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# Effects of Learning Process and Self-Efficacy in Real-World Education for Sustainable Development

**Bach Q. Ho**

School of Engineering, Tokyo Institute of Technology, 2-12-1, Ookayama, Meguro-ku, Tokyo 152-8550, Japan; ho.b.aa@m.titech.ac.jp

**Abstract:** To solve the "wicked problems" of sustainability, education for sustainable development (EfSD) that raises the young generation to become change agents is necessary. For this purpose, fieldtrips that educate students in the real world about other stakeholders are effective, but since sustainable issues do not have clear solutions, cooperative learning (CL) in which students learn from each other is useful. The purpose of this study is to clarify the influence of the learning process on learning outcomes and their influence on learning objectives in real-world EfSD using CL. A hypothesis model consisting of seven hypotheses was set up, and a questionnaire survey of high school students who participated in the real-world EfSD was conducted. Results of the structural equation modeling of data from 2441 respondents supported all seven hypotheses. Implicit learning as a learning process promotes knowledge acquisition as a learning outcome, while explicit learning enhances self-efficacy. Although knowledge acquisition promotes citizenship development as the learning objective of EfSD, self-efficacy does not promote citizenship development. Self-efficacy affects knowledge acquisition more than implicit learning. This study contributes to EfSD research by clarifying the difference in the effects of the learning process.

**Keywords:** education for sustainable development; cooperative learning; self-efficacy; citizenship; implicit learning; explicit learning



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## 1. Introduction

Many wicked problems increase as society matures, which reduces society's sustainability. Even with drastic changes to our lifestyles, climate change is unavoidable, and there will be insufficient global resources for humans to maintain our current lives [1]. People are moving to urban areas in pursuit of economic affluence, and depopulation is progressing in rural areas [2,3]. The sustainable issues caused by confrontations between the present and future generations are difficult for individuals to solve [4], and young generations must cooperate with society by having a sense of citizenship for the earth [5,6]. Achieving sustainable development requires improved thinking and behavior, created through high-quality education [7].

As the younger generation is expected to become problem-solvers and change agents to solve these wicked problems [8,9], sustainability content, such as the education for sustainable development (EfSD), has been added to education curricula, especially in universities [10]. Since students need to learn about other stakeholders' cultural backgrounds in EfSD [11], real-world fieldtrips can be an effective educational tool [12,13]. Students can develop their problem-solving competencies for working with governments, companies, and citizens [14]. In addition, students can get real-world experience and create new ideas that were not developed solely by citizens alone, thereby supporting sustainable development for the community [15].

Since each community has its own history and culture, students deepen their understanding of sustainability by engaging in an active approach rather than passive observation [16]. Furthermore, students develop interdisciplinary knowledge through on-site

learning [17]. By tackling actual sustainability problems, students become aware of the specific issues and their influence on society, realize competencies required to solve the problems, and better understand the well-being of not only themselves but also citizens in the field [18,19]. Students strengthen their ties with the field by going out and interacting with citizens, develop their citizenship, and eventually become introspective about their own community [20,21].

Previous studies on EfSD have mainly focused on qualitative case studies [22]. Those approaches are useful for describing macro systems regarding EfSD, but there have been insufficient quantitative measurements of learning effects. Social learning occurs by going into the field [23], and understanding how this learning happens is important. In addition, although EfSD is studied mainly in university education [4], long-term education is required for students to become change agents, and education for younger high school students is essential to increase the number of change agents in the future.

Therefore, this study focuses on cooperative learning (CL), which has been adopted in high schools, and analyzes real-world EfSD for high school students. With CL, students are divided into small groups to learn from each other [24]. Since there are no clear answers to sustainability problems in the real world, CL is considered to be useful in EfSD [25]. CL aims at mutual growth, and students can also improve social skills by teaching each other in small groups [26–29]. Students with diverse values interact with each other to enhance teamwork skills and creativity [30]. During the CL process, students learn the importance of sharing ideas and promote understanding of others and knowledge creation [31]. The role of teachers in CL is to facilitate the contribution of students to group work [32]. As everyone in the group contributes to learning, their knowledge retention increases [33]. In contrast to the traditional method where students are taught unilaterally by teachers, CL enhances students' intrinsic motivation and self-efficacy [34,35].

