

Disaster risk reduction education that enhances the proactive attitudes of learners: A bridge between knowledge and behavior

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ABSTRACT

Research on disaster risk reduction education (hereafter, DRR education) focuses on educational acts that take place between instructors and learners. Current research principally analyzes the knowledge and skills transmitted from instructors to learners, with the expectation that instructors teach learners knowledge and skills so that learners can engage proactively in DRR-related activities and respond appropriately to an actual disaster. However, previous studies have pointed out that increased knowledge and skills do not necessarily lead to behavioral changes in learners. Based on a literature review, the current study discusses why proactive attitudes are not fostered by current DRR education, which is underpinned by three approaches: (1) active instructor/passive learner approach, (2) knowledge-transmission approach, and (3) short-term knowledge evaluation approach. These three approaches, collectively termed the “transmission paradigm,” inhibits the fostering of a proactive attitude. Hence, this study proposes a new “proactive attitude paradigm” which consists of the (1) instructor/learner fusion approach, (2) participation in a community of practice approach, and (3) long-term commitment evaluation approach. The proactive attitude paradigm suggested in this study has been applied to a teacher training project in Nepal in which teachers developed a proactive attitude toward continuous DRR education. Further practical study of DRR education aimed at closing the gap between knowledge and behavior through adoption of the proactive attitude paradigm will be the focus of future research.

1. Introduction: gap between knowledge and behavior

Research on disaster risk reduction (DRR) education analyzes the educational acts that take place between instructors and learners, such as research on the effects of DRR educational training conducted by DRR education experts (instructors) with teachers (learners) and the effects of tsunami evacuation drills conducted by teachers (instructors) with children (learners). Also, a common thread running through DRR education is the expectation that instructors will teach learners the knowledge and skills of DRR so that learners will be able to engage proactively in DRR activities as well as respond appropriately in the event of an actual disaster. In other words, DRR education seeks to shape a proactive attitude on the part of learners. This is apparent from the frequent use of terms such as “behavioral change” [1–3], “culture of safety” [4,5], and “empowerment” [6] in articles on DRR education.

However, recent studies on DRR education have pointed out that even when instructors implement DRR education with learners, it does not necessarily lead to behavioral change in learners or lead them to proactively engaging in DRR activities, despite the stated objective of

shaping proactive attitudes on the part of learners. For example, Condreanu [7], in a review of 28 research articles, points out that DRR education in the context of school-based education increased knowledge and risk awareness but did not accomplish its principal objective, which was to engender proactive attitudes in learners. Likewise, Johnson et al. [8]; in a review of 35 research articles, revealed that although the evaluation of DRR education is based on how much learners' knowledge increases, there is not enough research evaluating whether learners behaved proactively. Other empirical studies have also pointed out the gap between knowledge and proactive attitudes. Shiwaku et al. [9] analyzed DRR education at five schools in Nepal and found that DRR classes did not lead students to take proactive measures. Shaw et al. [1] conducted a questionnaire survey of 1065 high school students in Japan and concluded that increased knowledge did not promote students' preparedness actions. Also, Wachinger et al. [10] rejected the premise that DRR knowledge and disaster risk awareness fosters behavior for DRR. They argued that knowledge and awareness have no correlation with behavior for DRR, a phenomenon they named the Risk Perception Paradox. These previous studies showed that even when learners gain

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knowledge and a heightened awareness of disaster risks as a result of DRR education, it does not necessarily accomplish the true goal of DRR education, which is to engender proactive attitudes in learners. This gap between knowledge and behavior has also been pointed out in a review paper by Johnson et al. [11] and an empirical study by Nakano et al. [12]; suggesting the need for DRR education research that truly contributes to the formation of proactive attitudes on the part of learners.

2. Objective, methodology, and structure of the paper

The objective of this paper is twofold: (1) to describe conceptually the factors that inhibit the development of proactive attitude on the part of learners through DRR education and (2) to suggest new DRR education approaches to overcome these inhibiting factors. Two research methodologies were applied. In the first methodology, a literature review identified current trends in DRR education and conceptual problems that inhibit the formation of a proactive attitude. The literature review incorporated not only DRR education studies but also educational relationship theory and Science and Technology Studies (STS) to better conceptualize the inhibitory factors. As discussed later, the study analyzed the idea that current DRR education is held within a “transmission paradigm” framework, which hampers the formation of a proactive attitude. Thus, the study suggests new DRR education approaches, namely the “proactive attitude paradigm,” to effectively foster proactive attitudes on the part of the learners. In the second methodology, DRR education training was implemented for teachers in Nepal to integrate the suggested “proactive attitude paradigm.” Thus, the suggested paradigm was examined in an actual DRR educational setting and its effectiveness in fostering a proactive attitude in Nepali teachers toward continuous implementation of DRR education at their own schools is discussed.

The remainder of this paper is structured as follows. Section 3 discusses the idea that current DRR education is based on three pedagogical approaches, namely (1) the “active instructor/passive learner approach,” in which the practice of DRR education is configured with the instructor as the subject of teaching and the learner as its object; (2) the “knowledge transmission approach,” in which DRR education is conceived of as the transmission of DRR knowledge and skills from the instructor to the learner; and (3) the “short-term knowledge evaluation approach,” which evaluates the effects of teaching practice by comparing short-term changes in the amount of knowledge before and after a teaching intervention. Moreover, these three approaches are not mutually exclusive, but rather exist in a mutually reinforcing relationship whereby the presence of one ensures the maintenance of the others. Based on these three approaches, we have dubbed the prevailing paradigm in DRR education the “transmission paradigm,” which inhibits the development of proactive attitudes on the part of learners.

