Development and application of environmental education program for in-service geography teachers using community mapping and photovoice

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Abstract

This study designed an environmental education program for in-service geography teachers using community mapping and photovoice methodology and applied it to in-service geography teachers to derive results. In addition, the study explored the possibilities and implications of these two participatory research techniques as pedagogical tools for geographical and environmental education. In-service geography teachers confirmed that community mapping activities combined with the photovoice methodology can support the development of the geographical skills and spatial thinking about the environment of students. Moreover, they recognized that the program is a useful pedagogical tool for connecting learners with geographical communities to actively explore various geographical and environmental issues in the region, connecting them inside and outside the classroom and reaching an in-depth understanding of geographical and environmental issues through the production of knowledge that expresses their perspectives and experiences. Furthermore, the program, which combines community mapping and photovoice, can be an effective pedagogical tool for fostering community competence and active citizenship in that participants actively participate in the community to create better community change.

Keywords: community mapping, photovoice, environmental education, spatial thinking, active citizenship

INTRODUCTION

Development in diverse fields of geography requires changes in the knowledge, attitudes, and behaviors of teachers. This development of geography calls for a change in the contents and methods of in-service programs for geography teachers while strengthening the importance of these programs. Geography teachers who participated in the in-service program use the knowledge gained through the program in their geography classes. Particularly, geospatial technology, which was not considered essential previously, is now accepted as one of the most crucial competencies that geography teachers must obtain. Interest in geospatial technology in the geography education community has been steadily increasing, and studies on the educational possibilities of geospatial technology and how geospatial technology can be effectively applied to learning have been continuously conducted (Bednarz & Bednarz, 2008; Grabbatin & Fickey, 2012; Kinniburgh, 2010).

The most critical thing in research on the educational use of geospatial technology is not to teach geospatial information technology but to employ it for geographical teaching and learning activities to become an effective tool for geographic thinking and inquiry (Bednarz, 2004; Bednarz & Bednarz, 2008; Jekell, 2008; Kerski, 2008; Metoyer et al., 2015). The importance of geospatial technology in geography education is emphasized; however, the integration of geospatial technology in geographical classes remains insufficient. Accordingly, the lack of a related curriculum, the complexity of software, and insufficient in-service programs for geography teachers is highlighted (Bednarz & Bednarz, 2008). In other words, this situation is creating a limitation of the lack of practical knowledge that geography teachers can utilize geospatial technology in their classes.

Contribution to the literature

- This study shows how community mapping and photovoice as a pedagogical tool can be applied to the planning, implementation, and evaluation of geography classes.
- This study explored the possibilities and implications of these two participatory research techniques as pedagogical tools for the subject of geography.
- In-service teachers use a geographical visualization data to explore and select places or environments where they felt dangerous and developed a narrative about why they felt dangerous.
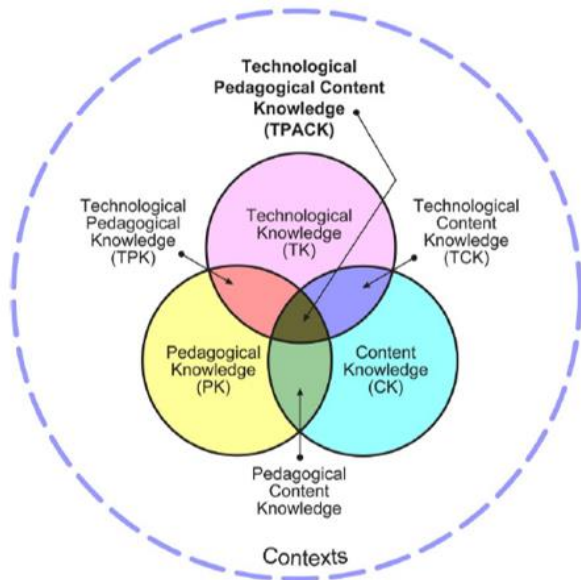
Figure 1. Components of TPACK (Doering et al., 2014)

This situation requires a change in the nature of in-service programs for geography teachers. Teacher education aims to improve school education by applying the knowledge that teachers have gained through in-service programs to their classes. Moreover, teachers are expected to have the expertise to successfully perform subject content knowledge and practical competencies in classrooms through in-service programs. Teacher education focuses on content knowledge and on cultivating competency related to pedagogical content knowledge by converting it according to the contextual situation of students (Shulman, 1986, 1987).

As such, the pedagogical content knowledge of teachers is regarded as a more vital part of their teaching expertise, and the importance of in-service programs that can cultivate "technological pedagogical content knowledge (TPACK)" necessary to integrate and utilize geospatial technology in the context of geography classes has been emphasized (Doering et al., 2014).

Figure 1 illustrates that the TPACK model (Mishra & Koehler, 2006) was continuously developed and systematized by them as it was expanded on the basis of the study on pedagogical content knowledge (Shulman, 1986, 1987). TPACK has demonstrated a new approach to how education using technology should be practiced and has been receiving great attention in relation to education using technology.