However, the effects of the learning process on learning outcomes and of learning outcomes on learning objects in real-world EfSD using CL have not been sufficiently clarified. Therefore, this study sets up two research questions (Figure 1): (RQ1) how does the learning process affect learning outcomes in real-world EfSD using CL? (RQ2) How do learning outcomes affect learning objectives in real-world EfSD using CL? As part of the learning process, this study focuses on implicit learning and explicit learning. This classification of the learning process has been applied in education studies. The sense of citizenship represents students' motivation to participate in problem-solving activities. Therefore, the objective of real-world EfSD is to encourage citizenship development among students. Furthermore, CL aims to improve knowledge acquisition and self-efficacy. Consequently, the purpose of this study is to clarify how the two types of learning process affect self-efficacy and knowledge acquisition as learning outcomes and how they eventually promote citizenship development as the learning objective. Thus, the learning effects due to the difference in the learning process in real-world EfSD are clarified.

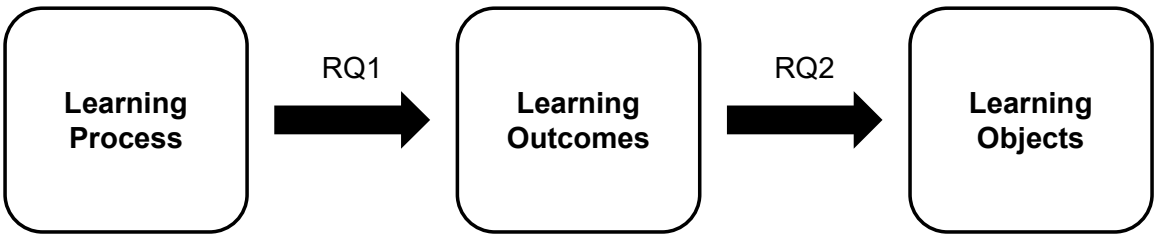


**Figure 1.** Research framework.

The structure of this study is as follows: First, an overview of implicit and explicit learning in the learning process is provided, and the hypothesis model is constructed (Section 2). Next, the survey in this study is explained (Section 3). The questionnaire was conducted on high school students who participated in the real-world EfSD, and 2441 valid responses were obtained. The results of structural equation modeling (SEM) on the

questionnaire data are then presented to clarify how the hypotheses were supported (Section 4). Finally, the contributions of this study are discussed (Section 5), and the conclusion and future research directions are presented (Section 6).

## 2. Hypotheses

The distinction between implicit and explicit learning has typically been used for the student learning process [36]. This classification was first used in language learning [37] but has also been applied to physical learning, such as sports education [38]. This study applies the classification because the real-world EfSD using fieldtrips also contains both language and physical learning through group work for verbal communication and physical activity in the field. While implicit learning refers to a learning process in which information is unconsciously input and becomes knowledge, explicit learning refers to a learning process that consciously recognizes and controls what kind of information is input [39]. Of these two types of the learning process, implicit learning is the basis for knowledge acquisition [40]. Students learn by themselves through observing citizens or other students in real-world EfSD. Therefore, Hypothesis 1 is established as follows.

**Hypothesis 1 (H1).** *Implicit learning in real-world EfSD through CL promotes knowledge acquisition.*

Achieving short-term results with only implicit learning is difficult, so it must be combined with explicit learning [41]. Explicit learning is the process by which information that has been consciously input is outputted and then turned into knowledge [42]. Explicit learning also enhances meta-knowledge, i.e., an awareness of what one is learning, which further facilitates knowledge acquisition [43]. By adapting CL in real-world EfSD, students were encouraged to teach each other explicitly, and they learn from that explicit learning. Therefore, Hypothesis 2 is established as follows.

