



## Improvement of Content and Proposed Infrastructure Based on E-Stream Technology Module: Aquatic Science

Mohd Razimi Husin<sup>1</sup>, Romarzila Omar<sup>2</sup>, Nordin Mamat<sup>3</sup>

<sup>1,2,3</sup>Universiti Pendidikan Sultan Idris

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**ABSTRACT:** The implementation of the Smart KEMAS Kindergarten STREAM (e-STREAM: aquatic science) module is a strategic initiative to strengthen integrated learning of science, technology, religion, engineering, arts and mathematics (STREAM) in early childhood education. However, although this module has been expanded nationally since the pilot project in 2018, internal implementation reports show that there is inconsistency in the use of the module, variation in the quality of digital content and technological infrastructure constraints between KEMAS kindergartens in various states. This situation raises questions about the level of consistency and effectiveness of the overall implementation of the e-STREAM module. This study uses a Needs Analysis approach with a mixed-method explanatory design to identify gaps in digital content, technological infrastructure and technological pedagogical coherence in the implementation of the e-STREAM module. Therefore, this framework provides a strong theoretical and operational foundation to support the study objectives in designing improvement proposals that are evidence-based and in line with the actual needs of implementation.

**KEY WORDS:** e-STREAM module, early childhood education, needs analysis, digital content, technological infrastructure, pedagogical coherence

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### 1.0 BACKGROUND OF THE STUDY

The Penang State Community Development Department (KEMAS) has chosen the theme of Aquatic Science based on the location of Penang State itself which is surrounded by the ocean and also the importance of aquatic life resources to humans and the environment. 71% of the earth's surface consists of water, aquatic ecosystems and the environment are the main ecosystems found on this earth. Therefore, aquatic biology and environmental biology are closely related to each other.

Aquatic ecosystems are located in watery environments (aquatic environments) and cover more than 71% of the Earth's surface. Examples of aquatic ecosystems include lakes, ponds, swamps, rivers, estuaries and the open ocean. There are two types of aquatic ecosystems: marine ecosystems and freshwater ecosystems. The main difference between the two types of aquatic ecosystems is the salinity of the water in the ecosystem. The amount of salt in the water greatly affects the types of species that can live in the aquatic environment. Marine ecosystems are located in the oceans around the world and provide habitat for a wide variety of specialized organisms from tiny plankton to giant creatures such as whales. Marine water (salt water) is found in most aquatic environments. Marine ecosystems are greatly influenced by water depth, temperature and the availability of light.

Freshwater ecosystems are characterized by non-saline water (water without salt). Freshwater ecosystems such as rivers and lakes cover less than 1% of the earth's surface but are home to many vulnerable plant and animal species, including 41% of all fish species. Based on the description of the ecosystem above, we can conclude that Aquatic Science is actually a very unique theme and is completely different from other themes where through Aquatic Science children are exposed to comprehensive learning about all the studies of water on earth where children will delve into all aquatic life found in the sea, rivers, lakes, freshwater and so on. Aquatic Science also includes all types of aquatic life that lives in water throughout its life. Aquatic life consists of groups of fish, aquatic plants, crustaceans, mollusks, amphibians and reptiles.

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## 2.0 PROBLEM STATEMENT

The implementation of the Tabika KEMAS Pintar STREAM (e-STREAM) module is a strategic initiative to strengthen integrated learning of science, technology, religion, engineering, arts and mathematics (STREAM) in early childhood education. However, although this module has been expanded nationally since the pilot project in 2018, internal implementation reports indicate that there is inconsistency in the use of the module, variation in the quality of digital content and technological infrastructure constraints between TABIKA KEMAS in various states (KEMAS, 2024). This situation raises questions about the level of consistency and effectiveness of the overall implementation of the e-STREAM module.

## 3.0 PURPOSE OF THE STUDY

This study aims to conduct a systematic needs analysis and design proposals for improving digital content and technology-based infrastructure for the e-STREAM Module (Aquatic Science) at TABIKA KEMAS, in line with the findings of current implementation which show content inconsistency, variations in digital quality and technological infrastructure constraints. Specifically, the purpose of this study is to: design proposals for improving standardized digital content and technology-based infrastructure specifications that are practical and appropriate for child development.

## 4.0 RESEARCH QUESTIONS

What are the standardized forms of digital content and the specifications of technology-based infrastructure that are practical and developmentally appropriate for children?