In the present study, Google Maps was selected as a geospatial information technology to develop an in-service program for geography teachers focusing on TPACK, and data collection was supplemented by the photovoice methodology. Community mapping, a participatory mapping method based on geospatial information technology, and photovoice, a methodology of community-based participatory research, are excellent pedagogical tools because participants (in-service teachers or students) can directly become producers of geographical information in relation to community issues, analyze geographical information, and ultimately cultivate active practical skills to solve community issues (Behrendt & Machtmes, 2016; Chai, 2019; Cook & Quigley, 2013; Derr & Simmons, 2020; Kurtz & Wood, 2014; Liu & Zhu, 2008; Moxley, 2018). Community mapping and photovoice methodology can provide participants with an opportunity to reach an in-depth understanding of the area they live in. In addition, geographical visualization data produced through community mapping and photovoice activities are mashed up on Google Maps, which can help participants understand local issues through cooperative work and provide an integrated perspective to solve them.

This in-service program focuses on how community mapping and photovoice as a pedagogical tool can be applied to the planning implementation, and evaluation of geography classes. This study designed an in-service program for geography teachers using community mapping and photovoice methodology and applied it to in-service geography teachers to derive results. In addition, it explored the possibilities and implications of these two participatory research techniques as pedagogical tools for the subject of geography.

In-service teachers use a geographical visualization data to explore and select places where they felt dangerous and developed a narrative about why they felt dangerous. Two questions guided the research:

1. Where do I feel dangerous in the place I live?
2. Why do I think that place is dangerous?

METHODOLOGY

Community Mapping

With the recent extensive research on geographical information systems (GIS) and public participation GIS

(PPGIS), the accessibility and use of GIS and spatial technology by citizens and communities and their effects have been reviewed. Specifically, these studies are related to issues regarding citizen participation, empowerment, and decision-making (Dunn, 2007; Elwood, 2002; Elwood & Leitner, 1998, 2003; Kyem, 2004; Panek, 2015; Parker, 2006; Sieber, 2004). The first discussion on PPGIS was made by the National Center for Geographic Information and Analysis (NCGIA), a leading US GIS research institute. The research institute proposed the theme PPGIS at a seminar called "Geographic Information and Society" in 1996 to overcome the limitations of existing GIS that require massive costs and high-level technologies, which increased interest in PPGIS (Sieber, 2004). Most of the research by public participation GIS aims to provide more democratic spatial governance and emphasizes integrating local voices into maps produced and managed by experts and combining current issues in the region (Perkins, 2007). Thus, PPGIS can empower citizens by activating their participation, thereby contributing to enhancing the efficiency and transparency of spatial decision-making in the policy process.

Community mapping based on PPGIS technology with these characteristics is a tool to recognize and solve problems in the community. Community mapping is a platform equipped with location-based information that can be easily accessed and participated in by any local citizens using GIS and can contribute to sharing, collaborating, and creating horizontal relationships of communication to solve local problems. Thus, community mapping will be able to function as an educational practice tool that can cultivate local citizenship. PPGIS is an Internet GIS technology that allows the public to conveniently build and utilize geographic information by realizing the interactive nature of geographic information through easy access and active production and the sharing of information without technical restrictions.

As such, community mapping can provide teachers and students with an opportunity to raise interest in the region and actively participate in spatial decision-making necessary for the community at the educational level. Previously, the subject of mapping has been conducted by a small number of experts, but individuals are defined as active "sensors of geographic information" because all members of the community can be the subject of mapping in this environment (Goodchild, 2007). Therefore, community mapping is a participatory research method that can give participants greater empowerment by actively participating in the process of solving various social, spatial, and environmental issues in the community using a medium called map.

Photovoice

Photovoice is based on the assumption that people can best identify and reproduce their reality. Photovoice also provides a camera in the hands of individuals staying in the periphery of the political realm. Along with photovoice, participants can urge actions for social change by representing the problems facing the community with pictures and explaining them in their own voices (Cook & Buck, 2010; Goodchild, 2007).

Photovoice has the following main objectives (Wang & Burris, 1997):

1. It allows participants to document aspects of their lives through photos and narratives.

2. It raises the critical consciousness of participants through critical dialogues.

3. It conveys the voices of marginalized people in the community to policy makers through photos to promote positive change.

The biggest significance of the photovoice method is that it shifts authority from researchers to participants in the research process and provides tangible benefits to participants and the community they live in (Nelson & Christensen, 2009).

Photovoice is a process in which people understand, reproduce, and confirm their region through specific photographic technology (Wang, 1999, 2006). Participants can share their stories through the process of taking and selecting photos that accurately reflect social issues. By using cameras to document their experiences, they create photographic evidence that provides insights into how they see their communities and the world (Palibroda et al., 2009). Moreover, photovoice is used for community-based participatory projects, and it is employed to empower people who cannot make their heard voices through photos or to promote social change.

Photovoice methodology can be converted into a pedagogical tool and utilized for geography classes at the elementary and secondary school levels. Geography classes using photovoice as a pedagogical tool can escape the teacher-centered approach of delivering objective knowledge to students. Students record what they observe with their own eyes on the issues facing the community, discriminate between photos in the classroom, and describe themselves narrative or story for the final selected photos. Subsequently, students reconsider through discussions in groups and urge social change by listening to these final results to decision makers or policy makers in various presentations. Therefore, geographical classes employing photovoice as a pedagogical tool can serve as an opportunity to shift to a constructivist, active participation-oriented, and student-centered approach (Cho et al., 2021).

Data Collection and Analysis

This study organized in-service geography teachers to conduct photovoice activities and community mapping activities using Google Maps. The study data consisted of the GPS data, photos, and text data recorded on Google Maps shared by in-service geography teachers during the activity and questionnaires completed by in-service geography teachers after project. The questionnaire comprised three open-ended questions. The results of the survey allowed the researchers to identify the possibilities and limitations of community mapping and photovoice as a geographical pedagogical tool.