**Hypothesis 2 (H2).** *Explicit learning in real-world EfSD through CL promotes knowledge acquisition.*

Since implicit learning can obtain learning benefits without imposing a heavy load on the student's consciousness, their self-efficacy can be naturally enhanced [44]. Self-efficacy is a concept advocated by Bandura [45] and is the belief that an individual can achieve a goal in a particular situation. In real-world EfSD, since implicit learning unconsciously acquires knowledge and can enhance self-efficacy, Hypothesis 3 is established as follows.

**Hypothesis 3 (H3).** *Implicit learning in real-world EfSD through CL promotes self-efficacy.*

Van Keer and Verhaeghe [46] argued that explicit learning for students enhances their self-efficacy as they teach each other in classroom learning. Similarly, students actively teach each other about the learning contents in fieldtrips using CL, so explicit learning about EfSD is likely to enhance self-efficacy. Therefore, Hypothesis 4 is established as follows.

**Hypothesis 4 (H4).** *Explicit learning in real-world EfSD through CL promotes self-efficacy.*

Students actively try to use what they have learned when their self-efficacy is high, and this increases their willingness to learn that then encourages knowledge acquisition [47]. Students may enhance their self-efficacy from a new experience in the field. They will find they can help others in some parts of the real world. Then, self-efficacy encourages students to acquire further knowledge in real-world EfSD. Hypothesis 5 is established as follows.

**Hypothesis 5 (H5).** *Self-efficacy in real-world EfSD through CL promotes knowledge acquisition.*

Students acquire knowledge by going out to the field and being involved in actual social issues, but it is difficult to demonstrate what they have learned without self-efficacy [48,49]. By increasing self-efficacy through education, students try to use what they have learned even after classes are over [50]. What students learn at EfSD is aimed at developing citizenship. Therefore, Hypothesis 6 is established as follows.

**Hypothesis 6 (H6).** *Self-efficacy in real-world EfSD through CL promotes citizenship development.*

A learning environment where students have open discussions promotes knowledge acquisition and enhances citizenship development [51]. Moreover, real-world EfSD has opportunities of open discussions, so it is thought that acquiring knowledge about sustainability through CL will develop citizenship. Therefore, Hypothesis 7 is established as follows. A hypothesis model summarizing H1–H7 is shown in Figure 2.

