

# Adaptive Micro-Learning Model Based on Dhamma Using Mixed Reality to Develop Students to Be Good Citizens

Kitiya Promsrorn<sup>1</sup>, Prachyanun Nilsook<sup>1</sup> & Pallop Piriyasurawong<sup>1</sup>

<sup>1</sup> King Mongkut's University of Technology North Bangkok, Thailand

Correspondence: Kitiya Promsrorn, King Mongkut's University of Technology North Bangkok, Thailand.

Received: October 8, 2024

Accepted: December 11, 2024

Online Published: March 20, 2025

doi:10.5539/ies.v18n2p123

URL: <https://doi.org/10.5539/ies.v18n2p123>

## Abstract

The COVID-19 pandemic forced school closures globally, leading to significant learning regression in academic performance, skills, and ethical development. This study aims to: 1) synthesize and develop an adaptive micro-learning model based on Dhamma principles using mixed reality (MR), 2) compare pre-and post-test results, and 3) assess the model's impact on students' good citizenship. Participants included 19 experts and 39 Grade 6 students. The methodology involved synthesizing and developing an adaptive micro-learning model, comparing pre- and post-study scores, and evaluating academic achievement and good citizenship development. The study identified seven key steps in the adaptive micro-learning model: 1) testing prior knowledge (Dhammanuta), 2) reporting prior knowledge results (Atthanyuta), 3) explaining learning objectives (Attanyuta), 4) outlining the learning path (Mattanyuta), 5) video-based learning (Kalanyuta), 6) collaborative learning via MR (Parisanyuta), and 7) peer knowledge exchange (Pukkalanyuta). The model's effectiveness was rated highly ( $\bar{x} = 4.78$ , S.D. = 0.34). Students' good citizenship scores significantly improved, increasing from a pre-test average of 15.87 points (52.90%) to a post-test average of 25.72 points (85.73%), with statistical significance at the 0.01 level.

**Keywords:** adaptive learning, micro-learning, mixed reality, dhamma principles, good citizenship

## 1. Introduction

### 1.1 Introduce the Problem

Prolonged suspension of classes results in a learning recession regarding academic knowledge, skills, and moral ethics. Morality and ethics are the guidelines for living for the development of society to be sustainable (Thonjinda & Srijumnong, 2019). Schools, which are social institutions that develop learners' quality of learning, play an important role in building learners into good and moral people. Ethics Although society is changing rapidly, schools still must take care of and develop the quality of learners to the appropriate limits (Kongtana et al., 2019). When learners have individual differences, their knowledge, skills, and abilities will differ. Using the same learning management method does not meet the needs of the learners. There is a need to change the learning model using Adaptive learning is the adaptation of the content and choice of how to implement the needs of the educational process, which allows participants to optimize various teachings (Smyrnova-Trybulska et al., 2022).

This research extends previous studies on adaptive microlearning using mixed-reality technology, which aims to reverse learning loss. The new objective is to develop learners into good citizens by integrating Buddhist principles to guide their moral and ethical development according to their age and responsibilities. Additionally, learning alongside peers in an augmented reality world helps students practice reasoning, self-evaluation, and societal adaptation. Since learners have varying abilities, learning activities must be tailored to each student's skill level. Adaptive micro-learning enhances learning processes, especially for Generation Z, by incorporating mixed reality to create engaging, interactive environments where students can collaborate, learn to adapt socially and experience the challenge of simulated scenarios blending real and virtual worlds. Fostering both academic development and good citizenship is essential, as it leads to a peaceful society that can advance alongside technological growth. Thus, integrating Buddhist teachings into the learning process is a crucial strategy to mitigate learning decline while promoting the development of students as responsible and ethical citizens.

The research hypothesis is that the Adaptive Micro-learning Model Based on Dhamma Using Mixed Reality can develop good citizenship, and students have higher good citizenship evaluation results after learning than before

learning. The objectives of the research are: 1) To synthesize and develop the adaptive micro-learning model, 2) to compare the results of the pre-test with the post-test, and 3) to compare the results of the assessment of good citizenship before studying with after studying.

### *1.2 Explore the Importance of the Problem*

Adaptive Learning aims to transform a teaching style that focuses on teaching from a learner-centered perspective (Smaili et al., 2020). It helps promote student motivation and independence in support of adaptive learning. Transform by using digital technology to be more interactive according to needs and adapted to students (Cheng et al., 2021). When learning can be appropriately adjusted to the needs of the learner, the learning content must be suitable for the generation of the learner. Currently, the learner is in Generation Z impatient, likes to win, and does not like to wait. Teaching with long, dense content does not answer the questions of two learners. Teachers should use Microlearning as learning management with learning units that focus on relatively small sizes. Consisting of abbreviated learning activities (usually 1 to 10 minutes) available on multiple devices, lesson strategies are designed for training based on learning and study skills. The short lessons are filled with interactive multimedia (Shail, 2019). Learning management facilitates learner potential by dividing new concepts into fragments, also known as micro-content. These small units are given to progressive learners (Díaz Redondo et al., 2021). Generation Z students expect more hands-on learning approaches, such as field trips, and practical application of learning concepts. Practical training virtual learning environment a study area outside the classroom with modules open 24/7 for learning and they expect a wide range of online academic resources and software. (Mahesh et al., 2021). Another interesting technology is Mixed Reality (MR) which combines the strengths of Virtual Reality (VR) and Augmented Reality (AR). A simulation where users can interact in an environment merges the real and virtual worlds into one (Phompanya, 2020). Adaptive micro-learning involves collecting and assessing learners' data to determine their proficiency levels and align learning objectives accordingly. This approach focuses on designing short, concise learning activities tailored to learners' varying abilities while utilizing technology that supports development-based assessments. Feedback is provided to enhance learning outcomes. Mixed reality technology, which blends real and virtual environments, further enhances this learning model by offering interactive scenarios that deepen learners' understanding. The integration of adaptive microlearning with mixed reality creates a dynamic and personalized learning experience that supports learners' development and comprehension of lessons (Promsron et al., 2024).

