

ORIGINAL ARTICLE



DEVELOPMENT OF A FLIPPED CLASSROOM MODULE BASED ON VIRTUAL REALITY TECHNOLOGY FOR THE TEACHING AND LEARNING OF THIRUKKURAL AMONG YEAR FOUR PUPILS IN TAMIL NATIONAL-TYPE SCHOOLS

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Abstract

This study aims to develop a teaching and learning module based on the Flipped Classroom approach integrated with Virtual Reality Semi Immersive (VRSM) technology to enhance the effectiveness of teaching Thirukkural among Year 4 pupils in Tamil National Type Primary Schools (SJKT). The study addresses challenges related to students' low motivation and limited understanding of the moral and philosophical aspects of Thirukkural, particularly when conventional teacher centered pedagogies remain dominant. The module was designed using the ADDIE instructional model and validated through the Fuzzy Delphi method. A quasi-experimental design was employed with two groups, an experimental group (using the VR Flipped Classroom module) and a control group (using traditional methods). The sample consisted of 60 Year 4 pupils from four SJKT in the Kinta Utara Zone, Perak. Quantitative data were collected through pre and post-tests and a learning motivation questionnaire, analyzed using paired t-tests and ANCOVA. Findings revealed a significant improvement in both achievement and motivation among the experimental group compared to the control group ($p < .05$). The study concludes that VR-based flipped learning enhances interactivity, comprehension, and value appreciation in Thirukkural learning within the 21st-century pedagogical context.

Keywords: Flipped Classroom, Virtual Reality, Thirukkural, Tamil Education

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Introduction

Tamil language education in Malaysia plays a crucial role in preserving cultural heritage, moral values, and classical intellectual traditions embedded in literary masterpieces such as the Thirukkural. However, in the era of educational digitalisation, traditional teacher centred and rote based instructional methods are no longer effective in engaging the interest of Generation Alpha learners. Contemporary pupils tend to prefer interactive, visual, and experiential learning approaches. In this context, Semi-Immersive Virtual Reality (VRSI) technology offers new opportunities to create immersive learning environments, while the Flipped Classroom approach allows pupils to explore content independently prior to classroom teaching and learning sessions.

The integration of the Flipped Classroom model with Virtual Reality has significant potential to enhance the effectiveness of Thirukkural instruction, as both approaches emphasise active learning and authentic experiences. Thirukkural, as a classical text rich in moral values, ethical principles, and philosophical insights, requires pedagogical approaches capable of illustrating its meanings within real life contexts. This study is therefore undertaken to develop a Flipped Classroom module grounded in Semi-Immersive Virtual Reality technology that can assist teachers in integrating innovative technologies into Tamil language teaching and learning in SJKT.

Previous studies indicate that the teaching of Thirukkural in Tamil National Type Schools (SJKT) continues to face persistent pedagogical and technological challenges. Traditional teacher centred instructional methods have resulted in passive forms of learning, limiting pupils' motivation and reducing their ability to interpret the implicit philosophical and moral meanings embedded in Thirukkural (Nagarajan & Muniisvaran, 2023). The absence of interactive digital resources further restricts pupils' opportunities to connect the moral teachings of Thirukkural with real life contemporary contexts (Lokeshwaran, 2024). At the same time, teachers struggle to implement 21st Century Learning (PAK-21) strategies due to the lack of structured, technology-based modules and clear implementation guidelines (Halili & Sumathy, 2021).

Empirical evidence highlights a broader contextual issue within SJKT, where pupils experience difficulties understanding Tamil literary texts due to insufficiently engaging learning materials (Murugan et al., 2022). Although the integration of online learning has increased significantly in Malaysia (Zulkifli, Hamzah, & Razak, 2020), this trend does not reflect the true extent of technology adoption within schools. The use of advanced educational technologies remains limited, especially in Tamil schools, which often face constraints in resources and technical expertise (Ramalingam, Jiar, & Mathiyazhagan, 2022). This situation underscores the urgent need for a structured technology enhanced instructional model such as the Flipped Classroom approach. Supporting this, Mukayah et al. (2022) found that digital tools can enhance Tamil word reading skills among primary pupils. However, research employing technological interventions specifically for the teaching of Thirukkural particularly through the Flipped Classroom approach remains scarce, revealing a critical gap in current pedagogical practices.