Hence, in Section 4, we discuss three new approaches to DRR education as a “proactive attitude paradigm” to replace the transmission paradigm; these include an “instructor/learner fusion approach” to replace the active instructor/passive learner approach; a “participation in a community of practice approach” as an alternative to the knowledge transmission approach; and a “long-term commitment evaluation approach” instead of the short-term knowledge evaluation approach. We argue that the incorporation of a proactive attitude paradigm consisting of these three new interactive approaches into the field of DRR education will spur a discourse that will elicit truly proactive attitudes in learners.

Section 5 highlights a case study that incorporates the proactive attitude paradigm. The authors implemented DRR education training for teachers in Nepal with the aim of fostering proactive attitudes on the part of teachers toward continuous DRR education classes in schools in Nepal. The effectiveness of the proactive attitude paradigm is discussed. Finally, Section 6 presents the conclusion and the limitation of this study.

3. Problematic transmission paradigm of DRR education

3.1. The problem with the active instructor/passive learner approach

DRR education has traditionally been dominated by a teaching style in which instructors impart knowledge to learners in a unidirectional fashion [13,14]; Hanson-Easey et al. [15]. For example, typical scenes in the context of DRR education include settings in which a DRR education expert (instructor) visits a school to give a lecture to students (learners) about preparing for earthquakes at home, or in which a disaster risk management official (instructor) plans a community evacuation drill and local residents (learners) stage an evacuation in accordance with that plan.

Educational relationship theory, with reference to authors such as Ikeya [16] and Tokunaga [17]; clearly indicates that unidirectional education from instructor to learner can interfere with fostering proactive attitudes on the part of learners. First, a characteristic of the instructor/learner relationship is that it can be positioned as a “subject/object” relationship. In other words, thinking in terms of the orientation of the intentions and approaches of the educational act, the instructor as the subject of the educational act behaves actively by teaching and the learner as the object of the educational act behaves passively by being taught. A further peculiarity of this relationship between instructor and learner, in addition to this active instructor/passive learner educational-act relationship, is that it is “always premised on a difference in level between the two” [17]; p. 94). In other words, we have an asymmetrical relationship between someone with mature knowledge and skills (the instructor) and someone whose knowledge and skills are still developing (the learner), which, in conjunction with an instructor/learner relationship, confers the instructor—who has an absolute advantage in terms of knowledge and skills—with a proactive attitude in the form of “teaching,” while conferring the learner with a subordinate attitude in the form of “being taught.” As a result, “teaching and learning” is achieved between the two, all the while interfering with the development of an active attitude on the learner’s side.

This instructor/learner relationship is further strengthened precisely because the educational act is based on “love” [16]. That is, the way in which the instructor tries to protect and guide the learner in the name of “love” (Ikeya calls this “educational paternalism”) entails active educational encouragement and guidance on the part of the instructor, who attempts to guide the learner in a certain direction. At the same time, the learner’s dependency is also reinforced. Thus, the strengthening and occupying character of the instructor’s active attitude result in forming the learner’s passive attitude, and it ends up forming a loop that strengthens the active instructor–passive learner relationship. This relationship (or more specifically, the configuration that places the learner in the subordinate position vis-à-vis the instructor) is a necessary and inevitable premise supporting the basic process of education that conveys knowledge and skills [18]. Even so, there is in principle an inherent paradox between an “instructor/learner relationship” and a “proactive attitude” in the sense that education must ensure a proactive attitude on the part of the learner. This mutually contradictory configuration is also found in DRR education whereby the instructor teaches learners in a unidirectional fashion with the aim of fostering a proactive learner attitude.

Nakano et al. [19] discusses the problematic active instructor/passive learner relationship in the context of DRR education. When an instructor (DRR education expert) gives a lecture to learners (students) about preparing for earthquakes at home, we expect that the learners (students) will use the knowledge and skills at home. Hence, a proactive attitude on the part of the learner must be promoted through DRR education. However, throughout the educational act of teaching learners, the instructor occupies an active teaching role that creates the passive role of learners being taught. In addition to this contradictory configuration, in the context of DRR education, instructors are positioned as DRR experts and learners as non-experts, and the high level of

knowledge and skills on the part of the former tends to reinforce the active instructor/passive learner relationship between the two. In other words, in DRR education, the paradox between the “instructor/learner relationship” and a “proactive attitude” is structured so that the former is more likely to be given priority [20]. This is precisely the pedagogical challenge whereby DRR education conducted on the basis of a unidirectional active instructor/passive learner approach will not lead to the formation of a proactive attitude on the part of the learner and is also the reason for the deep chasm between knowledge and behavior. Later, in Section 4.1, we argue in favor of an “instructor/learner fusion approach” for overcoming the theoretical impasse of this active instructor/passive learner approach and engendering a proactive attitude in the learner.

3.2. The problem with the knowledge transmission approach

Despite the reported gap between knowledge and behavior, Amri et al. [21] and Torani et al. [22] point out that many studies still propose conveying such knowledge to learners via DRR education, taking the position that learners are not able to take DRR measures proactively because they do not possess sufficient knowledge about how to respond in the event of a disaster and DRR measures in general. DRR education has traditionally relied heavily on the knowledge transmission approach, and the fact that this approach remains dominant has been pointed out by commentators such as Yamori [23]; Boon and Pagliano [24]; Johnson et al. [8]; and Ronan et al. [25].

Based on the STS, Iwahori et al. [26]; Cook and Zurita [27]; and Abunyewah et al. [28] argue that because the instructor has knowledge and the learner does not, the DRR education view based on the knowledge transmission approach is underpinned by the “information deficit model” in scientific communication theory, meaning that it is necessary to close the knowledge gap between instructor and learner by communicating knowledge. However, this model is a traditional style of scientific communication and has led to suspicion of science and distrust toward experts by non-experts and citizens, especially when scientific knowledge is accompanied by uncertainty. Consequently, a new type of communication has been proposed that breaks away from the deficit model and encourages full and proactive participation in scientific practice by laypersons, so that experts and non-experts alike will be able to make decisions under uncertain conditions. This has been called “interactive communication” [29] and a “civic participation-style approach” [30].