### *1.3 State Hypotheses and Their Correspondence to Research Design*

The research design of this study is grounded in the hypothesis that the Adaptive Micro-learning Model Based on Dhamma, combined with Mixed Reality Technology, can effectively enhance students' good citizenship. To evaluate this hypothesis, pre- and post-assessments will be conducted to measure any changes in students' citizenship development following their participation in the learning activities. The collected data will then be subjected to statistical analysis, employing techniques such as paired t-tests or ANOVA, to compare the pre-and post-assessment scores and determine the significance of the observed improvements.

## **2. Literature Review**

### *2.1 Good Citizenship*

Good citizenship consists of several elements, such as the personal, relational, and social aspects of a person (Villalobos et al., 2021). A reflective good citizen of community members is usually someone who has lived in the community for a considerable amount of time, participated in community affairs and had good relations with others, cooperated with community members, participated in community work, and must be aware of their rights and freedoms and the rights of others in the community (Kontinen & Bananuka, 2022). Good citizenship should therefore extend to good global citizenship. Good citizenship depends not only on knowledge and understanding of one's own country and bureaucracy but also on knowledge and understanding about the world with attitude. Therefore, the preparation of good citizenship must be carried out as a unit of the social world. A healthy society must have global boundaries (Upanan et al., 2022). In conclusion, being a good citizen means that a person's status depends on the laws or regulations of that society. According to the rules, the rights and obligations of a person are determined. An identity status determines rights and duties. A good citizen must be a virtuous citizen, i.e. a citizen with moral values, attitudes, and expected behaviors. Some actions demonstrate a society, and behaviors that reflect the unity or union of individuals.

Table 1. Synthesizes good citizenship attributes

| Good Citizenship Attributes                  | Reference                |                      |                  |                            |                           |                         |                         |                        |                             |                         |
|--|--------------------------|----------------------|------------------|----------------------------|---------------------------|-------------------------|-------------------------|------------------------|-----------------------------|-------------------------|
|  | (Martin & Ci-Hodo, 2008) | (Ke & Starkey, 2014) | (Li & Tan, 2017) | (Yinilmez Akagündüz, 2020) | (Tupper & Cappello, 2012) | (Reynolds et al., 2019) | (O'Brien & Smith, 2011) | (Treviño et al., n.d.) | (Universitesi et al., 2020) | (Kaeduang et al., 2019) |
| Volunteering in community                    | ✓                        | ✓                    | ✓                | ✓                          | ✓                         | ✓                       | ✓                       | ✓                      | ✓                           |                         |
| Moral education                              | ✓                        | ✓                    | ✓                | ✓                          | ✓                         | ✓                       | ✓                       | ✓                      | ✓                           |                         |
| Concern for the environment                  | ✓                        | ✓                    | ✓                | ✓                          | ✓                         | ✓                       |                         | ✓                      | ✓                           |                         |
| Civic participation                          | ✓                        | ✓                    | ✓                | ✓                          | ✓                         | ✓                       | ✓                       | ✓                      | ✓                           | ✓                       |
| Sense of nationalism and national pride      | ✓                        | ✓                    | ✓                | ✓                          | ✓                         | ✓                       | ✓                       | ✓                      | ✓                           |                         |
| Reasoning in Everyday Life/Critical Thinking | ✓                        | ✓                    | ✓                | ✓                          | ✓                         | ✓                       | ✓                       | ✓                      | ✓                           | ✓                       |
| Respect for relationships.                   | ✓                        | ✓                    | ✓                | ✓                          | ✓                         | ✓                       | ✓                       | ✓                      | ✓                           | ✓                       |
| responsibility behavior in the digital world | ✓                        | ✓                    | ✓                | ✓                          | ✓                         | ✓                       | ✓                       | ✓                      | ✓                           | ✓                       |
| engagement with real-world events            | ✓                        | ✓                    | ✓                | ✓                          | ✓                         | ✓                       | ✓                       | ✓                      | ✓                           |                         |
| Justice-oriented                             | ✓                        | ✓                    | ✓                | ✓                          | ✓                         | ✓                       | ✓                       | ✓                      | ✓                           |                         |

From the synthetic table, good citizenship characteristics include: 1) Volunteering in the community 2) Moral education 3) Concern for the environment 4) Civic participation 5) Sense of nationalism and national pride 6) Reasoning in everyday life 7) Respect for relationships 8) Moral education 9) Justice-oriented.

### 2.2 Mixed Reality (MR)

Recent technological advancements have led to the integration of artificial intelligence. AI and mixed reality (MR) make it a powerful tool to address critical challenges across a wide range of fields. A combination of the physical and digital worlds is known as Mixed Reality (Rithish et al., 2023). Combining the physical world with the digital world Mixed reality is the next evolution in human, computing, and environmental interaction (Aziz et al., 2020). Learning using a combination of VR and AR allows the physical world to be improved through reality (Vasilevski & Birt, 2020). Technology, multimedia, and real-time interactive are for the development of “augmented” environments (Pellas et al., 2020). Technology Educational Tools A type of augmented reality that allows digital objects to be superimposed in a real environment (Kang & Kang, 2022). The adoption of wearable touch devices has enabled a fully immersive environment to implement virtual and augmented reality applications. Advances in these matters, technology uses a variety of methods and stimuli to develop realistic tactile sensations with the focus points on the hands and fingertips. In touch devices (Christie et al., 2023). Since the start of the COVID-19 pandemic, Mixed-reality remote collaboration is also happening, gaining more attention. In this type of collaboration, remote users observe the local people’s environment through a virtual reality (HMD) head-mounted display (HMD) and collaborate with local users wearing AR HMDs (Luo et al., 2023). In conclusion, mixed reality (MR) refers to the integration of digital and real-world objects. It creates a simulation where users can interact in an environment that combines the real and virtual worlds into one so that virtual images.

### 2.3 Adaptive Learning

Students receive learning materials in different ways; some like to read, some like to listen, and some like to use their feelings. Traditional teaching uses only one teaching strategy. This is because it is impossible to implement all strategies in the classroom. At present the adaptive e-learning system allows for personalized learning materials to be tailored to the needs of learners (Ristić et al., 2023). An adaptive learning platform that provides personalized learning for each person. Students can identify student learning deficiencies. Create assessments and offer learning resources (Liu et al., 2021). Learning with adaptive technology adapts learning to an individual so that online learning is like working with that personal tutor and not like sitting and listening to a lecture (Thompson, 2022). In conclusion, Adaptive Learning refers to learning that can adapt the content and choices of learning paths according to the characteristics of different learners, needs, and abilities of learners by the difficulty of learning resources. Create assessments, offer learning resources, and help all learners achieve their goals.