The major themes of community mapping were set as traffic (walking) environment, security environment, natural environment, and built environment through the group discussions and whole discussions of in-service geography teachers. In addition, the researchers analyzed the activity data of in-service geography teachers to derive sub-themes according to these themes. They also reclassified the data (photo and text data) of in-service geography teachers into sub-themes and interviewed the teachers if their meaning was unclear. Two methods were applied when analyzing the data.

First, the researchers utilized a six-step guide to perform theoretical thematic analysis (Braun & Clarke, 2006). Theoretical thematic analysis is closely related to the theoretical propensity of the researchers and is generally coded to match the research goals. In step 1, the researchers immersed themselves in the data by repeatedly reading scripts to get used to the data. In step 2, an initial code was generated, and in step 3, the focus was on identifying themes based on the initial code. In step 4, the themes were reviewed and improved, and in step 5, the themes were defined, and the final names were given. In step 6, the research results were produced on the basis of the analysis over the previous five steps.

Second, the researchers developed nine themes using grounded theory (Charmaz, 2014) when analyzing the data. Grounded theory aims to construct a theory based on data, and categories based on grounded theory are derived from data without following a predetermined category (theme) (Strauss & Corbin, 1998). Therefore, the analysis follows grounded theory using data, and the newly constructed category is derived from observation. The researchers coded the data in triple order of open coding, axial coding, and theoretical coding. Through this coding process, "the conceptual abstraction of data and the recombination of data occur" (Holton, 2010). Line-by-line coding was used which involved developing in-vivo codes of particularly rich segments of the text and photo data, followed by focused coding. This step in the methodology entailed reexamining and re-coding the data with conceptual codes that emerged from the line-by-line analysis.

DESIGN AND IMPLEMENTATION OF IN-SERVICE PROGRAMS FOR GEOGRAPHY TEACHERS USING COMMUNITY MAPPING AND PHOTOVOICE

Design of In-Service Programs

Kyungpook National University located in Daegu, South Korea, provides an in-service program for geography teachers with more than three years of teaching experience every year. Generally, geography teachers attend this in-service program in person for two weeks; however, due to the circumstances created by the COVID-19 pandemic, it was conducted online using Zoom. The topic of this project is "Safety and Environment" and geography teachers participating in the in-service program use community mapping and photovoice as participatory research methods to explore unsafe places in the community they live in. There are 30 geography teachers who participated in the training, 22 living in Busan and eight living in Daegu. Thus, this study was conducted in various contexts of the two regions.

Geography is "a discipline and subject that connects natural and social sciences by studying the interaction between humans and the environment" (Johnston, 2005, p. 10). The key concept of the in-service project activity is "safety." The topic of safety is addressed in the "interrelationship between humans and nature," one of the key content elements of geography education in Korea and other countries. In essence, safety is geographic because places have unique physical environments and cultural systems. Geography is deeply related to safety issues and is a discipline that uses spatial analysis to secure greater safety.

Geography can help people understand the world and accurately locate everyday dangers and threats in space. The widespread interest of geographers is to understand how geography is involved in achieving or damaging the security (safety and sustainability) of the environment, people, and communities worldwide (Philo, 2012). Hence, geography is an essential subject in teaching the key concept of sustainability (Morgan, 2010; Smith, 2013).

Geographical information services have prevented natural disasters and strengthened the safety of individuals and communities through various relief services. Students must actively participate in the practice of "knowing the world" in which they live to recognize and solve factors that threaten the safety of the community. Thus, community mapping and photovoice activities are highly suitable pedagogical tools for safety education in that they can cultivate the qualities of active citizens through the active participation and collaboration of students, practical learning, and problem-solving experiences.

Table 1. Questions for writing narratives about photos (PHOTO) (Graziano, 2004)

Describe your *P*icture.
What is *H*appening in your picture?
Why did you take a picture *O*f this?
What does this picture *T*ell us about your life?
How can this picture give *O*pportunities for us to improve life?

The in-service program for geography teachers using community mapping and photovoice as a pedagogical tool primarily aims to accurately understand community mapping and photovoice, experience projects based on them from the point of view of a student and develop the ability to apply them successfully to their classes. To this end, the program focused not only on deepening the content knowledge that geography teachers already have but also on enhancing their understanding of community mapping and photovoice methodologies as pedagogical content knowledge that can better teach them. Geography teachers will be able to provide opportunities for their students to explore the safety environment in the school space or community they usually live in through community mapping and photovoice projects when they complete their in-service program and return to their schools.

This project was designed to be conducted during 10 classes in the course of two weeks via group and class discussions. The activities of the community mapping and photovoice project were conducted in three stages designed to be in the order of orientation, data collection, and production and presentation of materials.

In the orientation stage, the purpose and procedure of this project, explanation of community mapping and photovoice methodology, selection of inquiry assignments and activity groups, and selection of sub-topics through group discussions related to inquiry assignments were conducted. One of the researchers gave lectures for three hours under the themes of "Community Mapping and Spatial Information" and "Theory and Practice of Photovoice Methodology." One researcher who worked on this project organized 30 geography teachers participating in the in-service program into six groups (five people in each group). In addition, the researcher provided them with an inquiry assignment regarding the issue of "Unsafe Places in the Community."

