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The Subak Cultural Landscape as Environmental Education: Knowledge, Attitudes, and Experiences of Balinese Teachers, Student Teachers, and Students

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ABSTRACT

Bali's subak cultural landscape, with its ancient and extensive paddy-fields and irrigation system, is a valuable resource for place-based education. However, this landscape is threatened by various problems. Here we analyze the relationships among Balinese teachers, student teachers, and students, and review their knowledge, attitudes, and experiences toward subaks. This study finds that most of the Balinese teachers, student teachers, and students had limited knowledge and experiences regarding subaks, although their overall attitudes were positive. We conclude by discussing the study's implications for relocating environmental education into the local context.

KEYWORDS: subaks, valuable resource, place-based education, local context.

INTRODUCTION

There are hundreds of ancient farming organizations—locally known as subaks—located on the island of Bali, Indonesia. For more than a millennium, subak members have engaged in cooperative agricultural practices to harvest paddy rice from a complexly-engineered, terraced system, and accompanied by temple rituals (Steven, 1994; Lansing & Miller, 2003; Lansing, 2006). Subaks are not only agricultural planning units that manage water irrigation and planting schedules at the community level; they are also religious communities and autonomous legal corporations. Overall, the remarkable depth of cooperation within the subaks creates a sustainable rice farming system that is mediated through water temple networks (Lansing 1991; 2006; Fox, 2012).

Recently, several subak sites have been recognized by UNESCO (2012) as World Cultural Landscape Heritage sites, as they are rich in outstanding universal values. These holistic values can be applied to all human beings of current and future generations, regardless of religion, ethnicity, nationality, or political differences (Surata et al., 2012; UNESCO, 2012). These sites continue to reflect the traditional subak system as democratically managed and considered as a manifestation of the Tri Hita Karana—an aspect of Balinese ancient philosophy, under which humans must maintain good relationships with God and the environment to sustain our place in the world.

However, as commonly occurs in traditional cultural landscapes, the subak world heritage sites are now highly vulnerable and have almost reached a critical point where change has become irreversible, caused by varying levels of threats to their environmental, social, and economic viability (Marion et al., 2005; Wiguna & Surata, 2008; Kieninger et al., 2011). These problems have prompted public interest in conserving the traditional cultural landscape, and have put environmental education at the forefront of social consciousness, promoting concern and responsible behavior toward this issue. Nevertheless, only limited efforts have been made to promote the preservation of subaks in formal education. The subaks are not yet utilized as learning resources for modern education, especially within local communities, which are precisely those that should be taking responsibility to maintain their extraordinary ancient heritage. However, the subaks (and other cultural landscapes of outstanding universal value) can be sources of motivation and inspiration for younger generation to build their future through learning from the past (Surata et al., 2012; Surata, 2013).

More specifically, the subaks can be a valuable resource for place-based education (PBE) to "tear down" school walls so that community becomes integral to all facets of student learning" (Powers, 2004, p.18). According to David Sobel (2005, p.7), PBE "is the process of using the local community and environment as a starting point to teach concepts in language, arts, mathematics, social studies, science, and other subjects across curriculum." Place-based education is environmental education repositioned in a broader and more inclusive context "to look at how landscape, community infrastructure, watersheds, and cultural traditions all interact in shape each other" (Sobel, 2005, p.9). The local place is closely related to meaning, history, lifestyle, culture, spirit, and emotions (Orr, 1994; Meichtry & Smith, 2007; Reis & Roth, 2010). All of these

important components support effective environmental education for engaging youth in using their cultural lenses "to understand, explore, and value the cultural parameters of the environment, environmental problems, as well as environmental solutions" (Marouli, 2002, p.34). Hence, PBE can "raise ecological awareness and help ameliorate the ecological problems of our days" (Reis & Roth, 2010, p.84), increase science understanding and classroom discourses (Taptamat, 2011), enhance student academic knowledge and commitment to social service (Sobel, 2005), and contribute to the achievement of sustainable society (Meichtry & Smith, 2007).

