fighter from the neighbourhood regarding the causes and contributing factors of accidents	Q & A session with the experts will allow students to understand further that many factors must be looked into to prevent accidents from happening.
Step 2	Discussion on prevention of accidents by looking into factors causing it: Friction	Authentic activities Collaboration Coaching and Scaffolding	Students will carry out experiments by watching Youtube video and guidance by teachers to identify the factors that contribute to friction: Mass of Object and type of surface	Experiments carried out using different weight and types of surface to identify the best situation that can prevent and reduce accidents.

			Students will identify the factors by trial and errors.	
Step 3	Teacher will give a real -life situation to the students and ask them to come up with ways to reduce friction	Authentic activities Multiple Perspectives and differential views Authentic assessment	Group work: Each group will be given different situation that causes accident 1. Slippery road 2. Patterns on the tyre surface 3. Different types of vehicle eg: trailer, car, lorries and vans	Each group will come out with the best way to reduce friction and later will reduce the number of accidents.
Step 4	Students will be presenting their findings to the teachers and friends	Articulation	Teacher provides support and help the to correct any mistakes during the presentation	
Step 5	Presentation and exhibition on the students' findings will be carried out in front of experts invited: Firefighters and policemen	Reflection Articulation Authentic assessment	Expert views will be given while presentation by the firefighters or policemen	Re-evaluating students learning by carrying out the following activities – Reflection – Question and Answer – Expression of Feelings

CONCLUSION

It is obvious from the lesson plan above that the teaching process employing the genuine learning approach provides pupils more independence. They are given more freedom in designing their learning environment. The process of learning must be implemented in the actual situation that is most suited for the students' learning requirements in an authentic learning method. Contextualized assignments can be used to simulate real-world situations. The assignments should be inquiry-based with explorative learning activities that provide students with meaningful learning experiences and freedom in learning while also allowing them to take an active role in the community.

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