The distrust of experts by non-experts pointed out in theories of STS also applies to a certain extent to disaster risk communication in general. A particularly well-known example of this is the trial over the L'Aquila Earthquake in Italy. This earthquake, which struck in April 2009, caused the deaths of over 300 people. In the aftermath, seven Italian seismologists and disaster risk management experts who had announced immediately before the disaster that there was “no possibility of a major earthquake” were subsequently prosecuted over their remarks, prompting distrust of them by non-experts (for details of the trial, see Ref. [31]). In another case, at the time of the Nepal Earthquake of April 2015 (also called the Gorkha Earthquake), fatalities that resulted when children who had been outside trying to practice the “Drop, Cover, and Hold” method of responding in the event of an earthquake, which had been taught to them by DRR experts, ran into homes that subsequently collapsed, prompting the criticism that misleading DRR education messaging by experts cost lives (for a specific example see the Nepal Times [32]). Also, in the 2011 Great East Japan Earthquake, many lives were lost when the resulting tsunami inundated designated tsunami evacuation sites that had been deemed scientifically safe based on the results of tsunami simulations conducted by tsunami engineers. This, too, led to a distrust of experts on the part of non-experts.

Against this background, learners (non-experts and citizens) no longer unconditionally trust the knowledge and skills of instructors (experts) in the field of DRR education. As a result of this, there is an emerging tendency, even when instructors (experts) try to convey DRR-

related knowledge to learners (non-experts), for many people to adopt an indifferent or even excessively pessimistic attitude (for detailed discussions, see, e.g., Refs. [33,34]). These discussions have led to a modification and extension of the traditional knowledge transmission approach, which had been established precisely because of the “learner’s trust in instructors.”

This is to clarify that the transmission of knowledge in the active instructor/passive learner approach relies upon the interrelationship between or roles of the instructor and learner, not educational attitude as in the knowledge transmission approach. Thus, these two approaches are conceptually different. The knowledge transmission approach constitutes the second conceptual reason for learners being unable to engage proactively with DRR measures. Thus, later in Section 4.2, we propose “participation in a community of practice approach” to replace the knowledge transmission approach.

3.3. The problem with the short-term knowledge evaluation approach

The mainstream approach to evaluation in the context of DRR education is evaluation of short-term knowledge change, in which the degree of knowledge before and after a DRR education intervention is compared in order to determine how much knowledge has been transmitted. Chijiwa [35] identified and examined 50 research publications relating to the practice of DRR education from five journals: *The Japanese Journal of Safety Education* (Anzen kyōiku-gaku kenkyū; vols. 1 to 11), *The Journal of the Japan Society for Natural Disaster Science* (Shizen saigai kagaku, vols. 28 to 35), *The Journal of the Japan Society of Civil Engineers* (Doboku gakkai ronbun-shū, vols. 67 to 72), *Proceedings of the Japan Society for Disaster Informatics* (Nihon saigai jōhō gakkai yōkō-shū Vol.1-Vol.18), and *Summaries of Technical Papers for the Annual Meeting Architectural Institute of Japan* (Nihon kenchiku gakkai gakujutsu kōen kōgai-shū, 2011 to 2015). She found that 72 % (36) of the studies evaluated DRR education practice over a period of less than one week, averaging 1.4 days each within this sample. Only 14 % of the studies were carried out over a period of one year or more. Also, in terms of the evaluation methods adopted within these 50 publications, 72 % (36) involved the use of questionnaire surveys, and most of the indicators used were those that measured changes in knowledge or perception. These results show that the current evaluation of DRR education involves extremely short-term measurements based on a before-and-after comparison of DRR education interventions that are only carried out once or twice to determine whether learners have acquired knowledge or altered their perceptions.

The following is a typical example. Inagaki et al. [36] prepared a 7 min 30 s teaching video, which included a recreation of flood damage caused by a past typhoon, and then showed it to local children. A questionnaire survey was conducted before they watched the video and again one week later to investigate and analyze how much they remembered about the content of the video and how their perception had changed with regard to evacuations in the event of a flood. In another example, Yamaoka [37] prepared an educational pamphlet on slope-failure disasters, which they mailed out to local residents. To determine changes in knowledge or perception before and after the distribution of the pamphlet, they mailed out a survey form both before and after they mailed the pamphlet in order to investigate matters such as the timing of evacuations during heavy rain, intent to follow evacuation advisories, and stockpiling of emergency supplies. These studies are heavily inclined toward pre-testing and post-testing to evaluate the effectiveness of extremely short-term DRR education interventions.

A similar tendency has also been pointed out by Johnson et al. [8]; who identified and investigated 38 publications concerned with validating the effectiveness of DRR education. They pointed out the preponderance of analyses based on pre-test/post-test questionnaire surveys dealing with extremely short-term DRR education interventions. Similar findings are also presented in Ronan [25] and Johnson [11]; indicating that DRR education is dominated by the short-term

knowledge evaluation approach, which measures changes in amounts of knowledge over the very short term. Thus, the necessity of evaluating the attitude with long-term has been suggested by the literatures. If DRR education involves teaching “the history of flood damage” and later asks “do you know the history of flood damage,” it is only natural to expect an increase in affirmative responses. However, given that previous studies have pointed to the lack of any correlation between increases in DRR knowledge and behavior, the prevailing short-term knowledge evaluation approach has not even evaluated the formation of a proactive attitude on the part of learners, which can be said to constitute a third problem. Given the necessity of presenting a framework for evaluating proactive attitudes on the part of learners who have received DRR education, in Section 4.3 we propose a “long-term commitment evaluation approach” to replace the short-term knowledge evaluation approach.