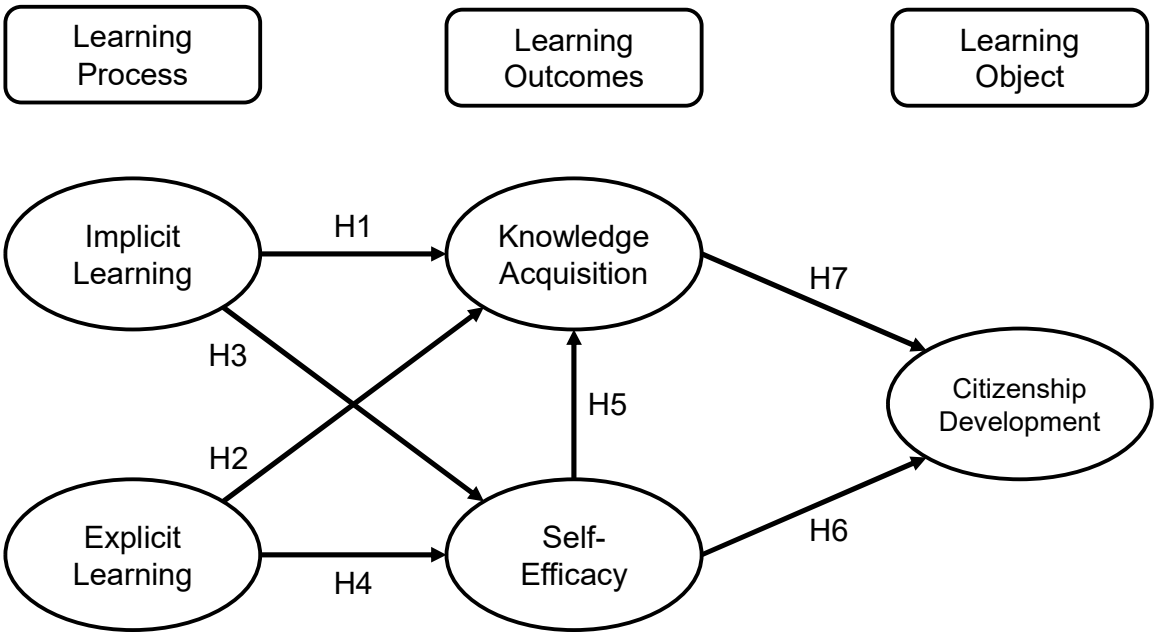


**Figure 2.** Hypothesis model.

**Hypothesis 7 (H7).** *Knowledge acquisition in the real-world EfSD through CL promotes citizenship development.*

## 3. Methods

### *3.1. Design*

The questionnaire survey was carried out for high school students who participated in fieldtrips as real-world EfSD, and the hypothesis model was quantitatively verified. Fieldtrips were organized by a social enterprise, and the questionnaire was distributed to schools participating in this real-world EfSD between April 2019 and March 2020. The mentioned social enterprise provides educational services to connect schools with nonprofit organizations (NPOs) and social enterprises that deal with sustainable problems, so schools can give their students an opportunity to participate in real-world EfSD. About three to six fields and topics of sustainability problems, such as waste management, depopulations, and diversity and cultural studies, are prepared for every school according to location constraints. Students select one of the topics (fields) from prepared alternatives as a small group of CL.

EfSD was conducted in the following program: (i) Pre-study, (ii) tour, (iii) group work. First, students received about ten hours of pre-study about one week before fieldtrips

to prepare for real-world EfSD. Teachers taught skills to cooperate with others and to respect diverse opinions in CL, and encouraged students to gather information on the sustainability problem of the field they planned to visit through the internet and books. After that, fieldtrips were held, consisting of a morning tour and afternoon group work. In the tour, students listened to lectures from problem-solvers (e.g., directors of NPOs) who are working on sustainability problems and experienced their problem-solving activities. Lecturers explained what kind of system was created with what intention along with what results were achieved. Students were able to ask questions freely. In the afternoon group work, the students were divided into predetermined groups and discussed new ideas for problem-solving based on the information obtained from the pre-study and the experience gained from the morning tour. At that time, students were instructed to clarify the ideal state of society that is desirable for the community and the current issues that are obstructing it before discussing ideas for problem-solving. This framework and procedure of CL help students to derive ideas in a short time. After about 4–5 h of discussion, each group presented their ideas to other students. This study conducted a questionnaire survey after the presentation. The respondents were 2441 high school students aged 16 and 17 years in Japan. The gender data were not collected due to time constraints and privacy issues, but all participating schools are coeducational and are state or private schools.

### *3.2. Measurement Instruments*

With regard to implicit and explicit learning, this study referred to question items of the SECI model [52–54]. The SECI model expresses knowledge creation through interactions by describing the spiral process of explicit and tacit knowledge that correspond to explicit and implicit learning. Elements corresponding to each learning process were extracted for learning in real-world EfSD, and eight question items for each learning process were derived from previous studies [52–54], such as "I had an experience in the field that is difficult to explain (Implicit Learning)" and "I was able to come up with new ideas by combining the thoughts of myself and the members in the group work (Explicit Learning)."

With regard to self-efficacy, this study referred to scales of self-efficacy [55,56], and arranged sentences to better fit the context of real-world EfSD. Six question items were asked, such as "Our presentation was better than other groups" and "I have competencies that can solve the problems."

With regard to knowledge acquisition, this study arranged sentences to better fit the context of real-world EfSD with reference to previous studies [57–59], and five question items regarding the knowledge acquisition recognized by students were asked, such as "I understand what is causing the problems in the field visited" and "I understand how to solve the problems in the field visited."

