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Investigating the effectiveness of introducing virtual reality to elementary school students' moral education

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ABSTRACT

This study was conducted to investigate whether a virtual reality (VR)-based morality education program is effective in cultivating morality among elementary school students. After conducting VR-based activities and classroom discussions, 162 elementary school students in South Korea were surveyed. According to Rest's theory, we measured moral sensitivity and moral judgment for the evaluation of moral development of students. The use of this model resulted in a significant improvement in moral sensitivity but no significant difference in moral judgment. This study revealed that, although moral sensitivity can be improved relatively easily through our educational program with VR, a separate educational effort is required to improve moral judgment. In addition, this study is meaningful in that it sheds light on the potential of VR, which is closely related to the technology used in the metaverse.

1. Introduction

Owing to the coronavirus disease 2019 (COVID-19) pandemic, physical movement and face-to-face contact have become difficult, resulting in various changes in daily life. Since regular activities at school or work could no longer be continued, technologies such as video conferencing, virtual reality (VR), and the metaverse have been implemented (Hyun & Park, 2020). In particular, the size of the related market has grown significantly owing to the spread of user experience in VR and the metaverse. According to Grand View Research (2021), the global VR market was estimated at $15.81 billion as of 2020, with an annual growth estimate of 18% from 2021 to 2028. As technological development and dissemination accelerate, potential ethical issues have also become complicated. At a time where laws and institutions cannot keep pace with technological development, ethical consciousness among members of society is important (Noddings, 2010). Hence, there is a need to discuss educational methods for cultivating morality.

Public education approaches for the youth's moral development vary from country to country. Unlike the United States, South Korea has separate morals-related subjects in its elementary schools (National Youth Policy Institute, 2011). The moral curriculum in South Korea consists mainly of learning the ethical theories of classical thinkers or explaining correct moral judgment through stories (Ministry of Education, 2015). However, this method of teaching makes it difficult for people to develop the capacity to sensitively perceive moral issues, make reasonable moral judgments, and choose moral actions courageously in practical moral dilemma situations. The Organisation for Economic Co-Operation and Development (2019) also presented "creating new value," "reconciling tensions and dilemmas," and "taking responsibilities" as the core competencies required for the future. In addition, individual competency is emphasized to create a society that can coexist sustainably and harmoniously despite various interests (Organisation for Economic Co-Operation and Development, 2019). Thus, it is necessary to identify a new method of teaching moral education that is suitable for the future.

Using VR to a moral development program has considerable advantages. Introducing VR is needed to understand the effects. In general, VR technology has characteristics that make it possible for participants to immerse, interact, and imagine. Education using such VR technology is known to have positive effects by increasing motivation and interest in learning and lowering anxiety (Huang et al., 2016). Until now, research on educational programs incorporating technologies such as augmented reality and VR has been actively conducted in various subjects such as science (Wojciechowski & Cellary, 2013), mathematics (Chen, 2019), and foreign languages (Hsu, 2017). However, there has been little discussion about the application of such technologies to moral education.

Morality appears to be a capability that can be developed through education programs (Cloninger & Selvarajan, 2010; Schlaefli et al., 1985). So trying to research various education methods to improve morality is meaningful. However, educational research using VR to

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cultivate ethics has been conducted with only college students (Sholihin et al., 2020) and teachers (Stavroulia & Lanitis, 2019). Just few studies use VR for ethical education targeting elementary school students. In addition, Existing VR-based educational research tends to fail in maximizing participants' immersion owing to limitations in the user interface (mouse click or keyboard text input while sitting) (Feng et al., 2022). Considering these limitations, this study targets elementary school students and is designed to enable realistic and flexible physical activity through a smart pad.

Furthermore, this research model consists of one student (Player) participating in VR and five students (Poll) voting on what decision to make on ethical issues. Cooperative learning that enables learner-learner interaction has great advantages in cognitive, emotional, and social development (Laal & Ghodsi, 2012). Since morality is related to interpersonal relationships, it is necessary to design interactions among learners, such as discussion and cooperation, in the context of teaching and learning (Rest, 1983; Schlaefli et al., 1985). Therefore, in this model, the interaction points were variously designed as "player and VR," "poll and VR," "player and poll," and "poll and poll." Unlike research on the educational use of VR technology, which has focused only on individual-device interactions (Chen, 2019; Hsu, 2017; Wojciechowski & Cellary, 2013), we attempted to increase the effectiveness of education programs by designing a model that enables learner-learner interaction.