In the data collection step, the data were collected through community mapping and photovoice activities made by individuals; then, the photos of the location and situation of the place displayed on Google My Maps were selected through group discussions. In addition, community mapping and photovoice activities were conducted individually by the participants, and the participants conducted community mapping through survey activities centering on the area where they lived (Daegu, Busan). During the week-long survey, the participants marked four or more places on Google My Maps that could highlight issues related to the sub-topics selected by their group based on the "Unsafe Place of the Community," took at least one photo of each location, and described a narrative of the photo. The participants should always keep ethical aspects in mind when taking pictures and consider what they want to say and how to express them effectively through photos when considering what photos to take. The participants wrote narratives for the photos they took, which were based on the types of photovoice questions presented in **Table 1**. Photovoice question types are important tools for reference when writing narratives for photos and can help participants explore the meaning of photos in depth.

Group discussion is the process of selecting the location of the place displayed on Google My Maps and the photos and narratives of each place by deliberating on the data collected through community mapping and photovoice activities. The participants in each group shared the location of the place they marked on Google My Maps, the photos they took, and their narratives with one another. The participants in each group explained their community mapping results directly to members and conducted discussion activities to share their thoughts and feelings. Subsequently, the location of one or two places that reveal the meaning of the inquiry topic well for each group and one photo of their place were selected. The narrative of the photos selected in the discussion process for each group was revised by reflecting the opinions of other members of the group.

In the third step, the materials to be presented were produced on the basis of the data selected through group activities and presented to all the participants. The presentation format can take the form of PowerPoint presentation, poster presentation, exhibition, and gallery work. Given that the program was made in the context of the COVID-19 pandemic situation, the presentation was made online through a PowerPoint presentation written by each group. During the presentation process, there were questions about the mapping results from the members of other groups, and the responses were made actively. The community mapping materials supplemented through photovoice activities are locations, photos, and narratives of the place. The opinions expressed through community mapping and photovoice activities were not conveyed directly to policymakers and decision makers in the community who could influence political changes. However, alternatively, the results of community mapping were mounted on the website of related organizations with policymakers and decision makers.

Implementation of In-Service Programs

The project activities in which in-service geography teachers participated in the position of students were conducted over 10 classes (50 minutes for each class) over two weeks (**Table 2**). Initially, the first to third

Table 2. Summary of project activities

Classes	Contents
1	Introduction to community mapping
2	Introduction to the photovoice/Introduction of the project schedule and activities
3	Organization of groups (30 people were divided in six groups)
4	Creation of 3-4 sub-topics for each group related to project topic
5-6	Selection of one/two places revealing meaning of sub-topics through discussions by group & one photo of the places
7	Production of presentation materials focusing on community mapping and photovoice data by group
8-9	Online presentation and feedback for each group
10	Peer evaluation by group and survey on project activities

classes were the introduction to this project; the schedules and activities of community mapping and photovoice project were guided; and the groups were organized. In the first and second classes, the instructor gave lectures on community mapping and photovoice to the in-service geography teachers and introduced the contents and schedules of the activities, and in the third class, 30 in-service teachers were divided into six groups (five people per group). The group was organized without separate distinction between teachers who teach geography in Daegu and Busan.

Further, classes from the fourth to sixth are the first half of community mapping and photovoice activities. In the fourth class, each group selected three to four sub-topics for inquiry through brainstorming for each group on the topic of this project, "Safety and Environment." After the fourth class, community mapping and photovoice activities were conducted through survey activities in the area where each individual lives according to the sub-topics selected for each group. Particularly, in the case of photovoice activities, participants generally write individual photovoice notes; however, here they uploaded photos to Google My Maps and wrote narratives about photos on the web. In-service teachers became participants, displayed four or more places per sub-topic for each individual on Google My Maps, took at least one photo showing the situation of each place, and wrote a narrative for each photo. Thereafter, in the fifth and sixth classes, each group selected one or two places that reveal the meaning of sub-topics well through discussions by group and one photo of those places.

Finally, the seventh to tenth classes are the second half of the project activities. In the seventh class, each group produced presentation materials focusing on their community mapping and photovoice data created through the fifth and sixth classes. In the eighth and ninth classes, each group presented the results of community mapping to unsafe places. In the tenth class, the participants conducted peer evaluations for each group and filled out a questionnaire about this project activity.

FINDINGS AND DISCUSSION

Findings

The present study aimed to explore unsafe places in the community using photovoice and community mapping. Two participatory action research methods were applied to capture the perception of unsafe places and spaces that in-service geography teachers think of in the area they live in. In this study, community mapping was conducted in Daegu and Busan, where in-service geography teachers reside; 205 unsafe places were mapped; and a total of 205 photos and narratives taken and described by them were analyzed by grounded theory. Five themes were derived from the initial analysis, but the themes were not clearly separated. Therefore, as a result of re-analysis, some themes were combined to finally derive four themes, namely, traffic (walking) environment, natural (climate, topographic) environment, and built environment as presented in **Table 3**. These themes were covered thoroughly below.

The mapping results can be checked on the web screen as shown in **Figure 2**, and the activity results of the six groups are classified by color. **Figure 2** is the result of community mapping for unsafe places created by in-service geography teachers living in Daegu and Busan. Mapping result URL address (https://www.google.com/maps/d/u/0/edit?mid=1s1Pd8jUdD0TEXFSsob77agZ_OG846eyH&ll=36.004733439573386%2C128.91750162681407&z=9).