#### *2.4 Micro-Learning*

Micro-learning has gained popularity, especially due to the proliferation of mobile devices and bringing new possibilities to track user activity. Web browsers provide convenience. Comfortable and of the same quality are not only for content display and interactivity, but also for tracking user activity (Skalka et al., 2020). Micro-learning open learning is becoming an eye-catching trend for the next generation, education where learners can learn anywhere with access to advanced cloud services. Short Videos Examples of websites or the Internet of Things Usually, microlearning activities are a special form of mobile learning within 15 minutes (Sun et al., 2018). Microlearning is a combination of sub-content and chronological transfers in multiple sections, empowering learners without having to acquire a lot of information about it (Rafiee et al., 2023). In conclusion, microlearning refers to small learning, adapted to the limitations of the human brain considering attention span. When engaging in a short period, focusing on “micro” learning activities, or learning little by little in an environment, digital media can complement the learner’s daily routine well. Learning is believed to be the best way to learn new things. Design for skill-based training, Learning, and Education The short lessons are filled with interactive multimedia.

#### *2.5 Principles of Buddhism*

Thailand is a Buddhist city. The much-talked-about concept of living a happy life according to Buddhism is to apply “Dharma” or “Buddhist principles” in learning management to develop learners to be good people and good citizens. Do not oppress others because they are a sign or qualification of a person (Singsorn, 2023). Sappuris Dharma 7 is a category of Dharma that can be carried out by being a harmonious principle in one’s daily life and about others. It can be practiced by children to adults, differing only in the awareness or habit of practicing (Neamsawas, 2007). It is the principle of faith. Dharma makes it a quality of a good person—Dharma of Good People (Sukamol, 2018). The application of the 7 principles of Sappuris Dharma consists of 1) Dhammanyuta is the one who knows the cause, 2) Attanyuta is the one who knows the result, 3) Attanyuta is the one who knows the self, 4) Mattanyuta is the one who knows about it, 5) Kalanyuta is the one who knows the tense, 6) Prisanyuta is the one who knows the community, and 7) Pukkalananyuta is the person who knows the person, all of which are things that they apply to the benefit of developing and managing themselves according to their status (PhraKhamse & Thitiwut, 2018). In conclusion, Sappuris Dharma refers to the dharma of a man or a good man, or the dharma of a fully human man. There are 7 things, study to know, understand, and practice, so that you can preserve all human values. The 7 principles of Sappuris are to know the cause, to know the effect, to know the self, to know the estimate, to know the tense, to know the community, and to know the person.

### **3. Method**

The development of this research study involved the design, development, and evaluation of an adaptive micro-learning model based on dhamma using mixed reality to develop students to be good citizens and used the following data collection, analysis, and methods.

Phase 1 Synthesize and develop an adaptive micro-learning model based on dhamma using mixed reality to develop students to be good citizens. Lead 19 experts to evaluate the appropriateness of the learning management process.

Phase 2: Develop an adaptive micro-learning model based on dhamma using mixed reality to develop students to be good citizens. Learners take a citizenship assessment before learning to know the basic knowledge. Learners learn through the mixed reality technology system with friends according to morality to develop good citizenship according to the steps of learning according to morality. Learners must know how to adapt to friends and society. The learning management system consists of microlearning media, which are short, concise, easy-to-understand video clips and 3D images, and allow learners to discuss and summarize knowledge from the content in the lesson.

Phase 3 compares the good citizenship before and after learning of the students with an assessment form that the researcher synthesized and created from the characteristics of good citizenship, consisting of students evaluating themselves, teachers evaluating students, and parents evaluating students. The average is calculated and compared using t-test statistics.

#### *3.1 Population and Sampling Technique*

Participants in this study were divided into two groups: 1) 19 experts selected by purposive sampling, consisting of lecturers from higher education institutions, administrators and teachers from the Ministry of Education and secondary schools, educational supervisors from the Area Education Office, technology experts from private companies, and monks from temples, all of whom had expertise in learning management technology; 2) 39 sixth-grade students selected by simple cluster random sampling from all six classrooms of Pathumthani Kindergarten School, totaling 214 students.

### 3.2 Instrument Recruitment

The adaptive micro-learning model using mixed reality to develop students to be good citizens consists of 1) a mixed reality learning system, 2) an assessment of the appropriateness of the learning management components by experts, 3) a pre-test and post-test through a quality control process, and 4) a student citizenship assessment by experts. Statistics used to analyze the data include margins, standard deviations, and percentages. About data collection, the researcher used the research tools detailed above to collect data from all participants who were required to maintain anonymity and anonymity, before this step and before proceeding with data analysis. We provided participants with detailed information on the evaluation criteria.

### 3.3 Research Design

Adaptive Micro-learning model Based on Dhamma using Mixed Reality for Develop Students to be Good Citizenship involves Research and Development (R&D) that focuses on development design. Researchers conducted Syntheses & Integration, Design & Development, and assessed the success and satisfaction of using learning systems created as learning materials based on Mixed Reality.

In the cognitive synthesis stage Study, the problems that learners have experienced in both academic and good citizenship learning recession due to long periods off from school, and study-related research to synthesize learning models assessed by experts. Apply the learning system to Grade 6 students to review their knowledge of science subjects in grades 4-6 to prepare for the entrance exam in Grade 1. Before normal class hours It takes about 6 hours to learn, learners must complete the assigned activities during that time. All participants used the Metaverse learning system with mixed reality glasses and computers developed by the researcher as part of an additional hour from the course. An adaptive micro-learning model based on dhamma to develop students' good citizenship by learning with peers in an online classroom. There is a pre-study and post-study examination system and a good citizenship assessment based on study behavior. Behavioral relations are between teachers Friends and Parents.