These limitations have contributed to declining interest and lower achievement levels in Thirukkural, despite its importance in nurturing moral reasoning, self-discipline, and critical thinking among young learners. Furthermore, contemporary pupils increasingly require learning environments that are visual, dynamic, and learner centred (Mazlan et al., 2024). In response to these needs, the development of a Flipped Classroom module integrated with Semi-Immersive

Virtual Reality technology represents a promising and innovative solution to address existing pedagogical gaps and to enhance pupils' learning engagement with Thirukkural.

This aligns with prior research demonstrating that pupils' are more motivated and attentive when learning involves interactive methods, collaborative activities, and multimedia technologies (Rajaendram, 2019; Kumar & Subramaniam, 2020). Mahalingam (2023) similarly found that technology supported language instruction can facilitate pupils' comprehension of complex concepts, reinforcing the potential impact of adopting innovative digital tools for teaching Thirukkural.

Research Objectives

This study is conducted with the following objectives:

1. To develop a Flipped Classroom module based on Semi-Immersive Virtual Reality technology for the teaching and learning of Thirukkural among Year 4 pupils in SJKT.
2. To evaluate the validity and usability of the module based on expert assessment using the Fuzzy Delphi method.
3. To determine the effectiveness of the module on pupils' achievement and learning motivation.

Flipped Classroom in 21st Century Education

The Flipped Classroom approach is a pedagogical innovation that restructures the conventional learning sequence by shifting direct instruction to pre-class activities and reserving in class time for higher order learning tasks. In this model, pupils access instructional videos, digital texts, or exploratory materials prior to face-to-face lessons, while classroom interactions are devoted to discussions, collaborative meaning making, and problem-solving activities (Mazlan, Rahman, & Lee, 2024). This instructional reversal encourages active, self-regulated learning and reinforces conceptual mastery through social interaction and peer supported dialogue. Empirical findings by Baig and Yadegaridehkordi (2023) further affirm that the Flipped Classroom approach enhances learner engagement, motivation, and academic achievement within language education settings across Southeast Asia.

In the context of teaching Thirukkural, this approach is particularly advantageous, as it enables pupils to familiarise themselves with philosophical and moral concepts beforehand through multimodal digital resources. Subsequent classroom interactions allow for deeper engagement through collaborative interpretation, guided discussion of virtues, and contextual application of Thirukkural teachings to real life scenarios. Such structured pre class exposure is especially relevant for pupils in SJKT, who benefit from learning at an individualised pace before receiving targeted guidance from teachers during the PdPc session.

Moreover, the approach addresses a long-standing challenge in Tamil language classrooms related to insufficient instructional time (Anusia, Raman, & Latifah, 2023). Integrating the Flipped Classroom also aligns with broader educational aspirations of the Malaysian Education Blueprint (PPPM 2013–2025), which emphasises learner centred pedagogies and the development of 21st-century competencies. Recent Scopus indexed studies likewise support its transformative potential: Lampropoulos and Kinshuk (2024) highlight that technology enabled flipped instruction

significantly boosts cognitive engagement and immersive learning experiences, while Halili and Sumathy (2021) demonstrate that combining the Flipped Classroom with immersive technologies such as Virtual Reality strengthens content retention and improves language learning outcomes. Collectively, these findings underscore the suitability of the Flipped Classroom approach as a contemporary pedagogical framework for elevating the teaching of Thirukkural in SJKT.

The development of a Flipped Classroom module using Virtual Reality (VR) for teaching Thirukkural to Year Four pupils in SJKT is an innovative and meaningful contribution to technology enhanced Tamil literature education. However, its implementation in rural schools may face practical challenges such as limited internet access, insufficient digital devices, and lack of technical support. These constraints could widen the digital gap if not addressed through proper infrastructure planning and equitable resource distribution (UNESCO, 2023; OECD, 2021).

Integration of Virtual Reality Technology in Language Learning

Semi-Immersive Virtual Reality (VRSI) is an emerging pedagogical tool that enhances learning experiences by presenting three-dimensional environments that partially immerse pupils in simulated real-world contexts. Virtual Reality fosters active engagement, imagination, and experiential interaction, allowing learners to explore dynamic scenarios beyond the limitations of traditional classroom instruction (Lampropoulos & Kinshuk, 2024). Within language education, VRSI has been shown to facilitate deeper interpretation of implicit meanings, cultural values, and contextual nuances by transforming abstract concepts into vivid, interactive representations.