There are a total of 205 dangerous places: 83 traffic (walking) dangerous environments, 36 security dangerous environments that can pose a risk to individuals, 38 dangerous natural environments, and 48 dangerous built environments. A total of 205 dangerous places experienced by in-service teachers and related photos and narratives are data collected through community mapping and photovoice. Contextual photos and narratives according to the location of the places displayed on Google My Maps are the results of activities conducted in photovoice activities by group.

Looking at the mapping results by category in **Figure 2** and **Table 1**, out of a total of 205 places, traffic (walking) dangerous environments were the most common. Although mapping data are insufficient to conduct extended research using this mapping result, community mapping is actively used as a pedagogical

Table 3. Themes and types of unsafe environments

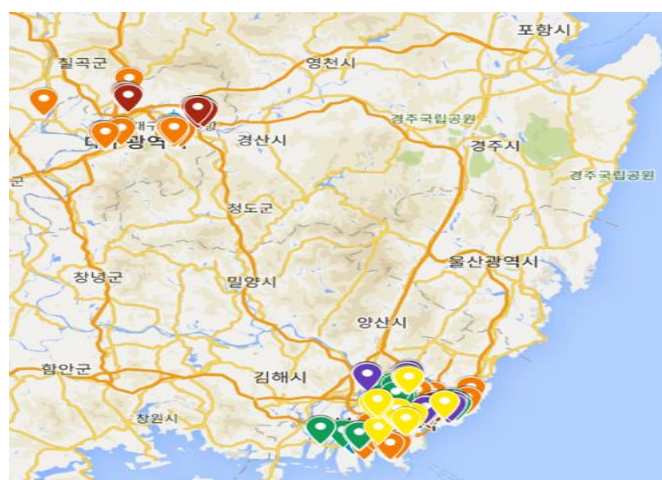| Themes	Types
Traffic (walking) environment	• Illegal parking • Bad sidewalks • Crosswalks and intersections without traffic lights • No sidewalks • Left unattended electric kickboard
Natural environment	• Wave caused by wind • Flooding of rivers • Falling rocks from the incision cliff
Security environment	• Walkways with nor or few streetlights • Alleyway with dark streetlights • Underground roads where streetlights are not maintained
Built environment	• Construction site due to redevelopment • Planned reconstruction site left as an empty house • Construction site due to river maintenance or walkway maintenance

Figure 2. Map showing the results of community mapping

tool in secondary geographical classrooms, which can increase students' knowledge and understanding of the local community and encourage them to actively participate in solving problems.

Dangerous traffic (walking) environment

As a result of the mapping, 42 out of 83 places were at risk of traffic (walking), accounting for approximately 50%. The in-service teachers presented four phenomena, such as illegal parking, crosswalks and intersections without traffic lights, no sidewalks, and left unattended electric kickboards as risk factors for traffic (walking). Among the four factors, crosswalks and intersections without traffic lights and neglected electric kickboards were most often suggested as walking risk environmental factors.

First, it is pointed out that crosswalks and intersections where vehicles, motorcycles, bicycles, and people travel a lot but where traffic lights are not installed are at high risk of traffic accidents and are not safe for walking (**Figure 3**). Specifically, as the risk of traffic and walking increases further at night, reducing the risk of accidents by installing LEDs or traffic lights to make things in the surrounding environment visible is necessary.

Second, in the case of electric kickboards, a new means of transportation in the city, many people ride without wearing protective equipment. Particularly, in the case of shared electric kickboards, people commonly leave them on the sidewalk after use, interrupting the passage of others. Thus, they interfere with the walking environment of people and increase the risk of safety accidents (**Figure 4**).

Third, some participants explained that the safety of vehicles and pedestrians is not secured due to illegally parked vehicles despite being near crosswalks or designated as child protection zones, increasing the risk of safety accidents. Specifically, it is asserted that despite being designated as a child protection area near kindergartens and elementary schools, large trucks, trucks, and cars are often illegally parked at night, thereby causing a great risk to pedestrian safety.

Fourth, some participants elucidated that the absence of sidewalks poses a great threat to the walking safety of people. For instance, it is affirmed that despite the road for elementary school students to and from school, only safety fences are installed, and there is no sidewalk, thereby increasing the risk of walking safety.

It is also validated that there is no sidewalk on the roads around libraries with high population flow due to high traffic; thus, there is a high possibility of collision between vehicles and people and that it is often difficult for vehicles to pass and pedestrians to move. They argued that to improve the risk of pedestrian safety, local governments must make efforts to increase the safety of access to public institutions and the safety of students commuting to and from school through the creation of sidewalks.
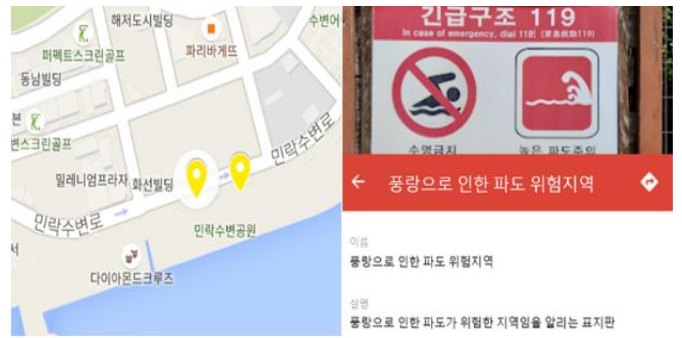
Dangerous natural environment