## 4. Results

### 4.1 Adaptive Microlearning

From the synthesis of Adaptive Learning with Micro-learning of Promsron et al. (2024), the steps are as follows: 1) Analyse the learner's ability level. 2) Inform learning objectives that correspond to the learner's ability level. 3) Design small, short-duration learning activities with small learning content suitable for learners with different abilities, 4) Use learning materials that are appropriate to the level of learning ability of learners with the use of technology, and 5) Development-based learning assessments and learning feedback. The adaptive microlearning process model can be shown as shown in the picture below (Promsron et al., 2024).



Figure 1. Adaptive micro-learning using mixed reality technology model

#### *4.2 Learning Management Process*

From synthesizing and developing the adaptive micro-learning model based on Dhamma using mixed reality to develop students into good citizens results of the study found that Adaptive Micro-learning based on Dharma using mixed reality has 7 steps including: 1) Knowing the cause (Dhammanyuta) is the learner who knows the cause that the test is to find out what causes the student to experience learning disabilities. 2) The learner knows what the results result in the student needing to learn. Thus, the learning recession can be successfully restored. 3) Self-acquaintance (Attanyuta) is the purpose of learning–Self-knowledge, abilities, aptitudes, and learning objectives. 4) Being an approximate acquaintance (Mattanyuta) informs the learning path according to the learning recession. Learners know how to fit in things, such as knowing how to estimate in learning, and knowing how to speak performing various activities. 5) A person who knows the tense (Kalanjuta) is a learner who learns from studying mixed reality media by knowing the appropriate time and the amount of time it will take to complete the activity. Perform study duties such as be on time, be on time, be on time, be on time, be on time. 6) Being a community acquaintance (Prisanyuta) is a learner who uses technology to attend classes together with peers as a creative learning community. What is it like to know that community or society, how to act to be suitable for that society to be able to fit into that community without being embarrassed or nervous. 7) A person who knows a person (Pukkalanyuta) is a learner who knows and understands the differences of a person. Respect the rights of others, know how to adapt, and work together in harmony.

#### *4.3 Appropriateness of the Learning Management Process*

We asked for the courtesy of 19 experts, including experts in curriculum development and technology learning. Both in the public and private sectors, university teachers and monks are with expertise in Buddhist principles. Assess feedback on learning management styles. The opinion information was found as follows: In terms of learning management principles, experts have the highest level of opinion ( $\bar{X}=4.80$ ). In terms of input, experts have the highest level of opinion ( $\bar{X}=4.80$ ). Regarding the learning process, experts have the highest level of opinion ( $\bar{X}=4.77$ ). In terms of evaluation, experts have the highest level of opinion ( $\bar{X}=4.70$ ). In terms of feedback, experts have the highest level of opinion ( $\bar{X}=4.87$ ). In terms of application, experts have the highest level of opinion ( $\bar{X}=4.89$ ). And experts have an average opinion on all aspects at the highest level ( $\bar{X}=4.78$ ).

Additional expert comments there are opinions that it is a very challenging approach to today's learning management because of the learning recession that occurs a lot in terms of knowledge and morality, good citizenship of learners if adopted this model will be a good option. There is an additional proposal for further development of research that should be designed by incorporating artificial intelligence. ChatGPT, Bard, or Bing are part of the personal assistant for learners.

#### *4.4 Learning Management System*

From the adaptive micro-learning model based on dhamma using mixed reality to develop students into good citizens process, the learning steps can be shown as shown in Table 2.

Table 2. Process of adaptive micro-learning model based on Dhamma using mixed reality to develop students into good citizens

| Adaptive micro-learning model based on Dhamma using Mixed Reality to develop students into good citizens   | Mixed Reality  |
|--|--|
| 1. Knowledge test (Pre-test, Post-test Using the principle of knowing the cause (Dhammanyuta), the learner has the knowledge of the cause that the test is to find out the cause of the student's learning disabilities.   | Online Quiz  |
| 2. Notify the test results using the principle of being a person who knows the results (ego), the learner knows what the results of the exam result in the student needing to learn. Thus, the learning recession can be successfully restored.  | Display dashboard                                      |
| 3. Inform learning objectives Use the principle of self-awareness (Attanyuta) to make learners known. Self-knowledge, abilities, aptitudes, and learning objectives  | Interactive dashboard                                  |
| 4. Inform learning paths based on learning recessions Using the principle of being an approximator (Mattanyuta) makes learners know how to fit in things, such as knowing about how to learn, and knowing moderation in speaking. Performing various activities  | Interactive dashboard                                  |
| 5. Students learn how to learn with mixed reality media systems. Using the principle of knowing the tense (Kalanjuta), students know the appropriate time and the amount of time that will be required to perform study activities, such as to be on time, to be timely, to be timely, and to be appropriate.  | - Metaverse<br>- Virtual Reality<br>-Augmented Reality |
| 6. Learners use technology to attend classes together with their peers. Using the principle of being a community knower (Prisanyuta), learners know how to adapt creatively to the learning community. What is it like to know that community or society, how to act in order to be suitable for that society to be able to fit into that community? without being embarrassed or nervous. | - Metaverse<br>- Digital board<br>brainstorming        |
| 7. Learners discuss and exchange knowledge. Using the principle of being a person-knower (Pukkalanyuta) makes learners know and understand the differences between individuals. Respect the rights of others, know how to adapt, and work together in harmony.   | - Metaverse<br>- Digital board<br>brainstorming        |

The above steps can be used to create an adaptive micro-learning model based on dhamma using mixed reality to develop students to be good citizens can be visualized as shown in Figure 2.