3.4. A mutually reinforcing relationship among the three problems

Thus far, we have presented the active instructor/passive learner approach, the knowledge transmission approach, and the short-term knowledge evaluation approach, on which the current study of DRR education is firmly based. Given that these approaches are based on the transmission of DRR-related knowledge from instructors to learners, we call this the “transmission paradigm” of DRR education. What is important here is that these three approaches are not mutually independent, but rather exist in a mutually reinforcing relationship in which the existence of one approach promotes the maintenance and strengthening of the other approaches.

This mutually reinforcing relationship is shown in Fig. 1. First, the relationship between the active instructor/passive learner approach and the knowledge transmission approach shows that the instructor has a proactive attitude and the learner a subordinate attitude is reinforced by DRR education based on the knowledge transmission approach. In other words, the combination of these two approaches produces a relationship in which the instructor is led to exert a stronger proactive attitude in the act of actively seeking to transmit knowledge according to the knowledge transmission approach and simultaneously strengthens the subordination of the learner through the act of receiving knowledge.

Next, let us consider the relationship between the knowledge transmission approach and the short-term knowledge evaluation approach. When adopting the knowledge transmission approach, an effective evaluation method is to evaluate changes in knowledge before and after DRR education interventions by using a questionnaire survey. Thus, the short-term knowledge evaluation approach is maintained. In the same way, the knowledge transmission approach is maintained when adopting the short-term knowledge evaluation approach as the principal

evaluation tool in the field of DRR education. Thus, these two approaches mutually reinforce each other.

Finally, let us look at the active instructor/passive learner approach and the short-term knowledge evaluation approach. Given that the active instructor/passive learner approach engenders a situation whereby the learner passively follows the instructor and does not engender proactive learner attitudes, knowledge evaluation, rather than evaluation of proactive attitude, is considered an effective evaluation method. In the same way, because the short-term knowledge evaluation approach is used predominantly in DRR education, formation of passive learner attitudes based on the active instructor/passive learner approach is overlooked and not evaluated.

Thus far, we have summarized the transmission paradigm consisting of these three approaches and explained their mutually reinforcing relationship. By resting on these three approaches, the transmission paradigm has undoubtedly played a role in enhancing the transmission effect of DRR-related knowledge. However, promoting the study of DRR education based on this transmission paradigm has not led to the formation of a proactive attitude on the part of learners, which is the true objective of DRR education. Therefore, to overcome the barrier between knowledge and behavior, we propose the proactive attitude paradigm as a new paradigm to replace the transmission paradigm.

4. A proactive attitude paradigm shaping proactive attitudes on the part of learners

In this section, as a new approach to DRR education aimed at promoting the formation of a proactive attitude in learners, we propose a proactive attitude paradigm comprising three new approaches, namely, the “instructor/learner fusion approach” to replace the active instructor/passive learner approach (4.1), a “participation in a community of practice approach” as an alternative to the knowledge transmission approach (4.2), and a “long-term commitment evaluation approach” instead of the short-term knowledge evaluation approach (4.3).

4.1. Instructor/learner fusion approach in place of the active instructor/passive learner approach

The problem with implementing DRR education through the active instructor/passive learner approach is that the very nature of instructors teaching learners hampers the formation of a proactive attitude in learners because it assigns a proactive attitude to the former in the form of “teaching” and a subordinate attitude to the latter in the form of “being taught.” Nakano [20] aimed to promote the formation of a

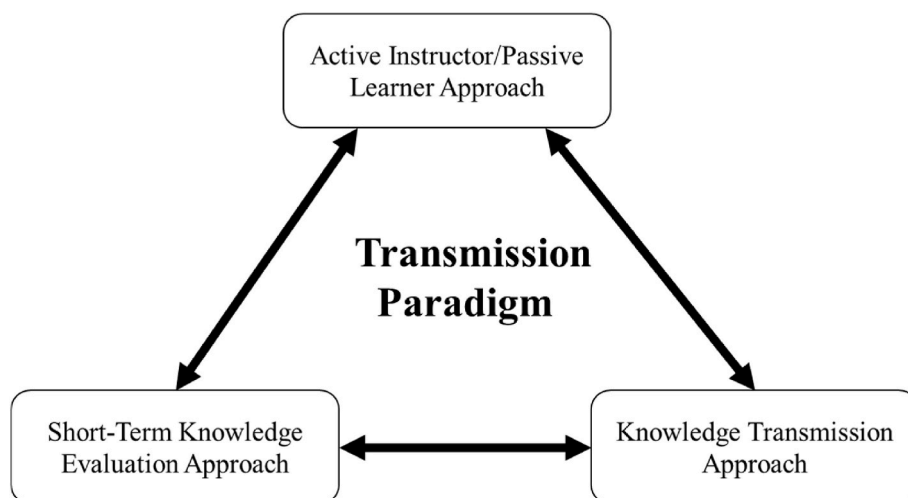


Fig. 1. Mutually reinforcing relationships in the transmission paradigm.

proactive attitude on the part of learners by breaking away from DRR education based on this active instructor/passive learner approach. Based on the instructor/learner relationship described above, Nakano [20] analyzes how local disaster risk management officials in the town of Zihuatanejo, Mexico have unidirectionally taught teachers how to carry out earthquake and tsunami evacuation drills, and how this seems to have interfered with proactive attitudes on the part of those teachers, despite the expectation that the teachers would proactively implement drills at school. Then, with the aim of eliciting proactive and continuous engagement in earthquake and tsunami drills by teachers, a research intervention was conducted over a more than 300-day period. This study reports on how, by incorporating into DRR education design a process in which teachers would devise their own evacuation routes, plan and practice drills, and provide feedback to disaster risk management officials, the teachers began to engage with disaster drills on an ongoing basis. It also describes how the training of teachers in DRR education, including education content for them to implement with their students, by disaster risk management officials resulted in teachers beginning to engage proactively with DRR education. To put this in more conceptual terms, the keys to restoring a proactive attitude in teachers who had held a subordinate attitude based on the active instructor/passive learner approach can be described as, firstly, an approach that reverses the teacher–learner relationship, and, secondly, a layering approach that places other learners under the original learners. The former saw the introduction into DRR education of a teaching style in which not only did disaster risk management officials (instructors) teach the teachers (learners), but the teachers (learners) also taught the disaster risk management officials (instructors). The latter was a style in which not only did disaster risk management officials (instructors) teach the teachers (learners), but the teachers (learners) then went on to teach other learners (i.e., their students). In this paper, we call this approach, which weakens the instructor/learner relationship and works toward fusion between instructor and learner, the “instructor/learner fusion approach.”