This study aims to explore the effect of a moral education program based on VR content. To this end, we first present the characteristics of VR that are considered when designing educational programs. The morality measurement tool used in this study and prior related research will be introduced. We also explain how to diversify the interaction point in the educational program. Finally, the conclusion provides a summary, critique, and implications of the findings.

2. Theoretical framework

2.1. Elementary school students' moral education in korea

Moral education should be directly related to the daily experience of children. Moral education which is related to the specific experience is effective in promoting the morality of children. For example, Nobumichi (2017) got a similar conclusion that the relation with experience can improve morality through his study about the connection between two accidents in Japan and the improvement of morality. With prior moral education, a teacher introduces some episodes to children and then the children think of and discuss them. This activity aims for children to get a moral realization. However, after the research by Nobumichi, he got the implication that some materials used in moral class like episodes have nothing to do with children's morality because they are not addressed in real experience.

In Korea, moral education is the main sector of school education and serves as the basis of the human image that the state wants to raise through education. Education of Korea aims to live like a human being by developing a personality and having the qualities of a democratic citizen. Based on this, it pursues a human being who practices consideration and sharing. And it assigns competencies such as empathetic understanding of humans, cultural sensitivity, and respect for others' opinions, values, and attitudes required by members of the community as the core competencies in order to achieve this purpose and wants to raise them in priority (Ministry of Education, 2018). Especially in elementary education where children start to get a real education, Korea shows the importance and authority of moral education by putting observing the rules and order and growing a caring attitude as the educational purpose. A moral human being is a goal of Korean education.

Korean moral education emphasizes the effect of experience for the morality cultivation of elementary school students. 'Being moral' starts with the experience of students, progresses with inquiring and reflection, and is gained by the process of practicing in one's own life. In reality, the moral curriculum (Ministry of Education, 2015) mentions that morality is a subject of 'practical character'. Moral class in elementary school includes activities associated with daily experience for students to learn moral values and knowledge. For instance, a teacher conducts a 'making a life plan' activity to teach diligence. Especially in the education of elementary school students, in addition, a teacher uses active ways like plays and role plays in order to increase the interests of students. Moral education via experience and activity helps students to internalize moral values by making them more immersed and focused on the situation. This leads to the results of the practice of moral values in daily life.

It is connected with the moral sensitivity of Rest to improve 'a moral thought ability that recognizes problems of life as the moral thing and make discrimination between right and wrong with reasonable argument through moral judgment and inference'. Morality pursued in an ethics class in Korea means not only academic inquiry and intellectual understanding but also the process of reflecting and practicing inner morality based on sensitivity to the moral situation in society (Kim, 2019). Developing moral sensitivity which is the ability to identify moral issues in a certain situation is the starting point of improving morality (Lee et al., 2011). So as to grow moral sensitivity, experience-oriented education is essential to apply in real life.

There is a moral human being at the base of the human being that Korean education aims for. In particular, elementary education is the starting point for students to learn moral values, so efforts to teach naturally without a feeling of resistance are needed (Kim, 2017). At this point, non-boring experiences and activities are required, and the Korean moral curriculum actually emphasizes this.

In addition, various kinds of technology are used in moral education (Moon, 2019). Teachers conduct classes with a computer and students follow it watching the screen. Sometimes they watch videos related to some moral situations and also they play games using electronic devices. Especially watching videos about some moral situations is helpful for children to understand and be absorbed in them. Considering the recent tendency that children are very interested in electronic devices and media with the development of science and technology, it would be worth trying to organize classes that are more interesting and can make children fall into situations using VR and other electronic devices.

2.2. Evaluating the moral level of elementary school students

A way to evaluate the moral level of children goes back to Kohlberg's six stages of moral development. At the Preconventional Level, the first level, a child responds to cultural rules. In stage 1 within the first level, the physical result of behavior decides its right and wrong and in stage 2 whether the need is satisfied instrumentally decides this. Second, at the Conventional Level, keeping the expectation of family, groups, or state is considered a valuable thing. In state 3 within the second level, people do moral behavior for the purpose of interpersonal harmony aiming for "good boy – nice girl", and in stage 4 people think right behavior is fulfilling their duties aiming for laws and order. In stage 5 within the third level, Postconventional Level, right behavior is defined as ordinary personal rights and standards that are critically verified by the whole society. Stage 6 is a stage of universal ethical principles so rightness is defined as a self-selected ethical principle (Kohlberg, 1975). About this, Gilligan thought that morality can be divided into the ethics of justice and the ethics of care and criticized Kohlberg's theory focused on just ethics of justice (Vikan et al., 2005). His theory consists of only observations of boys and the groups not included in his sample do not reach the top level. Thus, women are considered a group with weak moral development by his standards, but women's moral fields are different from men's. So Kohlberg's theory is male-centered (Gilligan, 1977). Noddings developed the ethics of care by Gilligan and stated the ethics of care that worry about others in a condition of emotional and moral strain (Noddings, 1984).