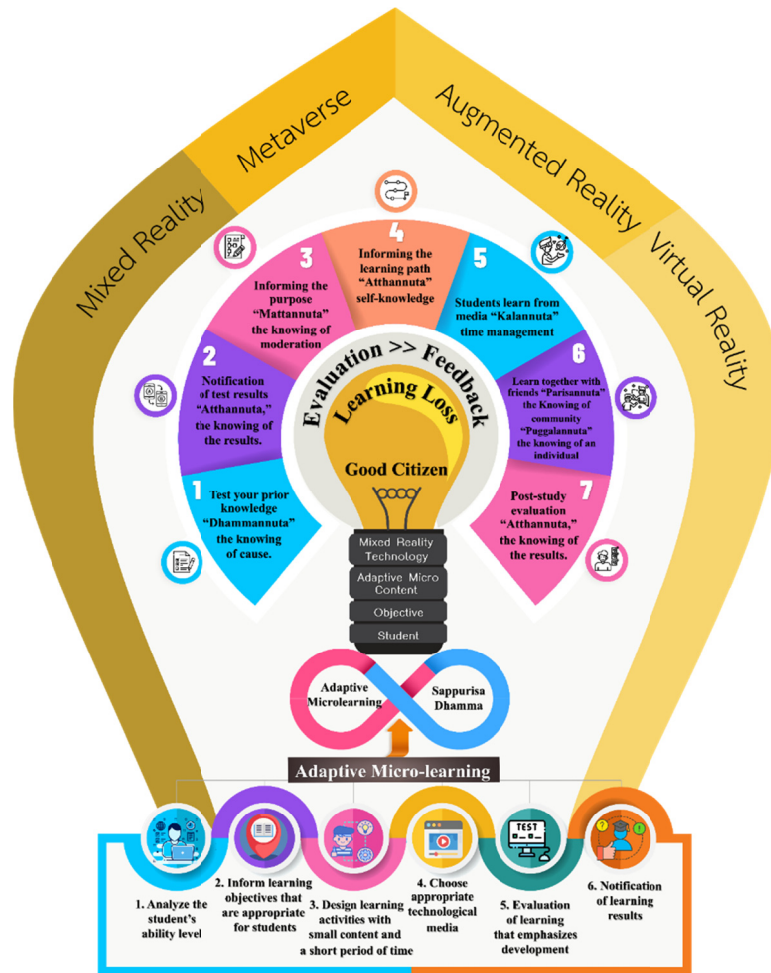


Figure 2. Adaptive micro-learning model based on dhamma using mixed reality to develop students into good citizens

From Figure 2, micro-adaptive learning management is based on mixed reality technology to develop students into good citizens. There are 4 components as follows:

I. Input factors include 1) learners who are learners at the basic education level who have a learning recession or learners who do not need to make up for it, 2) learning objectives according to the basic education curriculum, 3) adaptive micro-content, which is short, concise, and easy to understand. 4) Mixed reality technology is used for lesson content that wants to merge the real world with the virtual world.

II. The learning process consists of micro-learning adapted to the principles of Suppuridharma based on mixed truth technology, divided into 7 stages: 1) Being a knower of the cause (Dhammanyuta) Learners test their original knowledge before studying, 2) Being a knower of the result (Attanyuta), a system to notify the results of the original knowledge test in accordance with the principles of Sappurith, 3) Being a knower (Attanyanta), learners must know the reason, the system of informing the purpose of learning, 4) Being a knower of the approximation (Mattanyuta), a system of informing the learning path. Learners must estimate themselves and set goals to learn appropriately. 5) Being a Knower of Time (Kalanyuta) who learns from knowledge video clips. 6) Learners who know the community (Prisanyuta) who learn with their peers using mixed reality technology, learners who use the mixed reality technology system to attend classes together with their peers as a creative learning community, 7) Become a person who knows people (Pukkanyuta) Learn to respect the rights of others, know how to adapt and work together in harmony.

III. Post-Test: The final post-study assessment. When learners learn all learning units to evaluate as follows Learning Recession Test With the Good Citizenship Assessment form, learners must pass 3 assessors: self-assessment, peer assessment, peer assessment, and peer assessment and learner assessment teachers



IV. Feedback Factor The system notifies learners of the assessment results. If the learner completes the content that must be rehabilitated, the learning recession must be restored. And through the evaluation of good city results, the learning process can be completed. The passing criteria are as follows: The score after the study is higher than during the study according to the criteria, and the score is higher than or equal to 80 and passes the assessment of good city results. They must pass 3 evaluators, namely self-assessment learners, peer assessment peers, and learner assessment teachers, and then inform them of the content that needs to be learned to pass the criteria. In case the learner has not passed the criteria. Go back to learn more about the material and go through the evaluation process again.

An adaptive micro-learning model based on Dharma using mixed reality technology to recover learning loss and develop good citizenship can show the trial of the system to students, as shown in Figure 3.

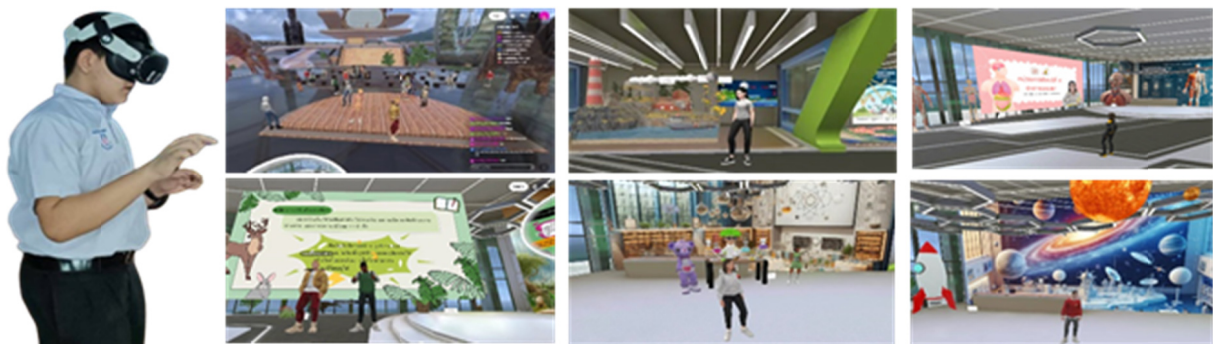


Figure 3. Learning management with an adaptive micro-learning model based on dharma using mixed reality technology to recover learning loss and develop good citizenship

#### 4.5 Results of Evaluation of the Effectiveness of the Learning Management System

The researcher provided 19 experts. Evaluate the effectiveness of the micro-adaptive learning management system based on mixed reality technology. The results of the evaluation are shown in Table 3.