The instructor/learner fusion approach has already begun to be introduced into the practice of DRR education in the last few years. One example of this is research by Okada and Yamori [38]. This research, which was conducted in areas of high tsunami risk, involved elementary school students (who would normally be in the position of learners) walking around the community to identify potential danger points in the event of an earthquake or tsunami and then creating a local DRR map. These students (learners) then explained the map they had created to teachers and local officials who would normally be in the position of instructors in order to assist with local DRR measures. This approach to DRR education, in addition to leading elementary school students to engage proactively in evacuation drills and local DRR activities, has led to other positive outcomes, including collaborations between elementary school students, teachers, and government officials and increased participation in local tsunami evacuation drills, as well as the seismic reinforcement of aging bridges along evacuation routes and the relocation of welfare facilities in inundation zones to higher ground. In this case, the approach has upended the normal relationship in which teachers and officials are instructors and students are learners to one in which students are instructors while teachers and officials are learners. It is important to note that although students played an instructor role in the process of DRR education, the teachers, experts, and officials gave them helpful suggestions for locating hazards and risks during the map making activity and so on.

Incorporating the “instructor/learner fusion approach” into the design of DRR education is likely to lead to the implementation of proactive DRR measures by learners, which is the original goal of DRR education. Chapter 5 further examines the effectiveness of this approach in fostering proactive learner attitudes.

4.2. A participation in a community of practice approach in lieu of the knowledge transmission approach

As pointed out earlier in Section 3.2, in DRR education based on the knowledge transmission approach, the instructor (expert) has knowledge and the learner (non-expert) does not, and thus the goal is to shrink the knowledge gap between the two by transmitting knowledge from the instructor to the learner. However, this style of DRR education did not work well due to the learners’ distrust of instructors. Based on studies such as Yamori [23]; Iwahori et al. [33]; and Iwahori et al. [26]; we would like to propose the “participation in a community of practice approach” as another approach to replace the knowledge transmission approach. The participation in a community of practice approach is based on the theory of legitimate peripheral participation proposed by Lave and Wenger [39]. Based on Iwahori [26]; this is a theory concerned with legitimate participation in various activities in a community of practice, which is defined as a “cluster of people participating in a given practice (e.g., a workplace or school).” In contrast to conventional ways of evaluating knowledge, such as the knowledge transmission approach, we regard learning outcomes to be a transformation of identity for both the instructor (expert) and the learner (non-expert). Yamori [40] positions this identity as learning, arguing that “it is not individual personality or identity in the narrow sense. Rather, it is a broader concept. In sum, it is the role, perspective, or position that the person in question occupies in a community of practice. [...] In other words, it is to become a member of a community that ‘does things together.’” Put another way, he sees learning outcomes as changes in role, perspective, or position in the context of the practices in which the participating subject (learner) takes part. The theory also involves proactive learning through participation in a community of practice by the learner, and it is compatible with the proactive attitude paradigm to which this paper aspires.

Let us take the example of a study reported in Iwahori et al. [33] and Iwahori et al. [26]; which drew on this theory. In this study, small-scale seismographs were installed in elementary schools, and the students there participated in actual seismic observations. That is, the students read the waveforms recorded by the seismographs and performed maintenance such as changing the batteries in the observation equipment maintenance as part of learning activities. The initiative took place over a period of more than five years and involved continuous reports on various behavioral transformations resulting from the students’ participation in the actual practice of seismic observation. In addition to the transmission of knowledge and skills relating to seismic observation, these also included the fact that the students recognized that they were playing a role in seismic observation, such as when they stopped playing near the seismographs in order to avoid making too much noise, and the fact that although it was Year 6 students who participated in this activity, a handover of responsibilities was carried out from Year 6 students to Year 5 students. The study discussed how this kind of DRR education, which authorizes non-experts (learners) to participate in practices normally carried out by experts (instructors), through participation in a community of practice in terms of seismic observation by non-experts (learners), has engendered a transformation of identity through the three elements of “knowledge and skills,” the “community of practice” in which these are used, and the “role” that is played therein. DRR education based on this kind of community of practice theory does not consider knowledge transmission as learning, but rather regards learning to be the transformation of the learner’s attitude through participation in legitimate practice, which is also consistent with the aim of DRR education proposed in this paper, namely the formation of a proactive attitude in learners.