Rest developed his theory after analyzing critics of scholars about Kolhberg's theory (Rest et al., 2000). To date, moral research consists of three stems: moral thinking, moral emotion, and moral behavior. The

cognitive development theory has focused on moral thinking, psychoanalysis has focused on moral emotion, and behaviorism and social learning theories have focused on moral behavior. Rest (1983, 1986) presented the Four-Component Model of Morality as a theoretical framework synthesizing these three elements. Rest (1986) viewed morality as the way to determine rights and obligations in social interaction, as well as the way of interacting for cooperation and promoting mutual welfare. He also suggested that moral behavior is accomplished through four components.

Rest's (1986) model consists of moral sensitivity, moral judgment, moral motivation, and moral character. Moral sensitivity involves perceiving moral issues embedded in a situation, appreciating how one's actions may affect or result in others, and identifying and understanding one's feelings about the problem. Moral judgment is the ability to integrate various situational considerations and determine which actions best satisfy moral ideals. Moral motivation is the degree of motivation to put moral values above other values (e.g., economic, social, and religious values). Moral characterization includes sub-characteristics such as ego-strength, patience, and courage; it refers to the ability to behave morally.

This study focuses on moral sensitivity and moral judgment among Rest's four moral components to investigate the effectiveness of VR-based programs for moral development. This is because moral judgment is a key factor in enabling moral behavior, and many studies using Rest's theory also focus on moral judgment (Rest, 1975, 1986, 1988; Rest & Thoma, 1985). In addition, moral sensitivity is inseparable from moral judgment, and the ability to perceive a specific situation as a moral issue is the foundation of moral judgment (Jordan, 2007). In particular, empathy plays an important role in moral sensitivity (Bebeau, 2002; Hoffman, 2000; Rest, 1983), and it is expected that the strengths of VR education, including presence, will increase moral sensitivity.

Meanwhile, the Defining Issues Test (DIT), which measures moral judgment among the four elements of morality and has been validated in various contexts, is commonly used (Lim & Chapman, 2021; Rest, 1979a, 1979b; Rest et al., 2000; van den Enden et al., 2019). Prior research has utilized the DIT with the following populations: elementary school students (Clark, 1979; Shafer, 1978), middle school students (Boland, 1980; Nichols et al., 1977), high school students (Codding, 1980; Fowler et al., 2009; Gallagher, 1978; Manville, 1979; Preston, 1979; Sach, 1978), and college students and professionals (Abdolmohammadi & Reeves, 2000; Bridston, 1979; Donaldson, 1981; Hanford, 1980; Hijazeen et al., 2021; Lan et al., 2019; Li et al., 2018; Oja, 1977; Rest, 1994; Wilhelm et al., 2021). Many researchers have reported that their educational programs had a positive effect on moral judgment. Such programs have been particularly effective when they include classroom discussions about a moral dilemma situation or an activity arousing emotional empathy or cooperation (Schlaefli et al., 1985).

DIT provides more empirical evidence than the measurement method of Kohlberg at the last level of morality, the Postconventional Level. According to this method of Kohlberg, there is little evidence about stage 5 and no evidence about stage 6. To measure the whole stage of moral development, it is helpful to use DIT. It has already been widely used in studies that investigate a wide range of moral issues for college students. So it plays an important role in understanding the moral judgment development of colleges (Patricia & Matthew, 2002).

2.3. Virtual reality

VR is an interface that creates a virtual environment or scenario through a computer so that users can feel as if they are interacting with the real world. The first VR head-mounted display was invented by computer scientists Ivan Sutherland and Bob Sproull in 1968, and the term "VR" was popularized by Jaron Lanier in the 1980s (Globaldata, 2020). VR technology is valuable because it allows users to view and manipulate an environment that is difficult to experience on a daily basis. In the 1990s, VR technology was mainly by the US military and NASA for training purposes. Since the 2010s, as a result of the development of software and hardware, the use of VR technology has been significantly expanded, such as for games, culture, tourism, medicine, education, exploration, and scientific visualization. As non-face-to-face activities increase after COVID-19, interest in the metaverse has increased, and the VR industry, which is closely related to this, is expected to grow significantly.