Halili and Sumathy (2021) demonstrate that integrating immersive technologies within a Flipped Classroom framework significantly strengthens learners' ability to comprehend linguistic, cultural, and symbolic elements through visual and kinaesthetic modalities. In the context of teaching Thirukkural, VRSI can be strategically utilised to visualise settings, characters, and moral situations embedded within each Thirukkural. This approach renders the philosophical teachings more concrete and meaningful. For instance, Thirukkural that promote virtues such as compassion, gratitude, or justice can be depicted through realistic virtual scenarios, enabling pupils to connect moral values to lived experiences in a more relatable and memorable manner.

Findings from the UNIMAS Research Team (2024) further reinforce the value of Virtual Reality in educational settings, showing improvements in visual literacy, semantic understanding, and learner motivation. This aligns with Kolb's Experiential Learning Theory (1984), where learning occurs through a cyclical process of concrete experience, reflective observation, abstract conceptualisation, and active experimentation. By facilitating this cycle, VRSI promotes deeper cognitive engagement and supports meaningful internalisation of complex ideas. Recent evidence from a Scopus-indexed study by Mazlan et al. (2024) also confirms that immersive digital environments enhance learners' focus, retention, and higher-order thinking, thereby positioning VRSI as an effective pedagogical innovation for elevating Thirukkural instruction in SJKTs.

Learning Theories Underpinning the Study

The design of this module is grounded in several key learning theories:

1. Constructivist Theory (Vygotsky, 1978) – This theory emphasises learning through social interaction and the construction of meaning based on experience. Within the context of the

Flipped Classroom integrated with Semi Immersive Virtual Reality, pupils construct their understanding of Thirukkural through collaborative activities and teacher-guided learning within the Zone of Proximal Development (ZPD). Through guided facilitation, dialogue, and peer interaction, learners connect prior knowledge with new experiences in a meaningful way.

2. Multimedia Learning Theory (Mayer, 2001) – This theory posits that learning is more effective when information is presented through a combination of text, audio, and visuals. The VRSI module supports this principle by providing multi-sensory input, enabling pupils to encode Thirukkural concepts through dual channels (verbal and visual). This reduces cognitive load and facilitates deeper comprehension of abstract moral values through concrete visual representation.

These theoretical foundations justify the integration of VRSI and the Flipped Classroom as an approach that not only enhances understanding but also supports active, experiential, and meaningful learning aligned with 21st-century pedagogical expectations.

Previous Studies on Flipped Classroom and Virtual Reality

Existing literature clearly demonstrates that the integration of Virtual Reality and the Flipped Classroom approach can enhance students' interest, motivation, and performance. However, there is still no systematic study that develops a complete teaching and learning module combining these two approaches specifically for the teaching of Thirukkural in Tamil National Type Schools (SJKT). Thus, this study addresses this gap by developing and evaluating a contextualised VRSI Flipped Classroom module tailored to the learning needs of Tamil pupils in Malaysia.

Previous studies have shown that the combination of the Flipped Classroom and Virtual Reality holds significant potential for improving the quality of teaching and learning, particularly in language and value-based education. Nevertheless, the actual implementation within the context of Tamil language education remains underexplored. Therefore, the development of a VRSI Flipped Classroom module for Thirukkural not only strengthens Tamil teachers' pedagogical practice but also contributes to national educational innovation aligning with the Ministry of Education's Digital Education Transformation Agenda (MOE, 2025) and the core principles of the National Education Philosophy.

Research Methodology

Research Design

This study employs a quasi-experimental design using pre-test and post-test procedures for both the control and experimental groups. This design is appropriate because the pupils could not be randomly assigned, and the study was conducted within a real school environment (Creswell & Plano Clark, 2018).

The experimental group utilised the Flipped Classroom Module based on Semi-Immersive Virtual Reality (VRSI), whereas the control group received conventional teacher centred Thirukkural instruction. This research design enables the researcher to evaluate the effectiveness of the module on pupils' achievement and learning motivation.