4.3. Long-term commitment evaluation approach in place of the short-term knowledge evaluation approach

As mentioned in Section 3.3, it has already been pointed out that evaluation based on the short-term knowledge evaluation approach did

not evaluate proactive attitudes in learners. Although very few articles have evaluated proactive attitudes in learners, we introduce two such studies here. Nakano et al. [12] conducted a long-term evaluation of a DRR education initiative that began in 2001 at Bal Bikash Secondary School in Nepal. Some students at the school took part in the School Earthquake Safety Club, learned about earthquake risk reduction, created risk maps, and staged plays related to earthquake safety at school as well as in extracurricular settings. Follow-up surveys of the club's alumni were carried out until 2015, and it was found that students continued to engage proactively in activities after graduation, including by taking part in Earthquake Safety Day events, getting involved in running school earthquake safety summits, attending training courses on seismic reinforcement, and establishing the Aalapot Village Disaster Prevention Youth Committee. In particular, the Youth Committee provided advice on seismic reinforcement to local residents, and, given that the houses of those who heeded this advice did not collapse during the 2015 Gorkha Earthquake, seemed to have an actual disaster mitigation effect. Beyond this, the alumni also heightened their sense of self-affirmation, deriving self-confidence from the DRR education classes conducted at Bal Bikash Secondary School. From this, Nakano et al. [12] point out that it is necessary to track learners over the longer term in order to evaluate changes in proactive attitudes on the part of learners, and to evaluate not knowledge, but rather how learners subsequently remain committed to DRR-related activities.

Another example of the evaluation of proactive attitudes in learners is found in Nakano et al. [41]; which conducted a follow-up survey of alumni of the Environment and Disaster Mitigation Course Maiko High School in Hyogo Prefecture. Alumni of the course, which was established with the aim of fostering civic leaders in the field of DRR, were followed up for ten years, at which point a questionnaire survey was conducted that involved groups of questions on themes such as how respondents' careers related to DRR, how they participated in or were involved in

DRR-related activities after graduation, and how the Environment and Disaster Mitigation Course had influenced their career choices. The results revealed that 21 % had chosen occupations and academic fields directly related to DRR, and that 65 % had found some connection to their current occupation or academic field with DRR. The study also found that even after graduation, many alumni of the Environment and Disaster Mitigation Course were proactively participating, whether as university students or professionals, in areas that included DRR education, disaster volunteering, and fundraising.

These previous studies are clearly distinguished from the traditional style of DRR education, which evaluates knowledge from a short-term perspective. Instead, based on long-term changes in learners' attitudes as a result of DRR education, they evaluated how learners have committed to activities related to DRR in areas such as their career choices, participation in DRR activities after graduation, self-affirmation and self-confidence, and their responses in the event of a disaster as well as the damage-mitigation effects of their DRR activities. Given this, a long-term commitment evaluation approach should prove effective in evaluating the proactive attitude as a replacement for the short-term knowledge evaluation approach.

4.4. Interactive relationships based on the proactive attitude paradigm

Thus far, we have discussed the instructor/learner fusion approach, the participation in a community of practice approach, and the long-term commitment evaluation approach. These three approaches have interactive relationships in which the practice of each approach reinforces the others, leading to a DRR education that engenders a proactive attitude in the learner (Fig. 2).

First, let us look at the instructor/learner fusion approach and the participation in a community of practice approach. The instructor/learner fusion approach has as its essence the easing and reversing of the

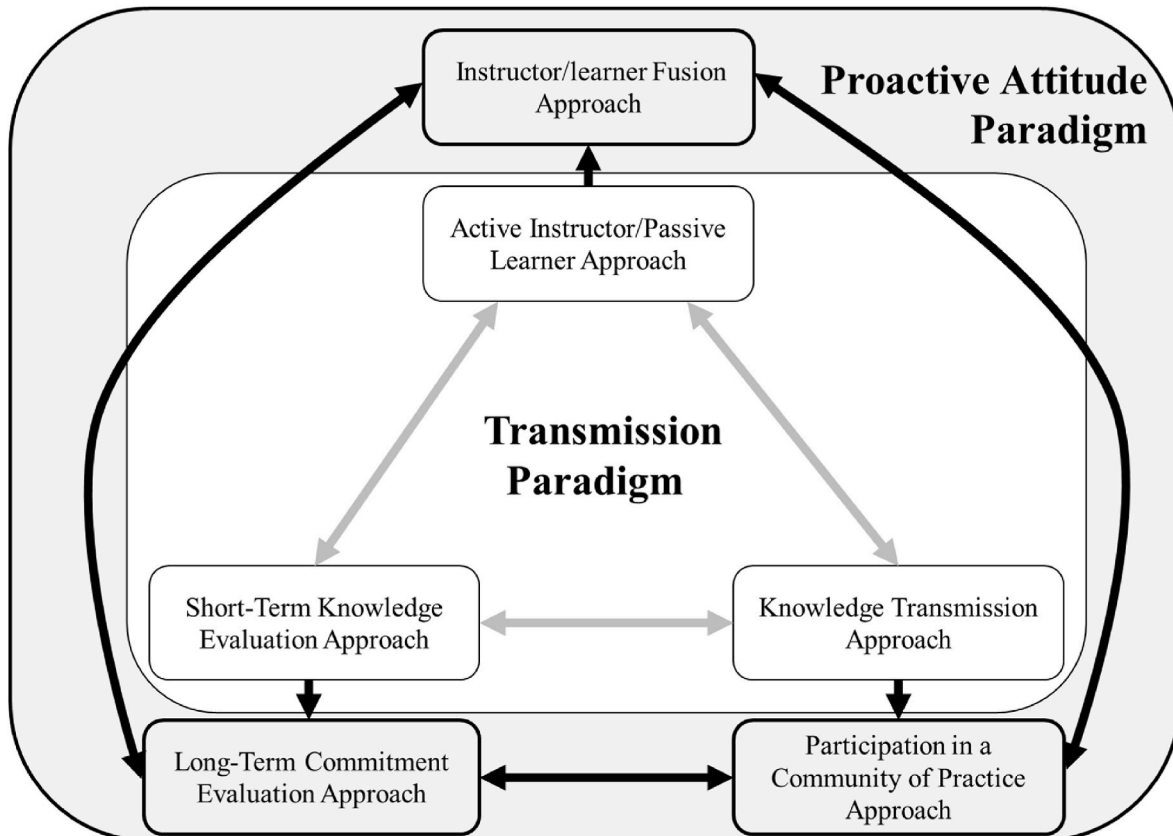


Fig. 2. Shift from a transmission paradigm to a proactive attitude paradigm.

instructor/learner relationship, whereas the participation in a community of practice approach positions learning as the transformation of identity that occurs as a result of a learner's participation in legitimate practices developed by an instructor. Participation, in other words, is participation in a community of practice that is realized through authorization from the instructor to the learner. The weakening of the instructor/learner relationship serves to enhance the degree to which the learner participates in the instructor's legitimate practice, and thus these two approaches have a synergistic and mutually reinforcing relationship.