This study involves the use of VR in the education field. VR-based learning environments provide real virtual learning environments and help learners interact and immerse themselves in the virtual space using various senses (Huang et al., 2016; Pantelidis, 2010). It also provides a practical context and a safe environment for learners to perform specific activities (Burdea, 1999).

The three main characteristics of VR are interaction, immersion, and imagination. Regarding interaction, the user explores the VR content through their sensory organs centered on vision and responds physically, psychologically, and behaviorally. VR content also detects the user's response and responds immediately or provides a new situation or scene. The sense of reality is maximized through the process of interaction between the user and the VR content, and between users participating in the same VR environment. In the VR learning environment, meaningful learning should be led by providing timely feedback on learners' responses (Burdea & Coiffet, 2003).

Immersion refers to how sensibly users immerse themselves and how meaningfully they interact in the virtual world (Sherman & Craig, 2003). The type and application method of multiple sensorial channels greatly influences the level of user immersion. The immersive experience in a VR-based learning environment helps learners maintain knowledge in the long term (Taxén & Naeve, 2002). VR-based simulation education provides learners with virtual situations or environments similar to real ones to acquire specific knowledge such as concepts, principles, and rules related to reality.

Imagination refers to the ability to recognize things that do not exist (Burdea & Coiffet, 2003). In a VR-based learning environment, imagination helps learners refine their thinking and participate in meaningful learning (Jonassen, 2013). In other words, learners can creatively perceive and imagine things that do not exist when learning in a virtual environment. The VR learning environment stimulates the imagination and leads to meaningful learning (Huang et al., 2010).

3. Moral education with a virtual reality program

In this study, the moral education with VR program was developed to overcome the limitations of existing ethics education. The model consists of VR activity with the elements of the story, play, discussion (conversation), and poll, as well as teacher-led classroom discussion as shown in Fig. 1. The entire process of the VR activity was designed to include collaborative learning along with the VR characteristics of interaction, imagination, and immersion. The story refers to a VR scenario that involves a mission including moral issues. Students become the main characters (Alice) of the VR content who try to overcome moral dilemmas and add opinions on the moral judgment from the time they encounter the dilemma situation (poll). The story unfolds differently depending on the students' performance and decisions (see Fig. 2).

Alice (play) is the main character in the VR content and directly performs a mission. The missions are divided into routine action (e.g., item acquisition, location movement, scene change, etc.) and moral action (e.g., decision-making in a dilemma situation involving moral issues). In the moral action mission, other students in the role of "poll" also vote on which action to choose after discussion, and the student in the role of Alice considers this and makes the final decision. Through this, the learner not only gets an opportunity to consider the moral dilemma situation from multiple perspectives but also experiences independent decision-making (see Fig. 3).

Discussion and poll involve collective decision-making to solve the missions given in the VR content. Students discuss which behavior to

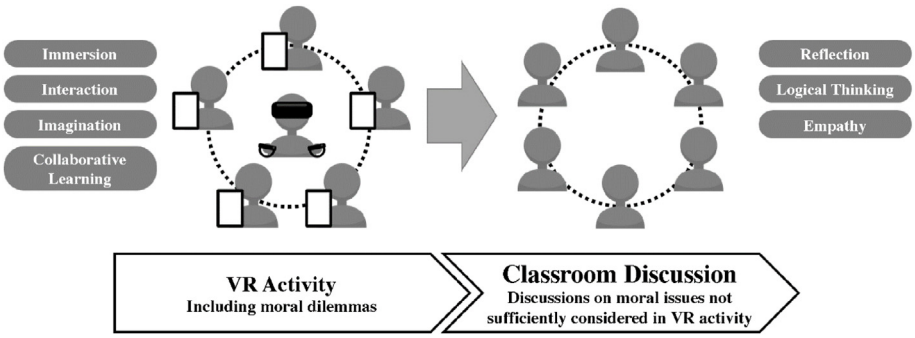

Fig. 1. Research model.