Mapping related to the dangerous natural environment was mainly performed by teachers living in Busan rather than teachers living in Daegu. The
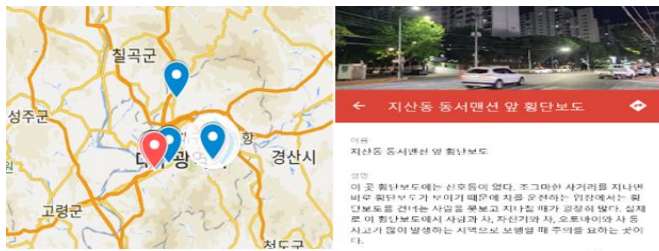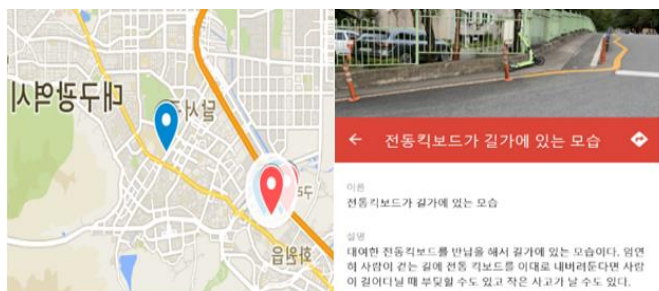
Title: Crosswalk in front of Dongseo Mansion in Jisan-dong
Narrative: There are no traffic lights on the crosswalk here. Because you can see the crosswalk right after passing a small intersection, from the perspective of driving a car, you often pass by without seeing anyone crossing the crosswalk. In fact, it is a place that requires caution when walking to areas where accidents occur a lot, such as people, cars, bicycles, motorcycles, and cars, on this crosswalk.
Figure 3. Risk factors for traffic (walking)–Intersection without traffic lights (Crosswalk in front of an apartment complex in Jisan-dong, Suseong-gu, Daegu)


Title: Left unattended electric kickboard
Narrative: It appears to have been left unattended after returning an electric kickboard rented by someone to the sidewalk. If you leave the electric kickboard on the sidewalk as it is, then it can hit people when they walk or cause small accidents.
Figure 4. Traffic (walking) risk factor–Left unattended electric kickboard (Sidewalk near a library located in Hwawon-eup, Dalseong-gun, Daegu)

Title: Areas where waves are dangerous due to wind
Narrative: The picture is a sign indicating that it is an area that can be dangerous due to waves caused by wind.
Figure 5. Dangerous natural environment–Wave caused by wind (Region around Minrak Waterfront Park in Minrak-dong, Suyeong-gu, Busan)
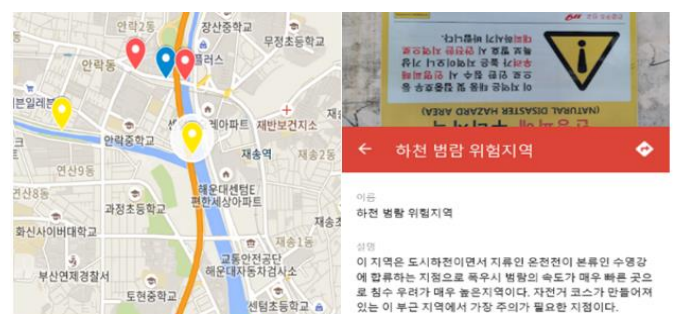
Title: Areas at risk of flooding rivers
Narrative: This area is the point where the Oncheoncheon Stream, an urban river and a tributary, joins the Suyeonggang River, the mainstream, and is an area with a very high risk of flooding in case of heavy rain. You must be most careful in the area around here where the bicycle course is built.
Figure 6. Dangerous natural environment–River flooding (Region around Oncheoncheon Stream in Anrak-dong, Dongnae-gu, Busan)

teachers suggested waves caused by the wind, river flooding, and rock falling from an incision cliff as major factors in the unsafe natural environment.

First, some teachers highlighted that the area adjacent to the sea is an area with a high risk of storm if the typhoon affects it (**Figure 5**). They emphasized the need to pay close attention to the maintenance of facilities such as breakwaters to mitigate these environmental risks and to present explanations for the area using geographic knowledge to adapt to environmental risks.

Second, some teachers validated that the point where the Oncheoncheon Stream, a tributary river of the Suyeonggang River, joins the mainstream is an area with a high risk of flooding due to torrential rains or soaring water levels during high tide (**Figure 6**).

Furthermore, they explained that in the case of river flooding, the flow rate increases rapidly and that there is a risk that steppingstones will lose weight due to slipperiness when crossing a bridge or walking along the river. They also emphasized the need for drainage work to ensure the stability of the river.

Third, some teachers disclosed that the Busan area has many incision sites due to the nature of urban development; therefore, in the event of torrential rains, it is exposed to the risk of soil leakage or rockfall every year. They affirmed that there are cases where roads are controlled, or casualties occur due to this. They also stressed that administrative authorities should come up with alternatives to disasters in terms of "safety" and "sustainability" in the region, as these problems are likely to intensify due to typhoons and heavy rains that are more likely to become frequent due to climate change.

Dangerous security environment

Some teachers mapped places with poor security environments to unsafe places. Particularly, they suggested walking paths with no streetlights or fewer streetlights, alleys with dark streetlights, and unmanaged underground roads as dangerous places in the city.