This paper explores framing PBE in the context of an ancient tradition of resource management with the goal of connecting Balinese students to their own rich cultural heritage. In addition, we show that focusing on the subaks as a resource of PBE strengthens educators' and learners' connections to place and creates vibrant partnerships between schools and communities, as well as enhances pride in their own identity and cultural heritage (Place-based Education Evaluation Collaborative, 2010). The subak system is a particularly rich focal institution that models success in managing complex situations (Falk & Surata, 2007). It offers a tried and true model of environmental education that crosses the borders between classrooms and real life, occupations and professions, and especially between cultures and generations. By using subaks as a source of PBE, students can be inspired to make decisions and act in culturally appropriate and locally relevant ways to solve problems that threaten our common future (UNESCO, 2002). It can also encourage students to recognize their traditional cultural heritage, as inspiration and motivation in solving novel problems without losing their cultural identity. This model of PBE is in contrast to the mainstream formal education system, which downplays the cosmological and cultural traditions (Kahn, 2010). Consequently, most formal educational

systems in the world neglect to help students engage with the emerging global ethics as their main roles are to preserve and reproduce the existing cultural traditions (Savelava et al., 2010).

One prerequisite for designing environmental education programs is to understand the existing knowledge, attitudes, and experiences of teachers, student teachers, and students, as human capital are essential for promoting subaks conservation. Here we begin by describing the current levels of knowledge, attitudes, and experiences among teachers, student teachers, and students toward subaks, and discuss the implications for designing new approaches in environmental education.

The Subaks as a Source of Environmental Education

The unique associations of subaks has attracted the interest of scientists working on a wide and diverse range of topics. The majority of published research has addressed the ability of subaks to adapt to emerging challenges—whether ecological, economic, or political—of high-population-density islands (Lansing, 1991; 2006). One beneficial finding of such research was a water temple network model, i.e. the intricate networks of temples and shrines constructed by Balinese farmers and dedicated to agricultural deities, which can have macroscopic effects on the topography of the adaptive landscape, and may be representative of a class of complex adaptive systems that have evolved to manage agro-ecosystems (Lansing & Kremer, 1993; Lansing, 2017).The network explains some roles of temple networks e.g. in significantly altering production strategies for the rice paddy system, entailing socio-spiritual inclusion, a healthy

ecosystem, and a high economic and political price (Lansing, 1991; Lansing & de Vet, 2012). Under this system, a high population density is sustained by the labor routines and activities established by residents and reinforced through their deep understanding of Balinese (human) ecology (Jha & Schoenfelder, 2011; Lansing & de Vet, 2012).

The subak system is "one of the most successful agro-ecosystem[s] in the world, producing several tons per acre year after year without ecological deterioration" (Stevens, 1994, p. 60). In the case of subaks, Scarborough (2003, p. 4366) has concluded "dense populations are not an explanation for overexploitation of an environment." Elsewhere it has been noted that the temple system of subaks is rich with cumulative deposits of knowledge, experiences, beliefs, values, attitudes, meanings and religion, and can be used to inform environmental education by bridging traditional knowledge and modern (Western) knowledge systems (Surata & Agung, 2010). This is a viable solution to combat the problems of resource depletion and environmental misuse (Sitienei & Morrish, 2014).

Therefore, there is a need to propagate information regarding the multi-functionality of subaks as a focus of environmental education that may can encourage attitudes and responsible behavior toward natural resources, and the preservation and protection of biodiversity (Kuo et al., 2008; Barney et al., 2005). Promoting the subaks as a source of environmental education is in line with expectations of the new Indonesia's education curriculum (called Curriculum 2013), which not only provide learners with a set of environmentally sensitive values, but also to take an active part in solving problems and protecting the environment (Rudy, 2015). It also can be a model of PBE to understand, value, and utilize "the diversity of views, values, and behavior in

the study of the environment and towards the delineation of innovative solutions to environmental problems" (Marouli, 2002, p.34).