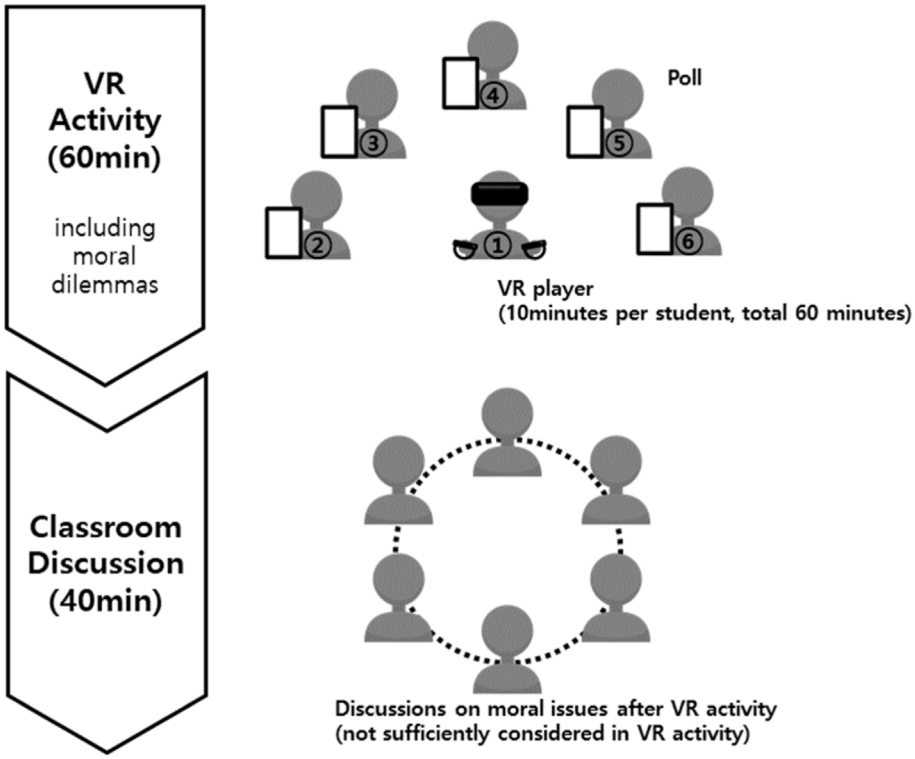

Fig. 2. The procedure of VR activity.

choose in the moral dilemma situation and then vote individually. This allows students to consider moral conflict situations from a different perspective and experience the process of deliberation on which decision is better. Thus, group decision-making provides students with an experience to reflect on moral issues socially and rationally.

Classroom discussion proceeds once the VR activity has concluded, enabling a more in-depth approach to moral issues encountered through VR content. In the discussion activity, students talk about moral issues they have not sufficiently considered or expressed while performing the VR activity. Through this, students have the opportunity to look back and reflect on what they judged and acted on in the VR activity. This also helps students consider practical ways to practice morally mature judgment and moral action in real-life situations.

The main point is that this moral education method with VR has a process with both VR activity and classroom discussion. Until now, without VR activity, most moral education is given just through classroom discussion. The VR activity which proceeds before the original way can lead to additional results in moral education for elementary school students.

4. Material and methods

4.1. Participants

The participants were 162 students from the 4th to 6th grades attending an elementary school in Seoul. In detail, there were 15 fourth-grade students (eight boys, seven girls), 70 fifth-grade students (35 boys, 35 girls), and 77 sixth-grade students (36 boys, 41 girls), with a total of 79 male students and 83 female students. We obtained informed consent to participate in the study in advance from the parents of all participants. This study was approved by the IRB.

4.2. Measures

In this study, tools for measuring VR components and moral development were used. First, in addition to the three major VR elements, that is, imagination, interaction, and immersion (Baños et al., 2004; Huang et al., 2010, 2016, 2021), collaborative learning (Dillenbourg, 1999), which is one of the main interests of the study, was measured. Each

Fig. 3. The appearance of VR activity.

element was measured with five items scored on a five-point Likert scale ranging from "1 = not at all" to "5 = strongly agree."

The participants' moral development was measured focusing on moral sensitivity and moral judgment. To this end, in this study, a measurement tool was developed and utilized by referring to the DIT devised based on Rest's four components of morality (Lau & Yuen, 2014; Leonard & Haines, 2007; Rest, 1975; Rest & Thoma, 1985). Each of the questions measuring moral sensitivity and judgment consists of two sets. One is a set item related to the story of Alice appearing in a program using a VR device ("Alice item"), and the other is a set item concerning a story of a prisoner that has nothing to do with Alice's story ("general item"). Students don't experience a VR program with the story of a prisoner. A story of a prisoner is an original way used in moral education so this consists of just classroom discussion. Unlike this, the story of Alice has both VR activity and classroom discussion. When students are given the story of Alice, they first enjoy the VR program and do a classroom discussion like the original one. Moral sensitivity consists of six items in each set, and one's sensitivity to a specific situation is measured using a five-point Likert scale ranging from "1 = not at all" to "5 = very much." Moral judgment is measured by ranking from first to fourth which question is most important to consider when determining moral action out of 12 issues given in each set. Specifically, 12 items were designed considering the stage of moral development.