Title: A trail without streetlights
Narrative: Although a walkway was built using the former Haeundae Station and railroad tracks, it is very dark and dangerous because this area has no streetlights and is not maintained.
Figure 7. Dangerous security environment–A walkway without streetlights (Region around Haeundae Station in U-dong, Haeundae-gu, Busan)

Title: Alley with dark streetlights
Narrative: These days, streetlights installed in alleys are installed with LEDs; hence, you can see that they are very bright. Nonetheless, there are still many streetlights in each alley, not LED lights; thus, you can see that it is relatively dark, and it is a deserted place. Hence, you can feel scared when walking at night.
Figure 8. Dangerous security environment–Alley with dark streetlights (Region around an apartment complex located in Beommul-dong, Suseong-gu, Daegu)

First, some teachers argued that in the case of trails, no streetlights or fewer places can cause problems in pedestrian safety at night and become vulnerable to crime (**Figure 7**). In addition, they emphasized the importance of creating a sustainable space by installing smart streetlights and LED streetlights and installing CCTVs to improve the quality of life of local residents to create safer trails.
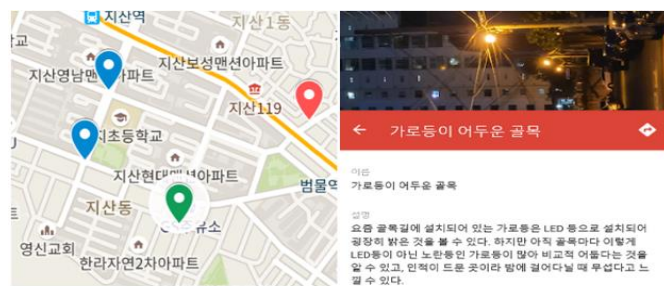
Second, some teachers explained that creating a space for people to walk more safely psychologically and physically is necessary by installing more streetlights or replacing them with LEDs in alleys where streetlights are dark (**Figure 8**). They also argued that local governments must make efforts to solve safety problems to improve the welfare of local residents by expanding facilities, such as safety return marks and stability lights, especially in alleys where there are few streetlights installed.

Third, some teachers highlighted that unmanaged underground roads remain a space of fear that people cannot easily access. They also asserted that in the case of underground roads built to increase accessibility, people rarely use them and often pass through the ground even if that takes a long time. Therefore, they argued that local governments must make efforts to allow people to pass comfortably and safely use underground roads through support such as lighting, CCTV installation, and continuous patrol.

Dangerous built environment

In-service teachers mapped construction sites due to redevelopment, planned reconstruction sites left as vacant houses, and construction sites due to river maintenance or walkway maintenance to unsafe places.

First, some teachers recognized that construction sites under redevelopment in the city are generally adjacent to sidewalks and have great risks such as soil leakage during precipitation. They further argued that there is a high risk of construction vehicles passing around the construction site and construction subsidiary materials away from the construction vehicle.

Second, some teachers affirmed that the planned reconstruction sites, which remained empty houses, have not been under construction for a long time; hence, it is commonly left unattended without being managed. Moreover, they emphasized that the surrounding environment is not hygienic, and odor is often generated due to unauthorized dumping of garbage (**Figure 9**). They also highlighted that the neglected reconstruction sites are empty houses; hence, they are highly likely to be utilized as a crime space because streetlights are not managed, and they are becoming spaces of fear/hate for residents living nearby.

Third, some teachers recognized the surrounding environment as a place where the risk of safety accidents could increase at night because of river maintenance or promenade maintenance, and no separate information boards or facilities were installed to prohibit people from passing (**Figure 10**). Particularly, it is elucidated that the existing walkway and construction sites are not distinguished; thus, the risk of safety accidents is high during evening walks. In addition, there is no separate safety facility, such as tarpaulin on slopes; hence, it remains an unsafe environment.

Discussion

On the basis of the following coding results, in-service geography teachers understood their daily landscape from a multidimensional perspective on the geographical core concept of "safety." Therefore, they understood unsafe places in the community as categories, such as traffic (walking), natural, security, and built environment. After this project was completed, the researchers conducted a survey of the participants aimed at reflecting on the possibilities and limitations that the in-service program using the two participatory methods can use in school geography classes and

Title: Udong District 2, planned redevelopment area
Narrative: It is a redevelopment area that has remained empty since a year ago, but construction has not begun; thus, there is no proper screen, making it a crime scene or threatening hygiene due to unauthorized dumping of garbage.

Figure 9. Dangerous built environment–Redevelopment area with empty houses (Region near Busan International Foreign Language High School in U-dong, Haeundae-gu, Busan)
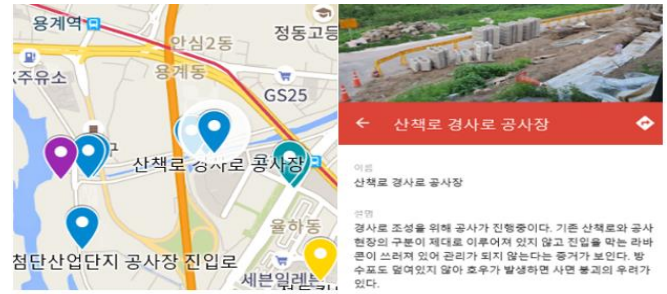
Title: Construction area of the slope of the walkway
Narrative: Construction is underway to create a slope. The existing walkway and construction site are not properly distinguished, and the lavacon that prevents entry has fallen; hence, this place is not properly managed. Waterproof cloth is not covered; thus, if heavy rain occurs, then there is a risk of slope collapse.