Table 3. Evaluation of the effectiveness of the adaptive microlearning management system based on mixed reality technology

| Assessment List  | Evaluation Results |      | Suitability level |
|--|--------------------|------|-------------------|
|  | $\bar{x}$          | S.D. |                   |
| 1. Mixed Reality Technology Learning Management System (Login)   | 4.82               | 0.25 | most              |
| 2. The micro-learning activity management system is adapted according to the principle of Dharma and is based on mixed reality technology. | 4.86               | 0.23 | most              |
| 3. Evaluation Management System  | 4.74               | 0.36 | most              |
| 4. Communication and Interaction Management System   | 4.84               | 0.37 | most              |
| Total Average  | 4.78               | 0.34 | most              |

From Table 3, it is found that the results of the evaluation of the effectiveness of the micro-adaptive learning management system are based on the principle of mixed reality technology. Overall, it is the most appropriate level ( $\bar{x}= 4.78$ , S.D. = 0.34).

#### 4.6 Comparative Results of Good Citizenship Before and after Learning

The Good Citizenship Assessment consists of assessing the behavior of the learners. The average value is calculated from the assessment of teachers, parents, and learners, consisting of 15 questions as shown in Table 4.

Table 4. The good citizenship assessment consists of assessing the behavior of the learners. The average value is calculated from the assessment of teachers, parents, and learners, consisting of 15 questions

| Assessment behavior  | False<br>(0 score)       | Maybe it's true<br>(1 score) | True<br>(2 score)        |
|--|--------------------------|------------------------------|--------------------------|
| 1. Try to care about other people's feelings. Respect relationships and be nice to others.   | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |
| 2. Willingness to share things with others (food, games, pens, etc.)                         | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |
| 3. You can rely on him if you are sad, in a bad mood, or uncomfortable.                      | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |
| 4. Most of my friends like him/you.  | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |
| 5. There are volunteers in the community to help others. (Parents, teachers, other children) | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |
| 6. Think before you act, use reason in everyday life.  | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |
| 7. Responsible for completing the work.  | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |
| 8. Work with others towards the same goal.   | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |
| 9. Caring for the Environment  | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |
| 10. Responsible in the digital world Do not violate the rights of others.                    | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |
| 11. There is a sense of patriotism and national pride.                                       | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |
| 12. Continuously engage with real-world events.  | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |
| 13. Have a good sense of citizenship.  | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |
| 14. Study morals and behave like a good person.  | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |
| 15. Emphasis on justice in life  | <input type="checkbox"/> | <input type="checkbox"/>     | <input type="checkbox"/> |

The sample was Grade 6 students from the classroom group sampling. 39 people were confidential and anonymous. Each learner is evaluated by 3 evaluators: the teacher, the parent, and the learner himself. Apply the score of the Good Citizenship Assessment before school and the results of the Good Citizenship Assessment after the class. Bring the score to the average as in the 5th place.

Table 5. Mean standard deviation t-test statistics and statistical significance levels in comparing the results of good citizenship assessments before and after studies

|           | Mean  | S.D. | t    | p        |
|-----------|-------|------|------|----------|
| Pre-Test  | 15.87 | 2.36 | 0.71 | < .001** |
| Post-Test | 25.72 | 1.53 |      |          |

\*\*P<.01.

From Table 4, it was found that the learners had an average good citizenship score before studying 15.87 points, or 52.90 percent, which is at a fair level, and the learners had an average good citizenship score after studying 25.72 points, or 85.73 percent, which is at a good level. Statistically significant is at the .01 level.

## 5. Discussion and Conclusion

The study presents the development and implementation of an adaptive micro-learning model based on Dhamma principles using Mixed Reality (MR). The model, evaluated by experts, received the highest average ratings in all aspects, indicating its suitability for organizing effective learning environments. When applied to student learning, the model produced significant improvements in both post-test scores and citizenship assessments, demonstrating the model's potential to foster good citizenship alongside academic achievement. This improvement is attributed to the active engagement facilitated by the adaptive learning management system, which enhances student participation and contributes to overall success (Panto et al., 2024).

Microlearning systems have also shown significant positive effects on students' ability to absorb and retain knowledge, making them an ideal component in modern education (Leela et al., 2019). MR technology further enriches the learning experience by allowing students to interact with virtual objects in ways that closely mimic real-life experiences, thereby enhancing understanding and engagement (Knyazev & Cheremukhina, 2022). These findings align with research that supports the integration of advanced technology into education as a means to increase student motivation and learning outcomes.

The learning process in this study was designed in the form of a virtual science museum, incorporating 3D images,

short video clips, and knowledge slides. This immersive design enabled students to explore content independently from anywhere, anytime while engaging with peers through the system's collaborative features. MR accessories enhanced this experience by merging the physical and digital worlds, making the learning process both exciting and engaging. Students could access the learning materials through various devices, including computers, tablets, or smartphones, each offering a unique and immersive experience tailored to the learners' needs.

However, the research also highlights limitations related to the use of technology and MR accessories. While MR technology provides a dynamic learning environment, its complexity requires proper training for both teachers and students. The initial setup and use of MR tools can be challenging, necessitating teacher preparation and clear guidelines to ensure that students respect the rights of others within the virtual world, like real-life interactions. Teachers must provide continuous guidance and feedback to ensure the system's effectiveness. These challenges are consistent with findings by (Viraktamath et al., 2021), who noted that while MR classrooms offer intriguing opportunities, the high costs and complexity of these technologies often push students and educators toward more traditional learning environments.

Incorporating moral and ethical guidelines derived from Dhamma principles into the learning model also plays a crucial role in fostering students' development as good citizens. Studies have demonstrated that applying such principles in education leads to balanced growth in mental, emotional, and social domains, which are essential for students to become responsible members of society (Thanda, 2023). This holistic approach to education emphasizes not only academic success but also moral integrity, ensuring that students are well-prepared to contribute positively to society.