The questions measuring moral judgment correspond to the pre-conventional level (morality as a means of punishment and obedience or satisfying needs), conventional level (morality for harmony in interpersonal relationships or compliance with law and order), or post-conventional level (morality as confidence in universal moral principles). Higher scores correspond to the post-conventional level and lower scores to the pre-conventional level.

Rest's Four-Component Model consists of moral sensitivity, moral judgment, moral motivation, and moral character. However, it turns out that each component is mutually independent and cannot predict or explain others (You & Bebeau, 2013). In addition, many previous studies focused more on moral sensitivity and reasoning ability than on moral motivation or moral characterization when examining the effectiveness of educational programs (Abdolmohammadi & Reeves, 2000; Park et al., 2012; Rest & Thoma, 1985). Therefore, this study also attempts to investigate the effect of the program focusing on moral sensitivity and moral judgment.

4.3. Procedure

Simply explaining, one group consisted of six students. Each student who participated in this study became a VR player and the other five students did a discussion and made a decision. It took 10 min per student so in total it took 1 h. After this, six members did a classroom discussion together for 40 min.

Six participating students were organized into one group, and the VR activity and classroom discussion on moral education with the VR-based program were conducted for 1 h each. In the VR activity, one student acted as the main player, and the other five students performed the discussion and poll. Everyone alternately experienced the role of the main player sequentially. The average playtime per main player was about 10 min, and in the case of some students who were reluctant to wear VR devices, the play was omitted. The following devices were used to run the VR activity: (1) a VR PC, (2) a stereo camera, (3) an HTC Vive business edition, (4) five Smart Pads, and (5) a 3D projection TV screen. When students wore the VR device, they were projected in the form of Alice on the TV screen.

The content of the VR activity consisted of 10 stages. The research team developed the educational content for the VR activity in collaboration with "Studio Coin," a company that creates educational content using augmented reality and VR. Each stage included elements such as an ethically neutral mission for one main player, scenes with moral issues for all participants, and discussion and poll for the other five students. Several game scenes were gathered to constitute the entire game story and play consisted of normal mission play (usual behavior play) and moral behavior play (ethical behavior play).

The entire story of the game is a reconstruction of the fairytale, Alice in Wonderland. Similar to what is known in the story, in the game, Alice fights against the queen, who wields absolute power, to bring justice. In this VR story, Alice drinks a potion that makes her small and comes to enter the queen's world. She meets some characters like a clock rabbit, mashroom, and dragon trainer and becomes a friend. Lastly, they fight against the queen together. In the process, scenes with moral issues are produced, and the game story unfolds differently depending on the results of decision-making, voting, and playing. In other words, the types and number of VR content components that students can experience vary according to the options they select and their decisions. In addition, some results may return the game to its previous level. For example, polls have to choose (1) to escape with the mushroom which Alice meets in a prison,

or (2) to escape alone in class.

When the VR activity was over, the six students were divided into two groups and discussions were conducted in each team. In the first discussion, the teacher determined in advance the behavior that could be selected in the moral conflict situation, and the team discussion was conducted on the relevant basis. Second, a free discussion was conducted wherein each student freely chose their behavior and presented reasons. In the final discussion, everyone in the classroom participated and several groups freely expressed their opinions. Through the discussion activities, students were given an opportunity to think more deeply about the moral issues experienced in the VR activity and to actively express some ways to implement moral behavior in real-life situations.

4.4. Data analysis

STATA 16.0 was used for all statistical analyses. It was confirmed through a *t*-test whether the average difference between moral sensitivity and moral judgment measured through Alice's story and the escaped prisoner's story was statistically significant. In addition, a *t*-test was conducted between groups in the sense that the degree of moral development would be different depending on the score of interaction, imagination, immersion, and collaborative learning for the experience of participating in the VR-based morality education program. To this end, after deriving the average score of each factor measured with five items, the average score of each participant was divided into upper and lower groups. For each VR factor, it was verified whether the upper and lower groups showed a significant average difference in Alice's moral sensitivity, Alice's moral judgment, general moral sensitivity, and general moral judgment.

5. Results

5.1. Moral sensitivity

The results show that the moral sensitivity measured in Alice's story was statistically significantly higher than that measured in the escaped prisoner story (Table 1). This seems to be owing to the environment in which a program using a VR device promotes interaction, imagination, and immersion so that the situation can be perceived more morally and sensitively.

The average of all four VR components measured in this study exceeded 4 points (Table 2). In particular, immersion and interaction experienced when using a VR device are known to increase the sense of presence (Baños et al., 2004). Through VR activities in which the participants became Alice or Alice's friend, they could accept the situation as if it were a reality closely related to their existence, and it seems that they could be more sensitive to the perception of what is morally wrong or unfair.