Figure 10. Dangerous built environment–A walkway under construction (Region near Yulha Station in Yulha-dong, Dong-gu, Daegu)

improving future programs. The questionnaire contains open-ended questions and comprises three main questions. According to the survey, researchers intended to discuss the possibilities and limitations of the two participatory research methods as a pedagogical tool for geography as follows. Three questions are, as follows:

1. How do you think community mapping and photovoice can be used as pedagogical tools for geography?
2. What do you think is the advantage of using community mapping and photovoice in geography classes?
3. What are the limitations in using community mapping and photovoice in geographic classes?

Regarding the first question, the results revealed that first, the teachers said that community mapping activities could allow students to acquire location knowledge as the basis of geographic literacy (Cook & Quigley, 2013). In addition, it was suggested that students can develop spatial thinking skills through the process of displaying information on a map, checking the location, or viewing a map and imagining topography or landscape. When community mapping using geographical information technology is applied to inquiry and problem-based geography education, the spatial thinking skills of students can be improved. When community mapping is employed in schools, students can effectively and intuitively investigate, compare, analyze, and share geographical data. Through this, students will be able to discover local problems and find solutions to them, and their interest and understanding of the region will deepen (Kerski et al., 2013). Second, teachers disclosed that the two participatory research methods can be utilized for performance evaluation or outdoor survey activities that can be conducted during club activities. Third, community mapping and photovoice activities can

increase interest and understanding of the region by exploring topics such as regional (re)development, sustainability, and natural disasters, for example, spatial issues appearing on various scales.

Regarding the second question, the teachers suggested usefulness in five aspects. First, community mapping and photovoice activities can cultivate geographical understanding through the process of student reading, analyzing, taking photos themselves, and writing narratives about them. Geography is a highly visual science because it relies on visual images (e.g., maps, slides, and photographs) as a means of expressing geographical knowledge (Balchin, 1972). Regarding teaching and learning using photographic images in school geography, the use of visual images, such as map and photography in geographical classes, is important in cultivating the geographicacy of students (Balchin, 1972). Second, the teachers mentioned that the two participatory research methods are effective tools of citizenship education. Moreover, they said that these two methodologies can help foster local citizenship or active citizenship by making students aware of various social, spatial, and environmental problems occurring in the community and play an active role in solving them. Third, community mapping and photovoice activities will allow students not only to interpret and reproduce community issues but also to connect abstract academic concepts discussed in geography to the daily experiences of students. They will be able to play a scaffold role in student learning and provide effective ways to achieve the class goals of teachers. Fourth, community mapping and photovoice activities can help students become active learners and reach an in-depth understanding of geographic issues through the production of various forms of geographic knowledge. Fifth, the two participatory research methods may help students personalize and internalize classroom knowledge because students are not passive in receiving knowledge from teachers through these activities but can

geographically visualize, show, and talk about their daily experiences in the process of interpreting, critically discussing, and presenting various visual information they have produced.

Regarding the third question, the teachers largely suggested limitations as lack of class time, difficulty securing objective criteria for evaluation, and safety issues. The results revealed first, many teachers highlighted the lack of class time as the biggest limitation in using community mapping and photovoice in geographical classes. The two research methodologies have the characteristics of time-consuming projects, such as checking regional exploration and location, taking pictures, and writing narratives. Nevertheless, in the case of South Korea, it was suggested that teachers have a burden of teaching the content elements presented in textbooks within a given time in the context of the national curriculum. Second, they claimed that difficulties may arise in securing the objectivity of evaluation. The results of community mapping and photovoice activities performed by students reflect the subjective tendencies of individuals. Therefore, when teachers evaluate which mapping results are more meaningful, there will be difficulties in establishing objective criteria for evaluation because there is much room for their subjectivity to intervene. Third, they raised great concerns about safety issues arising from the process of project activities. Further, they also raised the possibility of infection through outdoor activities in the COVID-19 pandemic situation and elucidated that if student activities are conducted without direct guidance from teachers, safety problems may arise in the process of selecting a location and taking pictures.

CONCLUSIONS

This study developed and applied an in-service program using community mapping and photovoice methodology for geography teachers. After analyzing the results of activities in-service geography teachers performed, the researchers explored the implications of these methodologies as pedagogical tools for geography. Using these methodologies, the in-service geography teachers put themselves in the position of students and explored "unsafe places in the community." Maps produced in the in-service program are not maps already produced and used by other institutions but are produced through the process of collecting and mapping data according to the themes selected by each group of in-service geography teachers as researchers. Through this process, the use of these participatory research methodologies in secondary geography education could promote the active participation of teachers and promote local identity and an understanding of the region. In addition, it was possible to find its potential as an effective pedagogical tool in cultivating citizenship that can view local issues with a geographical perspective and actively participate in solving them.

In addition, the in-service program using community mapping and photovoice for geography teachers aims to provide various opportunities for teachers to connect learners with geographical communities to explore various geographical issues in the region by effectively applying two participation techniques in their geographical classrooms. As a geographical pedagogical tool, photovoice has the significant advantage of developing students' key competencies based on critical thinking. In addition, it has the effect of enriching private geography through one's own voice (story or narrative) after capturing the public geography that students have learned in the classroom with pictures from outdoor sites (Cho et al., 2022). Those personal geographies should be recognized, respected, and reinforced in formal geography education (Slater, 1993). Therefore, if teachers return to their schools and apply these two participatory techniques to students, then it will help students develop their ability to actively participate in resolving issues by exploring the issues of the community in which they live. Particularly, if teachers apply these methodologies to their geographic classes, then their students will be able to cultivate community and citizenship competencies to actively participate in creating a better community.

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