With regard to citizenship development, five question items, such as "I am interested in the problems in the field visited" and "The problems in the field visited are related to me", were asked through referring to previous studies [60–63] and arranged sentences in line with the context of real-world EfSD. All questions were asked using a five-point Likert scale. The sentences of question items were arranged through discussion with schoolteachers and staff of the social enterprise providing real-world EfSD.

### *3.3. Data Analysis*

The reliability coefficient Cronbach's alpha was analyzed to verify the validity of the question items (observed variables) that constituted the five latent variables shown in the hypothesis model. At this time, if Cronbach's alpha was increased by removing a specific observed variable, that variable was excluded from the analysis. This procedure generated the most reliable latent variables. Then, SEM using the remaining variables was conducted to validate the hypothesis model. SPSS Statistics 24 was used to test the reliability of variables and correlation analysis, and SPSS Amos was used for SEM.

## 4. Results

The results of the reliability of Cronbach's alpha are shown in Table 1. Six observed variables were adopted for implicit learning, four for explicit learning, six for self-efficacy, five for knowledge acquisition, and four for citizenship development. The reliability coefficient of 0.7 or higher is considered acceptable [64], and all latent variables meet this criterion. Therefore, the latent variables used in SEM are appropriate. The correlation matrix of latent variables is shown in Table 2. All variables show the weak or medium positive correlation.

**Table 1.** Reliability of latent variables.

| Question Items | Mean | Standard Deviation |
|---|---|---|
| **Implicit Learning $\alpha$ = 0.828** | | |
| I had an experience in the field that is difficult to explain. | 3.629 | 1.054 |
| The words and actions of the people involved in the problems were impressive. | 3.850 | 1.002 |
| I learned from the attitudes of other groups | 3.640 | 0.997 |
| There were many things I did not know in the presentations of other groups. | 3.986 | 0.980 |
| I was able to find improvements in our presentation by observing other groups' presentations carefully. | 3.633 | 0.966 |
| I learned a lot about group work and presentation throughout the program. | 3.869 | 0.925 |
| **Explicit Learning $\alpha$ = 0.853** | | |
| I was able to actively express my opinion in group work. | 3.739 | 1.038 |
| I was able to come up with new ideas by combining the thoughts of myself and the members in the group work. | 3.812 | 0.998 |
| I listened carefully so that I could understand the opinions of the members in the group work. | 4.036 | 0.904 |
| All members worked together to advance the group work for the presentation. | 3.944 | 1.001 |
| **Self-Efficacy $\alpha$ = 0.833** | | |
| We were able to come up with effective solutions to solve the problems through group work. | 3.713 | 0.940 |
| Our presentation was better than other groups. | 3.311 | 1.002 |
| I have competences to solve the problems. | 3.099 | 0.997 |
| Group work went smoothly thanks to me. | 3.032 | 1.044 |
| Our group was able to work more collaboratively than other groups. | 3.423 | 0.972 |
| I can do group work well with anyone. | 3.221 | 1.016 |
| **Knowledge Acquisition $\alpha$ = 0.830** | | |
| I understand the whole picture of the problems in the field visited. | 3.697 | 0.890 |
| I know a lot about problems of sustainability other than the problem in the field visited. | 3.315 | 0.949 |
| I understand what is causing the problems in the field visited. | 3.571 | 0.937 |
| I can list many people who are involved in the problems in the field visited. | 3.251 | 1.060 |
| I know how to solve the problems in the field visited. | 3.254 | 1.002 |
| **Citizenship Development $\alpha$ = 0.830** | | |
| I am interested in the problems in the field visited. | 3.752 | 0.999 |
| I am interested in many problems other than those in the field visited. | 3.416 | 1.006 |
| I usually collect information about the problems in the field visited. | 2.564 | 1.068 |
| The problems in the field visited are related to me. | 3.417 | 1.118 |