## References

- Aziz, F. A., Alsaeed, A. S. M. A., Sulaiman, S., Ariffin, M. K. A. M., & Al-Hakim, M. F. (2020). Mixed reality improves education and training in assembly processes. *Journal of Engineering and Technological Sciences*, 52(4), 598-607. <https://doi.org/10.5614/j.eng.technol.sci.2020.52.4.10>
- Cheng, Q., Benton, D., & Quinn, A. (2021). Building a Motivating and Autonomy Environment to Support Adaptive Learning. *Proceedings-Frontiers in Education Conference*, FIE, 2021-October. <https://doi.org/10.1109/FIE49875.2021.9637397>
- Christie, M. D., Fredericksen, T., & Li, W. (2023). Development of a Magnetorheological Elastomer Actuator for a Mixed Reality Haptic Glove. *IEEE/ASME International Conference on Advanced Intelligent Mechatronics*, AIM, 2023-June, 507-510. <https://doi.org/10.1109/AIM46323.2023.10196291>
- Díaz Redondo, R. P., Caeiro Rodríguez, M., López Escobar, J. J., & Fernández Vilas, A. (2021). Integrating micro-learning content in traditional e-learning platforms. *Multimedia Tools and Applications*, 80(2), 3121-3151. <https://doi.org/10.1007/s11042-020-09523-z>
- Skalka, J., Drlik, M., Obonya, J., & Cápáy, M. (2020, April). Architecture proposal for micro-learning application for learning and teaching programming courses. In *2020 IEEE Global Engineering Education Conference (EDUCON)* (pp. 980-987). IEEE. <https://doi.org/10.1109/EDUCON45650.2020.9125407>
- Kaeduang, K., Pimthong, S., & Poonpol, P. (2019). Psycho-Social Factors Affected Good Citizenship Behavior in Digital World of High School Students under the Basic of Education Commission in Bangkok 1. *Journal of Behavioral Science for Development (JBSD)* (Vol. 11, Issue 1).
- Kang, Y. J., & Kang, Y. (2022). Mixed reality-based online interprofessional education: A case study in South Korea. *Korean Journal of Medical Education*, 34(1), 63-69. <https://doi.org/10.3946/kjme.2022.220>
- Ke, L., & Starkey, H. (2014). Active citizens, good citizens, and insouciant bystanders: The educational implications of Chinese university students' civic participation via social networking. In *London Review of Education* (Vol. 12, Issue 1). <https://doi.org/10.18546/LRE.12.1.06>
- Knyazev, A., & Cheremukhina, J. (2022). Regulatory and Methodological Support for the Mixed Reality Technology in Education. *Proceedings-2022 2nd International Conference on Technology Enhanced Learning in Higher Education, TELE 2022*, 37-39. <https://doi.org/10.1109/TELE55498.2022.9801029>
- Kongtana, S., Suntrayuth, D., & Kosaiyawat, S. (2019). A STUDY OF FEATURES GOOD CITIZENSHIP AND FEATURES CONDUCIVE TO THE DEVELOPMENT OF THE COUNTRY OF THAI STUDENT IN EASTERN AREA. *E-Journal of Education Studies, Burapha University*, 6(2), 67-81.
- Kontinen, T., & Bananuka, T. H. (2022). NGO Legitimacy as a Continuous Negotiation Process: Fostering 'Good Citizenship' in Western Uganda. *Nordic Journal of African Studies*, 31(4), 350-373. <https://doi.org/10.53228/njas.v31i4.963>

- Leela, S., Chookaew, S., & Nilsook, P. (2019). An effective microlearning approach using living book to promote vocational students' computational thinking. *ACM International Conference Proceeding Series*, 25-29. <https://doi.org/10.1145/3369199.3369200>
- Li, H., & Tan, C. (2017). Chinese teachers' perceptions of the 'good citizen': A personally-responsible citizen. *Journal of Moral Education*, 46(1), 34-45. <https://doi.org/10.1080/03057240.2016.1277341>
- Liu, Y., Liu, Y., & Yue, K. (2021). Investigating the factors that influence technology acceptance of an educational game integrating mixed reality and concept maps. *Proceedings-IEEE 21st International Conference on Advanced Learning Technologies, ICALT 2021*, 409-413. <https://doi.org/10.1109/ICALT52272.2021.00130>
- Luo, L., Weng, D., Hao, J., Tu, Z., & Jiang, H. (2023). Viewpoint-Controllable Telepresence: A Robotic-Arm-Based Mixed-Reality Telecollaboration System. *Sensors*, 23(8). <https://doi.org/10.3390/s23084113>
- Martin, L., & Ci-Hodo, J. J. (2008). *AMERICAN INDIAN STUDENTS SPEAK OUT: WHAT'S GOOD CITIZENSHIP?* Retrieved from <https://files.eric.ed.gov/fulltext/EJ944022.pdf>
- Neamsawas, S. (2007). *Construction of a test to Measure Emotional Quotient in Accordance with the Buddhist principles of 7 Sappurisdhamma for students Matthayom Sueksa 1-3*.
- O'Brien, J. L., & Smith, J. M. (2011). Elementary Education Students' Perceptions of "Good" Citizenship. *Journal of Social Studies Education Research*, 2011, 21-36.
- Panto, I. L., Feliscuzo, L., & Pantaleon, C. B. (2024). Designing an Adaptive Learning Management System at AMA Computer Learning College-ORMOC (ACLC): Development and Analysis. *ICDXA 2024-Conference Proceedings: 2024 3rd International Conference on Digital Transformation and Applications*, 243-248. <https://doi.org/10.1109/ICDXA61007.2024.10470726>
- Pellas, N., Kazanidis, I., & Palaigeorgiou, G. (2020). A systematic literature review of mixed reality environments in K-12 education. *Education and Information Technologies*, 25(4), 2481-2520. <https://doi.org/10.1007/s10639-019-10076-4>
- Phompanya, K. (2020). *Virtual world technology moves towards real-world*.
- PhraKhamse, P., & Thitiwut, M. (2018). The Sappurisa Dhamma Theory Self Management. *Alumni Association Journal Mahachulalongkornrajavidyalaya University*, 7(2), 69-76.
- Promsorn, K., Nilsook, P., & Piriya-surawong, P. (2024). *Adaptive Microlearning Using Mixed Reality Technology* (pp. 53-60). [https://doi.org/10.1007/978-981-97-3883-0\\_5](https://doi.org/10.1007/978-981-97-3883-0_5)
- Rafiee, N., Mehrabi, M., & Karimian, Z. (2023). Design, implementation and evaluation of the effectiveness of training caregivers of Alzheimer's patients by micro-learning method. *10th International and the 16th National Conference on E-Learning and E-Teaching, ICeLeT 2023*. <https://doi.org/10.1109/ICeLeT58996.2023.10139898>
- Reynolds, R., Macqueen, S., & Ferguson-Patrick, K. (2019). Educating for global citizenship: Australia as a case study. *International Journal of Development Education and Global Learning*, 11(1), 103-119. <https://doi.org/10.18546/ijdegl.11.1.07>
- Ristić, I., Runić-Ristić, M., Savić Tot, T., Tot, V., & Bajac, M. (2023). The Effects and Effectiveness of An Adaptive E-Learning System on The Learning Process and Performance of Students. *International Journal of Cognitive Research in Science, Engineering and Education*, 11(1), 77-92. <https://doi.org/10.23947/2334-8496-2023-11-1-77-92>
- Rithish, R. S., Vaishali, V., Balavedhaa, S., Sushmita, V., & Sabitha, B. (2023). Collaboration of Mixed Reality for Interactive Visualization of Ocean Mapping. *2nd International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation, ICAECA 2023*. <https://doi.org/10.1109/ICAECA56562.2023.10199242>
- Shail, M. S. (2019). *Using Micro-learning on Mobile Applications to Increase Knowledge Retention and Work Performance: A Review of Literature*. *Cureus*. <https://doi.org/10.7759/cureus.5307>
- Singsorn, N. (2023). The Integration of Proactive Leadership according to the Principles of the Sappurisa Dhamma VII for School Administrators in the VUCA World Era. *ASEAN Journal of Religious and Cultural Research*, 6(1), 14-18.