Next, let us look at the participation in a community of practice approach and the long-term commitment evaluation approach. What takes place as a result of the participation in a community of practice approach, which positions the transformation of the learner's roles, standpoints, and positions as learning, is a transformation at the learner's level of practice. To evaluate this transformation, it is necessary to follow the transformation of the learner over the long term, rather than through short-term knowledge evaluation. By assessing the learner's proactive attitude and behavior as an evaluation of long-term commitment, it is possible to evaluate the participation in a community of practice approach.

The same relationship is found with the instructor/learner fusion approach and the long-term commitment evaluation approach. To evaluate whether a learner is demonstrating a proactive attitude as a result of the instructor/learner fusion approach, it is necessary to observe how the learner has subsequently been involved in DRR related activities, and an evaluation of long-term commitment is essential.

We believe that introducing the proactive attitude paradigm, which combines these three paradigms into the field of DRR education, will serve to stimulate discussions about the formation of a proactive attitude in learners and lead to further enhancement of DRR education methodologies aimed at promoting the formation of a proactive attitude. In addition, the shift from a transmission paradigm to a proactive attitude paradigm will lead to our overcoming the gap between knowledge and behavior, which has been identified as an issue in the field of DRR education. The next chapter introduces a case study to examine the effectiveness of the proactive attitude paradigm. The proactive attitude paradigm consists of three approaches and was integrated into the design of a DRR education training project for teachers in the Nuwakot district in Nepal.

5. Application of the proactive attitude paradigm

5.1. Background of the project

The Nuwakot district is located north of the capital city of Kathmandu in Nepal. The training targeted approximately 30 teachers across eight schools that were located in rural mountainous areas. A total of 2296 students attended the eight schools, with between 109 and 466 students at each school. These eight schools were seriously affected by the 2015 Gorkha earthquake. In fact, the eight schools originally had 107 classrooms, of which 69 had collapsed or were disabled by the earthquake. Since the earthquake, the Nepali Department of Education developed a teacher's manual for use as a reference to implement DRR education at subsequent teacher trainings held at schools throughout Nepal, including the eight targeted schools. However, none of the eight schools replicated the DRR education at their own schools. The problem of stagnation in the proactive attitudes of Nepali teachers was first seen in 2003 when the first author observed the Nepali government and local NGOs conduct local DRR education training that could not foster a proactive attitude in teachers. These trainings basically adopted a uni-directional, classroom-type training, with knowledge transferred from instructor to learners (teachers). Thus, the traditional training program was held within a transmission paradigm that applied the active instructor/passive learner approach and knowledge transmission approach. As such, it seemed reasonable to introduce the proactive

attitude paradigm for teachers at the targeted schools.

5.2. Project design and implementation

The proactive attitude paradigm, which consists of the instructor/learner fusion approach, participation in a community of practice approach, and long-term commitment evaluation approach, has been integrated into the DRR education training design for teachers in the Nuwakot district. The training project was held in collaboration with the local NGO and the Nuwakot Department of Education from August 2016 to February 2018. In this project context, the first author and another Japanese DRR education expert were the instructors, while the teachers were the learners. The project's main objective in integrating the proactive attitude paradigm was to engender a proactive attitude in teachers toward continuous DRR education implementation at their own schools. Table 1 shows that six teacher trainings were held. Fig. 3 shows a schematic of the DRR education training process.

In August 2016, 27 teachers participated in the first teachers seminar. Being the first seminar, the instructors explained basic information about DRR education, including its pedagogy. The teachers were asked to develop a teaching plan on DRR education during the seminar and then implement DRR education classes at their own schools before the second teachers seminar held in February 2017. Thus, the first training was held within a transmission paradigm, which adopts an active instructor/passive learner approach and knowledge transmission approach.

As discussed so far, the transmission paradigm is ineffective for fostering a proactive attitude in teachers (learners). Among 27 teachers who attended the first seminar, only three implemented DRR education at their own schools before the second seminar, suggesting the limited effectiveness of the first seminar. Thereafter, from the second to the sixth seminar, the instructor/learner fusion approach was adopted. More

Table 1
Series of teachers' seminar.

No.	Month/ Year	No. of attendees	Contents
1	Aug. 2016	27	<ul style="list-style-type: none"> ●Instructors explained basic information about DRR education (terminology, earthquake mechanisms, DRR education pedagogy) and gave practical examples ●Teachers developed a teaching plan for DRR education
2	Feb. 2017	17	<ul style="list-style-type: none"> ●Two teachers presented their practice experience with DRR education classes ●Discussion of DRR education practices among all participants including instructors ●Instructors presented a case study of trauma counseling in Japan and DRR education practices
3	June 2017	17	<ul style="list-style-type: none"> ●Workshop to discuss the Manual's index ●Five teachers presented their practice experience with DRR education classes ●Discussion of DRR education practices among all participants including instructors ●Instructors presented a case study on storytelling of disaster experiences in Japan and DRR education practices
4	Sept. 2017	13	<ul style="list-style-type: none"> ●Workshop to discuss the Manual's contents ●Two teachers presented their practice experience with DRR education classes ●Discussion of DRR education practices among all participants including instructors ●Workshop to discuss the Manual's contents
5	Jan. 2018	16	<ul style="list-style-type: none"> ●Manual writing workshop
6	Feb. 2018	15	<ul style="list-style-type: none"> ●Workshop on disaster timeline and role of teachers ●Discussion on how to create a teaching plan for DRR education among all participants, including instructors