**Table 2.** The correlation matrix of latent variables.

| | Explicit Learning | Self-Efficacy | Knowledge Acquisition | Citizenship Development |
|---|---|---|---|---|
| Implicit Learning | 0.465 ** | 0.209 ** | 0.395 ** | 0.329 ** |
| Explicit Learning | | 0.251 ** | 0.426 ** | 0.327 ** |
| Self-Efficacy | | | 0.240 ** | 0.198 ** |
| Knowledge Acquisition | | | | 0.492 ** |

** $p$: <0.01.

The results of SEM are shown in Figure 3. The Goodness of Fit Index (GFI) is 0.897, the Adjusted Goodness of Fit Index (AGFI) is 0.881, and the Root Mean Square Error of Approximation (RMSEA) is 0.071. Since GFI and AGFI are recommended to be 0.88 or higher [65], and RMSEA is less than 0.08 [66], the validity of the hypothesis model is adequate.

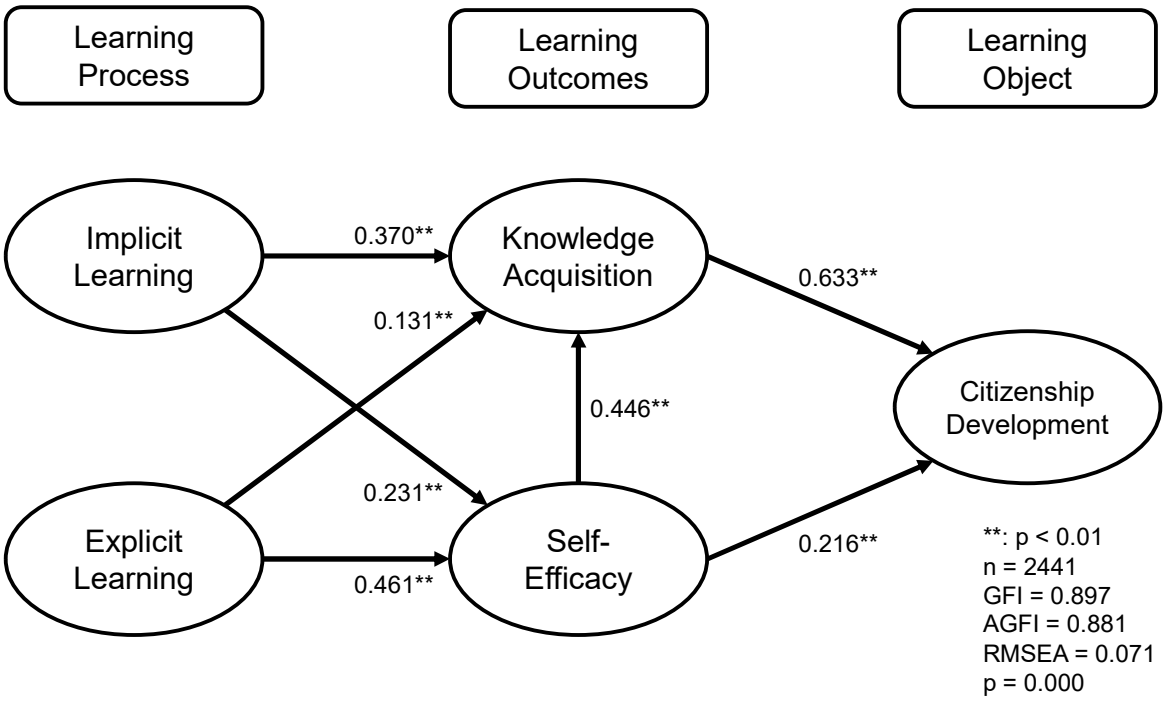


**Figure 3.** The results of SEM.

Hypothesis 1 was supported by the significant difference in the path coefficient from implicit learning to knowledge acquisition at 0.370. Hypothesis 2 was supported by the significant difference in the path coefficient from explicit learning to knowledge acquisition at 0.131. Hypothesis 3 was supported by the significant difference in the path coefficient from implicit learning to self-efficacy at 0.231. Hypothesis 4 was supported by the significant difference in the path coefficient from explicit learning to self-efficacy at 0.461. Hypothesis 5 was supported by the significant difference in the path coefficient from self-efficacy to knowledge acquisition at 0.446. Hypothesis 6 was supported by the significant difference in the path coefficient from self-efficacy to citizenship development at 0.216. Hypothesis 7 was supported by the significant difference in the path coefficient from knowledge acquisition to citizenship development at 0.633.