Table 1*Quasi -Experimental Research Design*

Group	Pre-test (O ₁)	Treatment	Post-test (O ₂)
Experimental	O ₁	Flipped Classroom VRSI Module	O ₂
Control	O ₁	Traditional Teaching	O ₂

Population and Sample

The study population consists of Year 4 pupils from four Tamil National Type Schools (SJKT) in the Kinta Utara Zone, Perak. The selection of Year 4 is based on the Bahasa Tamil Year 4 DSKP, which formally introduces moral value comprehension through Thirukkural.

Purposive sampling was used to identify schools equipped with basic ICT facilities and teachers willing to implement technological innovation in teaching and learning. The sample comprised 60 pupils, with 30 pupils in the experimental group and 30 pupils in the control group. The study was conducted over five weeks, covering four units of Thirukkural based on themes such as respect, compassion, gratitude, and honesty.

Development of the Flipped Classroom Semi-Immersive Virtual Reality Module

The module was developed based on the ADDIE Instructional Design Model (Branch, 2009), which consists of five systematic phases: Analysis, Design, Development, Implementation, and Evaluation.

Analysis Phase

This phase identified user needs, school ICT capabilities, and Tamil language teachers' readiness for technology-enhanced PdPc. Needs analysis involved interviews with five teachers and questionnaires distributed to 40 pupils. Findings revealed that 78% of pupils felt bored with traditional Thirukkural teaching and recommended visual elements and gamified activities.

Design Phase

Learning outcomes, objectives, and Flipped Classroom activities were constructed during this phase. Learning videos, interactive worksheets, and VRSI features were planned. The module utilised Unity 3D software, where each Thirukkural was visualised as a 3D scenario accompanied by narration, Tamil text, and virtual interactions.

Development Phase

The module was produced based on a PdPc script incorporating two key components:

1. Pre-class Component (Online): Pupils viewed Thirukkural learning videos via Google Classroom, followed by interactive quizzes.
2. In-class Component (Face-to-Face): Pupils interpreted Thirukkural values through Semi-Immersive VR exploration using computer hardware, followed by group discussions.

Implementation Phase

The module was piloted in four selected SJKTs. Teachers conducted PdPc using the provided module and teacher's manual. Support sessions ensured standardised implementation across schools.

Evaluation Phase

Two types of evaluation were conducted:

- Formative Evaluation: Ongoing expert feedback during module development.
- Summative Evaluation: Post-implementation assessment to determine the module's effects on achievement and motivation.

Content Validity Using the Fuzzy Delphi Method

Content validity was established using the Fuzzy Delphi (FD) Method, involving 10 experts from three main fields: Tamil language lecturers (2), Educational Technology Officers (2), Tamil Language Head Panel Teachers (3), and ICT teachers (3).

Experts evaluated module items using a 7-point Likert scale, focusing on content suitability, usability, alignment with DSKP, and VRSI interactive elements.

The threshold value (d) for each item was calculated using the Fuzzy Triangular Number (FTN). Items with $d \leq 0.2$ and consensus $\geq 75\%$ were considered valid. Results showed an average $d = 0.12$ with 87% expert consensus, indicating high content validity.

Research Instruments

Three instruments were used in this study:

1. Pre-test and Post-test Achievement Assessment
Consisted of 25 objective items measuring comprehension and application of Thirukkural values. Validated by two language experts and one measurement specialist.
Cronbach's Alpha = 0.84
2. Learning Motivation Questionnaire
Adapted from the Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich & De Groot (1990). Contains five constructs: interest, self-efficacy, task value, anxiety, and engagement.
Overall reliability $\alpha = 0.89$
3. Teacher Evaluation Form
Used to collect feedback on module usability, activity effectiveness, and technical support.

Research Procedure

The study was conducted in three main phases:

Phase 1: Preparation (2 weeks)

- Development of the VRSI Flipped Classroom Module
- Expert validation using Fuzzy Delphi
- Training sessions for implementing teachers

Phase 2: Implementation (4 weeks)

- Weeks 1–4: PdPc using VRSI module for the experimental group; traditional PdPc for the control group
- Pre-test and post-test data collection

Phase 3: Data Analysis and Evaluation (2 weeks)

- Data analysis using SPSS Version 31
- Paired t-tests for within-group differences
- Independent t-tests and ANCOVA for between-group comparisons

Data Analysis

Data were analysed using descriptive and inferential statistics. Mean, standard deviation, and percentage values were used to summarise achievement and motivation scores.