- Smaili, E. M., Khouda, C., Sraidi, S., & El Hassan Charaf, M. (2020, December 2). An optimized method for adaptive learning based on PSO Algorithm. *2020 IEEE 2nd International Conference on Electronics, Control, Optimization and Computer Science, ICECOCS 2020*. <https://doi.org/10.1109/ICECOCS50124.2020.9314617>
- Smyrnova-Trybulska, E., Morze, N., & Varchenko-Trotsenko, L. (2022). Adaptive learning in university students' opinions: Cross-border research. *Education and Information Technologies, 27*(5), 6787-6818. <https://doi.org/10.1007/s10639-021-10830-7>
- Sukamol, T. (2018). An Application of the Sappurisa-Dhama in the Management Integration of Panai Sub-District Administrative Organization, Phrao District, Chiang Mai Province. *Journal of Buddhist Studies, 9*(1), 69-81.
- Sun, G., Cui, T., Yong, J., Shen, J., & Chen, S. (2018). MLaaS: A Cloud-Based System for Delivering Adaptive Micro Learning in Mobile MOOC Learning. *IEEE Transactions on Services Computing, 11*(2), 292-305. <https://doi.org/10.1109/TSC.2015.2473854>
- Thanda, I. (2023). *Learning Management by Sufficien Economy According to Suppurisadham 7 of Secondary Sahabumrungwittaya School, Dontom District, Nakornpathom Provice*. Mahachulalongkornrajavidyalaya University, 1-129. Retrieved from <https://so02.tci-thaijo.org/index.php/jemri/article/view/266161/178883>
- Thompson, J. (2022). *Types of Adaptive Learning Types of Self-led e-Learning, Micro-Adaptive Systems and Algorithm-Based Systems*.
- Thonjinda, B., & Srijumngong, J. (2019). A Construction of Good Citizenship Test for Prathom Suksa VI Students under Nongbualumphu Primary Educational Service Area Office 2. *Ubon Ratchathani Journal of Research and Evaluation, 8*(1), 21-30.
- Treviño, E., Carrasco, D., Claes, E., & Kennedy, K. J. (n.d.). *IEA Research for Education 12 A Series of In-depth Analyses Based on Data of the International Association for the Evaluation of Educational Achievement (IEA) Good Citizenship for the Next Generation A Global Perspective Using IEA ICCS 2016 Data*. Retrieved from <http://www.springer.com/series/14293>
- Tupper, J. A., & Cappello, M. P. (2012). (Re)creating citizenship: Saskatchewan high school students' understandings of the "good" citizen. *Journal of Curriculum Studies, 44*(1), 37-59. <https://doi.org/10.1080/00220272.2011.618951>
- Üniversitesi, D., Gökalp, Z., Fakültesi, E., Türkiye, D., & Bilgisi Öz, M. (2020). *Good Human Good Citizen from the Perspective of Secondary School Students*. <https://doi.org/10.14812/cufej.673422>
- Upanan, A., Boonsriton, P., Phuwanatwichit, T., & Wannapaisan, C. (2022). Path of Khruba: Leadership for Empowering Good Citizenship. *International Education Studies, 15*(3), 85. <https://doi.org/10.5539/ies.v15n3p85>
- Vasilevski, N., & Birt, J. (2020). Analysing construction student experiences of mobile mixed reality enhanced learning in virtual and augmented reality environments. *Research in Learning Technology, 28*. <https://doi.org/10.25304/rlt.v28.2329>
- Villalobos, C., Morel, M. J., & Treviño, E. (2021). *A Comparative Approach to Notions of Good Citizenship* (pp. 51-66). [https://doi.org/10.1007/978-3-030-75746-5\\_4](https://doi.org/10.1007/978-3-030-75746-5_4)
- Viraktamath, S. V., Sajjanar, T. P., Angadi, A. A., Nabhapur, S. S., & Sunanda, G. (2021). The Impact of Mixed Reality in Education System-the Classroom Environment. *2021 International Conference on Circuits, Controls and Communications, CCUBE 2021*. <https://doi.org/10.1109/CCUBE53681.2021.9702735>
- Yinilmez Akagündüz, S. (2020). Citizenship Consciousness and Moral Values in Civics Textbooks in Turkey (1924-1945). *Educational Policy Analysis and Strategic Research, 15*(4), 69-85. <https://doi.org/10.29329/epasr.2020.323.4>

**Acknowledgments**

This research was supported by a research grant from the Secondary Education Service Office Pathum Thani and King Mongkut's University of Technology North Bangkok.

**Authors contributions**

Dr. Kitiya Promsron was responsible for study design, revising, and accountable data collection. All authors read and approved of the final manuscript.

**Competing interests**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**Informed consent**

Obtained.

**Ethics approval**

The Publication Ethics Committee of the Canadian Center of Science and Education.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

**Provenance and peer review**

Not commissioned; externally double-blind peer reviewed.

**Data availability statement**

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

**Data sharing statement**

No additional data are available.

**Open access**

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).

**Copyrights**

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.