## 5. Discussion

The results of the questionnaire survey supported all seven hypotheses. Interestingly, the effects of the learning process on learning outcomes and the effects of learning outcomes on the learning object differ between factors. In terms of the effects of the learning process on learning outcomes, implicit learning had a stronger effect on knowledge acquisition than on self-efficacy. On the other hand, explicit learning had little effect on knowledge acquisition but was effective for self-efficacy. Regarding the impact of learning outcomes on the learning object, knowledge acquisition promotes citizenship development while the influence of self-efficacy on citizenship development is relatively small, and self-efficacy is more likely to promote knowledge acquisition. The effect of self-efficacy on knowledge acquisition is larger than that of implicit learning. These results imply that implicit learning promotes knowledge acquisition and consequently promotes citizenship development, while explicit learning enhances self-efficacy and promotes knowledge acquisition, thereby contributing to citizenship development.

This study clarified the structure of learning, specifically the effects of a learning process on a learning objective. Although previous studies have emphasized the analysis of learning contents [67,68], focusing on the learning process is also important. This study identified that implicit learning was more effective than explicit learning, as the former directly impacts knowledge acquisition. The findings contribute to the EfSD research by clarifying how knowledge acquisition is promoted by the learning process.

The results imply that students did not want to participate in problem-solving with the sense of citizenship, even if they enhanced self-efficacy, when they had not acquired useful knowledge. This is probably because sustainability problems are complex and can be exacerbated if mishandled. Since schoolteachers do not always have a deep knowledge of EfSD, it is necessary to prepare learning opportunities, such as fieldtrips, in cooperation with external organizations that provide real-world fieldtrips [13] to promote EfSD for high school students. Teachers need to concentrate on encouraging students to learn spontaneously rather than teach learning contents by themselves.

Teaching correct, relevant, and useful knowledge is important in the real-world EfSD, and knowledge acquisition is mainly achieved by implicit learning. However, implicit learning lessons are hard to design. Implicit learning needs to be combined with explicit learning; however, explicit learning does not promote knowledge acquisition directly. Self-efficacy should be the desired learning outcome as it leads to knowledge acquisition. Therefore, when implementing real-world EfSD through CL, teachers are encouraged to design explicit learning that enhances self-efficacy while paying attention to students' implicit learning.

## 6. Conclusions and Future Research Directions

This study conducted a questionnaire survey of high school students participating in real-world EfSD using CL. The results of SEM supported all seven hypotheses and the hypothesis model. Furthermore, the findings imply that implicit learning promotes knowledge acquisition, while explicit learning promotes self-efficacy. Knowledge acquisition promotes citizenship development, but self-efficacy does not have much effect on citizenship development. However, self-efficacy promotes knowledge acquisition more than implicit learning. To develop students' citizenship through real-world EfSD using CL, it is important to aim for knowledge acquisition through implicit learning and improvement of self-efficacy through explicit learning. The findings of this study demonstrate how the learning process affects learning outcomes, and how learning outcomes affect learning objectives in real-world EfSD using CL for high school students.

There are two future research directions. CL studies have pointed out that differences in learning culture between Western and Asia can influence learning effects [69]. This study only analyzed Japanese high school students, and it is necessary to examine whether the same learning process affects Western students.

This study targeted students who participated in one-day fieldtrips and set citizenship development as a learning objective. Citizenship represents the willingness of students to engage in solving sustainability problems. However, there is no guarantee that this motivation will last and that students will actually display prosocial behavior after fieldtrips to become change agents. As future work, it is necessary to continuously follow up on the students who participated in the real-world EfSD using CL to see how the citizenship that they developed led to the promotion of actual actions.

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