METHODS

Participants

A survey was conducted from January to November 2014 with a group of 718 participants. A two-staged cluster sample was drawn. At first, 61 elementary schools, 40 middle schools, 25 high schools, and 7 universities were chosen randomly from different regions around the Cultural Landscape Heritage of Bali Province, Indonesia. This landscape consists of five blocks of rice terraces and their water temples that cover 19,500 hectares (UNESCO, 2012). Then, 160 teachers, 268 student teachers, and 290 students participated as samples of these schools and universities, using a simple random sampling technique.

Twenty-four student teachers from the Department of Biology Education, Universitas Mahasaraswati Denpasar, distributed questionnaires directly to all participants and they were not part of the sample. We selected the students on the basis of their achievements in the course of statistics and research methodology. A workshop that involved three experts, namely social, agricultural, and education fields, was conducted to train students in collecting data by using questionnaires and explaining the meaning of the questions to the participants in case they were unable to understand them. In order to ensure the equal distribution of questionnaires among participants, the students were instructed to select participants in a balanced manner on the basis

of their gender, by randomly determining samples in equal proportion of male and female: 4–6 students and 2–4 teachers from each school; and 30–40 student teachers from each university. This sampling was designed to examine the difference gender and educational position and experience may have on knowledge, attitudes, and behaviors (Ehrampoush & Moghadam, 2005; Fuhrman & Copenheaver, 2005; Oladele, 2010). We achieved a very high response rate (92.3% of 718 questionnaires). Nearly 49 questionnaires were discarded because of incomplete answers.

Instruments

The survey instrument was modified from a questionnaire created by Pe'er et al. (2007). The original version of the questionnaire aimed "to investigate environmental knowledge and attitudes of students in teacher-training colleges in Israel" (Pe'er et al., 2007, p.47-48). This questionnaire had five sections: (a) background including sociodemographic questions, (b) sources of information on environmental issues, (c) ecological and environmental knowledge consisting themes including fundamental ecological principles and processes, global environmental issues, local environmental issues, and strategies for environmental action, (d) students' attitudes toward a national resource management policy and the use of environmental legislation and law enforcement as tools for environmental management, and (e) behavior to scale students' carried out environment-related activities.

We focused on understanding participant knowledge, attitudes, and behavior toward their cultural landscape. The original version of the questionnaire was modified, specifically, by developing questions that focused on the subak cultural landscape as a valuable resource for PBE. Our modified questionnaire consisted of two sections. The first section required participants to provide their demographic information, such as age, school level, sex, area of residence, educational background (for teachers and student teachers), and a question, "Do you want to be a farmer?" with two choices (yes or no) and a space for a short answer explaining the reason why he or she wants (or does not want) to be farmer. Section two comprised four sets of questions. The first listed 10 sources of information and asked participants to rate the degree to which each source contributed to their current knowledge about subaks on a 5-point Likert scale ranging from 1 (not at all) to 5 (very much). The second consisted of a set of 10 items that required participants to rate their level of knowledge of subaks related topics on a 4-point Likert scale ranging from 1 (I don't know) to 4 (I know and I can describe it to others). The third contained a set of 10 items ranging from 1 (strongly disagree) to 5 (strongly agree) concerning participants' attitudes. The fourth listed a set of 15 items running from 1 (never) to 5 (4 times or more) concerning participants' behavior.