5.2. Moral judgment

However, there was no statistically significant difference between moral judgment measured through the Alice story and the escaped prisoner story (Table 3). In other words, although the measurement result based on the Alice story showed higher moral judgment, which is an indicator of the degree of moral reasoning in the fifth to sixth stages (post-conventional level), it was not statistically significant.

Table 1
Moral sensitivity: Alice vs. escaped prisoner (n = 162).

	Mean	SD	Z	P
Alice	3.970	.485	2.848**	0.005
Escaped prisoner	3.797	.578		

SD: standard deviation.

Table 2
Descriptive statistics of virtual reality's four components (n = 162).

Variable	Mean	SD	Min	Max
IA	4.605	.517	3	5
IG	4.282	.654	2	5
IM	4.304	.546	2.2	5
CL	4.280	.614	1.8	5

IA: interaction; IG: imagination; IM: immersion; CL: collaborative learning; SD: standard deviation.

Table 3
Moral judgment: Alice vs. escaped prisoner (n = 162).

	Mean	SD	Z	P
Alice	4.685	2.072	1.516	0.132
Escaped prisoner	4.302	2.534		

SD: standard deviation.

Table 4
Moral sensitivity: Alice (grouped by virtual reality score).

	Obs	Mean	SD	Z	P
High IA	81	4.093	.443	3.299**	.001
Low IA	81	3.848	.498		
High IG	81	4.077	.430	2.831**	.005
Low IG	81	3.865	.517		
High IM	81	4.047	.465	2.036*	.043
Low IM	81	3.893	.497		
High CL	81	4.078	.466	2.889**	.004
Low CL	81	3.863	.484		

IA: interaction; IG: imagination; IM: immersion; CL: collaborative learning; SD: standard deviation.

5.3. VR score and moral development

Table 4 shows that the mean differences in moral sensitivity measured through the Alice story between the upper and lower groups were significant. In other words, the group that responded high to the VR factor also had significantly higher moral sensitivity on average than the group that responded low. Specifically, it was found that moral sensitivity measured through the Alice story was significantly higher in the high interaction group than in the low interaction group. Likewise, the group with a high level of imagination had significantly higher moral sensitivity measured through Alice's story than the group with a lower level of imagination. In addition, the group with high immersion had statistically significantly higher moral sensitivity measured through Alice's story than the group with low immersion. The group with high collaborative learning had statistically significantly higher moral sensitivity measured through Alice's story than the group with low collaborative learning. Thus, according to the levels of interaction, imagination, immersion, and collaborative learning, there was a significant average difference in moral sensitivity measured based on Alice's story.

However, contrary to the above, Table 5 shows that moral sensitivity measured based on the story of the escaped prisoner did not show a significant difference according to the VR component scores. The immediate effect of the VR-based moral education program did not appear significantly on the moral sensitivity measured through the story of an escaped prisoner, which had no similarity to the scenario experienced in VR activities.

Table 6 shows that the average difference in moral judgment according to VR scores was not significant in both stories. In other words, moral judgment measured based on the Alice story did not show a significant difference according to the VR component score. In addition, moral judgment measured based on the escaped prisoner story did not show a significant difference according to the VR component score.

Moral judgment is an indicator of the degree of thinking at the post-

Table 5
Moral sensitivity: escaped prisoner (grouped by virtual reality score).

	Obs	Mean	SD	Z	P
High IA	81	3.780	.622	.362	.718
Low IA	81	3.813	.534		
High IG	81	3.802	.636	−.108	.914
Low IG	81	3.792	.517		
High IM	81	3.830	.600	−.742	.459
Low IM	81	3.763	.556		
High CL	81	3.841	.603	−.997	.320
Low CL	81	3.751	.551		

IA: interaction; IG: imagination; IM: immersion; CL: collaborative learning; SD: standard deviation.

Table 6
Moral judgment (grouped by virtual reality score).