## 5.0 SCOPE OF STUDY

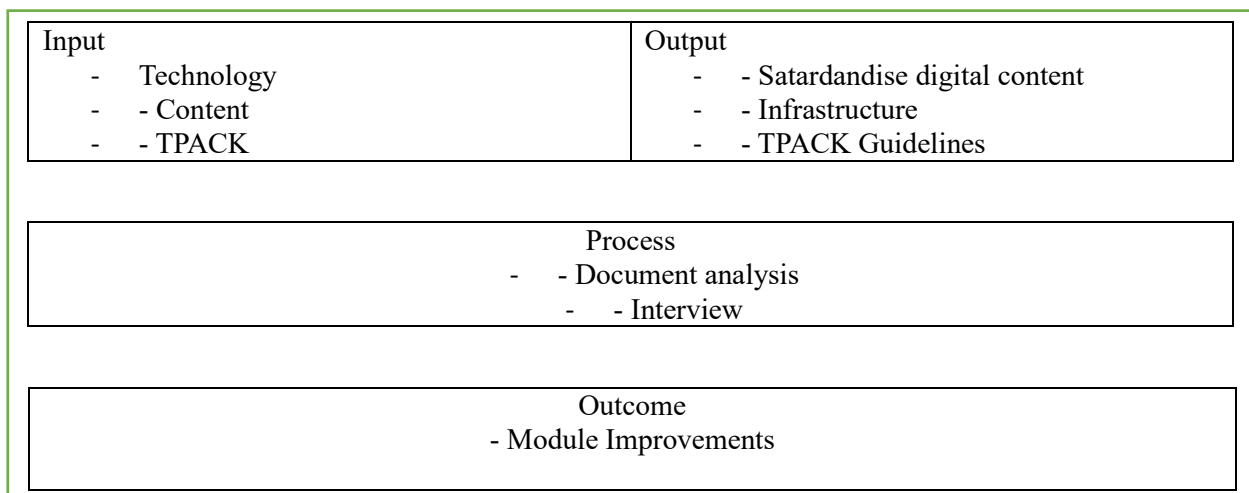
This study involved TABIKA KEMAS implementing the e-STREAM Aquatic Science Module theme in Penang. The selection of the state was based on thematic implementation identified in the e-STREAM report (KEMAS, 2024), and aimed to assess the needs of digital content and technological infrastructure in the context of actual implementation at the field level. Focusing on these themes allowed the study to identify implementation gaps contextually and suggest more specific and targeted improvements.

State	Theme of e-STREAM	Location of TABIKA KEMAS
Malaysia	Aquatic Science	Pulau Pinang, Malacca and Selangor

## 6.0 CONCEPTUAL FRAMEWORK

The conceptual framework of this study was developed to explain the relationship between the implementation gap of the e-STREAM module, the needs analysis process, and the design of proposed improvements to digital content and technology-based infrastructure. This framework is based on three main pillars, namely the Technological Pedagogical Content Knowledge (TPACK) framework, the systemic digital education ecosystem approach, and the principles of developmentally appropriate practice (DAP) in early childhood education.

First, the TPACK framework emphasizes that the effectiveness of technology integration in teaching and learning (TdPc) depends on the dynamic interaction between content knowledge, pedagogical knowledge, and technological knowledge (Mishra & Koehler, 2006). In the context of early childhood education, technology should not be seen as a mere add-on tool, but needs to be pedagogically integrated to support exploration-based and play-based learning (Campbell, 2021). Recent systematic studies have shown that the development of teachers' digital competencies is a critical factor in ensuring the meaningful and quality use of technology at the preschool level (Dardanou et al., 2023).



### 7.0 RESEARCH METHODOLOGY

The study design was implemented in three phases. The first phase involved a needs analysis focusing on three main constructs in line with the study objectives, namely (i) the digital content and resource kit gap, (ii) the technology infrastructure gap, and (iii) the level of teacher TPACK integration. Data were collected through document analysis of the e-STREAM module for three main themes, an audit of technology infrastructure in sample TABIKAs, semi-structured interviews with Community Educators (PEs) and Lead Trainers (LTs), and a structured questionnaire. The use of mixed methods is in line with the recommendations of Creswell and Creswell (2018) which emphasizes triangulation to increase the validity of findings in educational research.

### 8.0 RESEARCH RESULTS

First, in line with the Objectives of this study, a package of digital content improvements and resource kits are standardized for the Aquatic Science theme. This package includes a more systematic content structure, alignment with children's developmental levels, and the integration of a play-based inquiry pedagogical approach. This standardization is expected to reduce variation in content quality between TABIKA and increase consistency in the learning experience. The three main themes from the interview results are as follows:

Theme 1: Strong internet access

This theme is to make it easier for teachers to carry out activities assisted by digital applications.

Theme 2: Prioritizing aspects of local values

Local values are intended such as relating incidents involving aquatic science to the Quran and the like.

Theme 3: Conducting a Needs Study in the aspect of curriculum and pedagogy

The curriculum and pedagogy needs study must be in line with the needs of the community to attract their interest in sending their children to TABIKA KEMAS schools.

Overall, the results of this study not only produce technical and pedagogical recommendation documents, but also provide an empirical basis to support planning for infrastructure upgrades, strengthening teacher training, and scaling up the implementation of the e-STREAM module more consistently and systematically at the national level.

### 9.0 IMPACT OF THE STUDY

This study is to have a significant impact on the policy, implementation management and pedagogical quality of the e-STREAM module at TABIKA KEMAS. Based on the findings of the needs analysis, this study provides an empirical basis to address the issues of digital content inconsistency, technological infrastructure variations and the level of technological pedagogical integration identified in the current implementation report.

From a systems perspective, the main impact of the study is increasing consistency in the implementation of the e-STREAM module through content standardization and the establishment of minimum–optimum infrastructure configurations. This helps reduce the gap between TABIKAs with different facilities, thus supporting more equitable and systematic implementation, especially in rural areas.

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