Reliability and Validity Instrument

We used test–retest reliability to assess temporal stability and Cronbach's alpha correlation coefficient for internal consistency of the instrument (Drost, 2011). The test–retest reliability was measured after 24 student teachers completed questionnaires twice during 16 days—before they were trained to be assistants in this study—and yielded value of 0.72. It was consistent with the *r*

values accepted by other researchers (such as Kuhlemeier et al., 1999; Dimopoulos et al., 2008; Stanifer et al., 2015). The Cronbach's alpha correlation for knowledge ($\alpha = 0.69$), attitude ($\alpha = 0.84$), and experiences ($\alpha = 0.86$) scales were found to be reliable (Ghasemi et al., 2012). A panel of lecturers, teachers, and experts examined the instrument to establish content-related validity (Kruse & Card, 2004; Dimopoulos et al., 2008; Abdullah et al., 2013). The questionnaire's face validity was also checked by the student teachers (Abdullah et al., 2013).

Data Analysis

We generated frequency tables and calculated the mean values of each variable and Likert-scale responses for the survey instruments. One-way analysis of variance was used to examine the relationships between participant category and their knowledge, attitudes and experiences.

RESULTS

Background Data

The age of participants ranged from 9 to 59 years old. The percentages of students, student teachers, and teachers were 40.9%, 37.1%, and 22.0%, respectively. The range of educational background of the teachers and student teachers was very wide, including natural sciences (e.g. Biology and Physics), social sciences (e.g. History, Geography, Economics, and Art), languages (e.g. English, Japanese, Indonesian and Balinese) and Mathematics, as well as classroom teachers (who taught all subjects for elementary school classes from first to third grade). Nearly all of the students (96%) and undergraduate students (91%) did not want to become farmers. The

percentage of women (56.6%) was higher than men (43.4%). The proportions of participants living in rural (43.1%) and urban (42.3%) areas were higher than those living in suburban areas (14.6%). We examined the influence of demographics and found the overall of knowledge, attitudes and behavior of participants were not significantly influenced ($P > 0.05$) by either sex or area of residence.

Sources of Information

As shown in Table 1, the average rating choices of teachers, student teachers, and students were below 3 on a 5-point of Likert scale, indicating they rarely acquired knowledge about subaks from various information sources. Close family and television were participants' major sources of information, while government leadership and radio were only minor sources of their knowledge of subaks. The ratings of teachers were significantly higher than others ($P = 0.001$) for nearly all sources of information. Only the internet was rated significantly higher ($P = 0.01$) by student teachers than by others. We found a significant relationship between participant category and information source ($P = 0.001$). Teachers tended to have acquired more information regarding subaks compared to student teachers and students.

Knowledge

The knowledge of participants regarding subaks was relatively low, denoting participants' low level of ability to describe their knowledge to others (Table 2). Participants did not possess knowledge to share on the majority of subak topics. Only on the topic of the role of subaks in

preserving land and water and subaks as a cultural core of Balinese people, teachers have knowledge that they could explain to others. Although the knowledge of teachers was limited, they were more knowledgeable than student teachers and students. This finding was not surprising given the greater experience of teachers and student teachers.

Attitudes

Table 3 shows that most of the participants had positive attitudes toward subaks. They were favorably disposed to caring about subaks, raising awareness, receiving more information, participating in preservation, playing a role in preservation, government responsibility, the uses of subaks for environmental education, human behavior threatening the sustainability of subaks, and schools' responsibility for the preservation of subaks. However, participants held negative attitudes toward the adequacy of schools' preservation of subaks. We found significant relationships between participant category for their overall attitudes ($P = 0.001$). Teachers and student teachers had more positive attitudes than students.

Experiences

The Batur Lake, Ulun Danu Batur, and Tirtha Empul Temples were found to be very popular destinations, since most participants visited these places for about two and three times in the last 2 years (see Table 3). However, the majority of participants never or only travelled once to the Museum of Subak or the Batur Geopark Museum. Teachers and students tended to travel more

often to Gunung Kawi and Taman Ayun Temples, whereas teachers visited Tamblingan Lake and the Temple of Batukaru at a greater frequency than others.