Fig. 3. Schematic of the process of teacher training.

concretely, two out of three teachers who had implemented DRR education after the first seminar were invited to the second seminar to present their experiences with DRR education classes. In other words, these two teachers, who started out as learners at the first seminar, played the role of instructors throughout the second seminar by sharing their experiences with other teachers. This was the layering approach as original instructor (authors)/learners (teachers) relationship were weakened as two teachers played the role of instructors. It was the structural changes in the educational relationship from instructor (authors)/learners (teachers) relationship to instructor (authors)/instructors (two teachers)/learners (other teachers). This seminar style led to incremental changes in the teachers' attitudes. As mentioned, only three out of 27 teachers replicated DRR education after the first seminar, which was based on the transmission paradigm. In comparison, among 17 teachers who attended the third seminar, which was held using the instructor/learner fusion approach, 10 replicated DRR education before the fourth seminar. Furthermore, five of these teachers went on to share their DRR education experiences at the fourth seminar, leading to more teachers choosing to implement DRR education at their own schools. As such, throughout the instructor/learner fusion approach in which teachers played the instructor role at the seminars, the teachers demonstrated a proactive attitude and transferred this attitude to other teachers. As a result, over the period of a year, from February 2017 to February 2018, DRR education classes were held 36 times at the eight targeted schools. Teachers have proactively committed to develop DRR education content, including conducting evacuation drills, performing street dramas to convey the importance of trauma counseling, making DRR posters, and designing paper crafts to consider earthquake-resistant structures. These diverse types of DRR education were held at the eight schools, which is a significant outcome given their rare occurrence at these schools before the project.

As teachers accumulated experience carrying out DRR education, the project integrated into DRR education the creation of a teacher's manual by the teachers. This approach exemplifies the participation in the community of practice approach because it authorized teachers (learners) to get involved in practices normally carried by DRR education experts or experts at the Department of Education. In the seminar series, teachers discussed the manual's index at the second seminar, the

manual's contents at the third and fourth seminars, and then independently wrote the contents at the fifth seminar (two-day workshop). All these processes took place with the guidance of DRR experts from the local NGO and the authors. The completed manual contained eight chapters: (1) Introduction to Disasters and the Disaster Context in Nepal, (2) Earthquakes, (3) Floods, (4) Landslides, (5) Storms, (6) Fires and Wildfires, (7) Epidemics, and (8) Psychological Counseling. Each chapter described how to prepare to reduce disaster risks and how to respond during a disaster. Furthermore, the manual encouraged discussion among students about appropriate countermeasures and responses depending on the situation, including local disaster experiences. This manual was reviewed and approved by the local NGO, the Department of Education, and the authors.

As for evaluating a proactive attitude, as mentioned earlier, the teachers' continuous commitment to carry out DRR education was observed during the project period, with DRR education held at the eight schools 36 times, as well as the adoption of different methodologies such as street drama and paper crafts. Furthermore, three years after the project ended (March 2021), telephone-based interviews were conducted to determine the long-term impact of the project. In fact, two out of the eight schools had continuously utilized the manuals, thereby maintaining the proactive attitude of the teachers and confirming continuous DRR education. However, the author could not reach the remaining six schools by telephone due to the schools' rural locations, and so further field study is needed to examine the effectiveness of the long-term commitment approach in the proactive attitude paradigm, which cannot be carried out during the COVID-19 pandemic.

6. Conclusion: prospects for future study

In this paper, we identified as a current challenge in the field of DRR education, which consists of the active instructor/passive learner approach, the knowledge transmission approach, and the short-term knowledge evaluation approach. Then, we pointed out the difficulty of overcoming the immediate gap between knowledge and behavior in studies of DRR education based on this paradigm. We also proposed studying DRR education within a proactive attitude paradigm, which consists of the instructor/learner fusion approach, the participation in a

community of practice approach, and the long-term commitment evaluation approach in place of those other approaches. The proactive attitude paradigm was applied to the teacher training project held in Nuwakot, Nepal, which confirmed the effectiveness of at least the instructor/learner fusion approach and participation in a community of practice approach. The long-term commitment evaluation approach requires further study to examine its effectiveness through the teacher training project. We believe that promoting DRR education based on this proactive attitude paradigm from both a practical and theoretical research perspective will give rise to a DRR education methodology that will truly contribute to the formation of a proactive attitudes on the part of learners.

Finally, we would like to present some important issues concerning the relationship between the transmission paradigm and the proactive attitude paradigm. In this paper, we have thus far proposed a shift from the transmission paradigm to a proactive attitude paradigm, but this does not mean that we are insisting that the transmission paradigm should be completely abandoned. The introduction of the proactive attitude paradigm into DRR education will certainly promote the formation of proactive attitudes in learners and enable them to engage in DRR and take appropriate action in the event of a disaster. However, because the proactive attitude paradigm weakens the instructor/learner relationship between instructor and learner, DRR education that is based solely on a proactive attitude paradigm might end up weakening the effect of the transmission of DRR-related knowledge from instructor to learner. In promoting DRR education, it is also important to transmit knowledge from instructor to learner. Although it is necessary to use a methodology based on the transmission paradigm and the proactive attitude paradigm for different purposes as needed, this point has not been addressed in this paper. Also, the proactive attitude paradigm presented here is partially examined based on the empirical study of teacher training in Nuwakot. Thus, further practical study of DRR education with the aim of closing the gap between knowledge and behavior by adopting the proactive attitude paradigm will be the focus of future research.

Declaration of competing interest

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

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