Inferential tests included:

- Paired t-test – to identify pre- and post-test differences within each group
- Independent t-test – to compare experimental and control groups
- ANCOVA – to control covariates (pre-test scores) when determining module effectiveness

The significance level was set at $p < 0.05$.

Research Findings**Effectiveness of the Module on Learning Achievement**

Table 1 presents the mean scores and standard deviations for the pre-test and post-test Thirukkural achievement scores for both the experimental and control groups.

Table 2

Mean Scores and Standard Deviations for Pre-Test and Post-Test Achievement

Group	Pre-Test (Mean $\pm$ SD)	Post-Test (Mean $\pm$ SD)	Difference
Experimental (n=30)	41.73 $\pm$ 6.12	78.30 $\pm$ 7.25	+36.57
Control (n=30)	42.16 $\pm$ 6.45	59.88 $\pm$ 8.04	+17.72

Paired-sample t-tests indicated a significant improvement in the post-test scores for the experimental group ($t = 10.82$, $p < .001$). Independent-sample t-tests revealed a significant difference between the experimental and control groups in the post-test scores ($t = 8.94$, $p < .001$). These findings demonstrate that the Flipped Classroom Module integrated with Semi-Immersive Virtual Reality significantly enhanced pupils' comprehension and achievement in Thirukkural learning.

Effectiveness of the Module on Learning Motivation

Analysis of the Motivation Survey (MSLQ) indicated substantial improvements across the five core constructs: interest, self-efficacy, task value, active engagement, and reduction of anxiety.

Table 3

Average Motivation Scores (Pre and Post)

Construct	Experimental (Pre → Post)	Control (Pre → Post)	Δ Change
Interest	3.21 → 4.51	3.18 → 3.52	+1.30
Self-Efficacy	3.14 → 4.47	3.09 → 3.48	+1.33
Task Value	3.36 → 4.62	3.22 → 3.67	+1.26
Active Engagement	3.05 → 4.40	3.01 → 3.42	+1.39
Anxiety	3.48 → 2.86	3.51 → 3.28	−0.65

ANCOVA results confirmed that the differences between groups were significant for all motivation constructs ($F(1,57) = 14.93, p < .001$). These results indicate that the integration of Semi-Immersive Virtual Reality in the Flipped Classroom improved pupils' interest and engagement while reducing anxiety associated with learning abstract values in Thirukkural.

Discussion

Comparison with Previous Studies

The findings of this study align with Guo (2019), who reported significant improvements in language achievement through a VR-based Flipped Classroom using animated learning materials. The motivational gains observed in this study further support Halili and Sumathy (2021), who highlighted the potential of technological integration in promoting deeper, more interactive learning experiences in language education.

However, this study extends prior research by focusing on the teaching of Thirukkural, a classical text rich in ethical and cultural values. This elevates the module beyond a technological tool into an instrument of cultural preservation, tailored specifically to the local SJKT context. The study therefore contributes a novel dimension to Tamil language pedagogy by demonstrating the cultural and educational relevance of integrating VR with classical literature.

Conclusion and Implications

This study demonstrates that the Flipped Classroom Module integrated with Semi-Immersive Virtual Reality effectively enhances pupils' understanding, motivation, and appreciation of values in Thirukkural teaching and learning within SJKTs. The approach successfully transforms conventional teacher-centred instruction into more interactive, meaningful, and 21st-century aligned learning experiences.

In the long term, the sustainability of this module depends on continuous teacher training. Teachers need not only technical skills to use VR but also pedagogical knowledge to integrate technology effectively with literary content (Mishra & Koehler, 2006). Without systematic

professional development and institutional support, the effectiveness of such innovation may be limited. Therefore, while the module has strong academic value, its success relies on infrastructure readiness and sustained teacher capacity building.

From an instructional standpoint, this module may serve as an official pedagogical resource for Tamil Language Panels in SJKTs to strengthen technology-enhanced PdPc. From a policy perspective, the findings support the Ministry of Education Malaysia's agenda to expand digital innovation in primary schools. From a theoretical perspective, the study reaffirms the effectiveness of integrating Constructivism and Multimedia Learning Theory within a Virtual Reality environment.

In conclusion, learning Thirukkural through VRSI is not merely a teaching tool but a medium that strengthens moral development among Tamil pupils in Malaysia representing a synthesis between classical heritage and future oriented educational technology.

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