		Obs	Mean	SD	Z	P
Alice	High IA	81	4.778	2.139	.568	.571
	Low IA	81	4.593	2.011		
	High IG	81	4.481	2.225	−1.253	.212
	Low IG	81	4.889	1.897		
	High IM	81	4.753	2.119	.416	.678
	Low IM	81	4.617	2.035		
	High CL	81	4.630	2.058	−.340	.734
	Low CL	81	4.741	2.096		
Escaped prisoner	High IA	81	4.185	2.673	−.588	.558
	Low IA	81	4.420	2.673		
	High IG	81	4.531	2.360	1.148	.253
	Low IG	81	4.074	2.693		
	High IM	81	4.321	2.317	.092	.926
	Low IM	81	4.284	2.749		
	High CL	81	4.198	2.304	−.526	.600
	Low CL	81	4.407	2.756		

IA: interaction; IG: imagination; IM: immersion; CL: collaborative learning; SD: standard deviation.

conventional level of social cooperation (Narvaez & Rest, 1995). For this, logical and cognitive development is the key, so moral judgment seems to be a difficult construct to develop only in the VR environment. These findings suggest that to strengthen moral judgment ability, there is a limit to simply providing an environment that facilitates a sense of reality, and that educational content that can lead to the development of thinking skills should be included more directly.

6. Discussion and conclusions

The purpose of this study was to explore whether a moral education program using VR devices is effective in improving the morality of elementary school students. The results can be summarized as follows. First, moral sensitivity measured in Alice's story was statistically significantly higher than that measured in the escaped prisoner story. However, there was no statistically significant difference in moral judgment between the Alice story and the escaped prisoner story. Further, the group that responded high to the VR factors also showed significantly higher Alice-based moral sensitivity on average than the group that responded low. However, there was no significant difference in moral sensitivity measured through the escape story, which was not similar to the scenario experienced in VR activities, depending on the VR component score. Finally, the mean difference in moral judgment according to the VR score was not significant in both stories.

Introducing VR to elementary moral education cannot result in moral development directly because it affects only moral sensitivity. Visual and auditory stimulations of VR draw out the attention and motivation of elementary school students but there is a difficulty to lead to improvement in moral judgment. Eventually, growing moral judgment in elementary moral education is necessary for students to practice morality in daily life. Thus more elaborate teaching-learning method is needed.

Although this research model was effective in increasing moral sensitivity, it did not show a significant effect in enhancing moral judgment. This could be due to the following reasons. First, to improve moral judgment by utilizing a moral dilemma, it is necessary to present the moral reasons and grounds for each of the compatible positions more clearly. If the moral basis for the compatible position is not presented in a balanced manner in the conflict situation that the protagonist faces, the moral education program may end up as an activity to find the correct answer, which may not have a significant effect on improving moral judgment. Second, to strengthen moral judgment ability, there is a limit to only providing an environment that provides a sense of presence, and educational content that helps people make decisions based on higher-level reasons in a moral dilemma situation should be included. In the sense that moral judgment is an index showing the degree of post-conventional level thinking about social cooperation, cognitive development is key (Narvaez & Rest, 1995). Therefore, it is difficult to develop simply by increasing immersion in the story by providing a VR environment. Additional educational content should be considered to promote the development of students' thinking processes.

With the recent rise of the Metaverse, the virtual world is now within the reach of more individuals. Active participants in the metaverse are young people with high openness and adaptability to new technologies. In the cyber world characterized by anonymity, special efforts are required to encourage ethical behavior (Spinello & Tavani, 2004). Unlike the rapid development of technology, the pace of reforming laws and institutions is very slow. Hence, younger children in the institutional blind spot are more likely to participate in or be exposed to crimes in the metaverse. In this context, the VR-based ethics education program is meaningful in that it can be effective in nurturing moral agents in the virtual world, which has become a part of daily life.

This study suggests that the government should make ethical education content suitable for each school level. And also establishment of a platform-based curriculum and teaching method from the college of education that trains teachers and continuously re-educates existing teachers is needed. Above all, financial support from the government is essential to create a classroom environment that utilizes VR education, and cooperation and collaboration with related IT companies such as technology sharing and development are required. In the future, similar to the moral education with VR program presented in this study, it is necessary to continuously develop and research VR ethics education contents that maximize interaction between participants.

The limitations of this study are as follows. First, it is necessary to validate the test tool in consideration of the change in educational media and target age. Further, unlike previous studies on moral education programs that revealed the effects of classes in the mid-to-long term over several sessions, this study collected data for only one class owing to practical constraints. The limitations of this study must be supplemented through more strictly designed follow-up studies.

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Credit author statement

I am the sole author of this manuscript.

Data availability statement

The datasets generated and/or analyzed during the current study are not publicly available due to the subject's request.

Ethical approval

This study was approved by the IRB committee of Korea University Institutaional Review Board (KUIRB-2018-0101-01).

Ethical statement

This study received ethics approval from the Korea University Institutional Review Board (approval number: KUIRB-2018-0101-01). Informed consent was obtained from all participants.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:Jaekwoun shim reports financial support was provided by National Research Foundation of Korea.

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