The experiences of participants for activities related to agriculture was relatively limited. During the last two years, participants applied organic fertilizer in their farming activities only once or twice. In comparison with student teachers and students, teachers more often participated in discussion of topics related to subaks, helped farmers work in the fields, and worked together with the subak members. Teachers had the highest scale of experiences, followed by students, and student teachers. Several places, for example the temples of Pura Tirta Empul and Pura Taman Ayun, were most visited by local communities mainly for ritual activities. The rice terraces of Jatiluwih and the Lake of Batur were visited as tourism destinations. While other places, such as the Museum of Subak and Batur Geopark Museum, are seldom visited, they collect and preserved data and items concerning the subaks and other geological, and cultural features.

DISCUSSION

Most Balinese teachers, student teachers, and students have limited knowledge and experiences of subaks, although their overall attitudes were positive. This may be because of the subaks were widely regarded as a cultural achievement of the Balinese people, and their vulnerability is a frequent topic in Balinese newspapers, television, and seminars. Hence, the participants might be more aware of the existence of the subaks as well as environmental problems and their implications for the quality of life (Pe'er et al., 2007). This is similar to results from other studies which found that low knowledge scores did not predict negative attitudes in studies of secondary

schools (Kuhlemeier et al., 1999), elementary school children (Dimopoulos & Pantis, 2003), elementary schools, high schools, undergraduate and postgraduate students (Barney et al., 2005), and teacher training (Pe'er et al., 2007). Furthermore, Kuhlemeier et al. (1999, p. 10–11) discovered that "the lack of knowledge did not seem to prevent students from caring about the environment". Consequently, although they are interested and tended to support conservation efforts, "these attitudes alone do not translate to environmentally friendly behavior" (Barney et al., 2005, p. 53).

Teachers, Student Teachers and Students

Teachers tended to be more knowledgeable, had more positive attitudes and had more frequent experiences compared to student teachers and students. This finding is not surprising because there was a gap in age and education levels of participants in which teachers outweighed all others. According to Barney et al. (2005), knowledge grows progressively more sophisticated with increasing age and education. However, the experiences levels of students were higher than those of student teachers, probably because most primary and secondary schools in Bali had regular study tours at the end of each semester that involved traveling to several subaks destinations. Otherwise, although student teachers and university students in Indonesia often engaged in community service in urban and rural areas, their engagement with subaks areas has never been reported.

Other explanations for the low knowledge and experiences of student teachers and students in comparison with teachers could be attributed to tendency of having more experience in the rice

fields than younger people. Until three decades ago, the majority of young Balinese were active in helping their parents in rice cultivation. However, since the 1980s, the development of mass tourism in combination with the negative impact of green revolution and abandonment of the agriculture sector have confronted subaks with threats of varying levels, such as loss of soil fertility and paddy ecology, decreased incomes from rice farming, reduction of forest cover and spring flows, and commercial development and land conversion (Lansing et al, 2001; Marion et al., 2005; Strauß, 2011). The problems of poverty, images of uneducated farmers, and the stigma of dirty work associated with agriculture keep most Balinese youth away from farm-based livelihoods (Wiguna et al., 2005; Wiguna & Surata, 2008). This study has shown that nearly all of students (96%) and student teachers (91%) did not want to become farmers for reasons indicated by their short comments:

> "too hot due I must dig land on the sun" [*sic*] (Eka, elementary school student).
>
> "I do not have land because government has converted the rice field of my grandfather to be residence areas" [*sic*] (Manik, junior high school student).
>
> "work as farmer is only suitable for old people" [*sic*] (Agus, senior high school student).
>
> "to be a farmer one must work hard with unexpected income" [*sic*] (Putu, student teacher).

Hence, it is not surprising, as Fox (2012) reported, that Balinese farmers expected their children not to prefer working in rice cultivation. These situations might influence the low knowledge and experiences of student teachers and students despite their positive attitudes toward subaks.

Over-centralization, overlapping responsibilities, and teacher-centric pedagogy in the Indonesian education system may also be impacting on the low knowledge and experiences of students toward subaks (King, 1998, Zulficar, 2009). Under this system, teachers have

difficulties drawing connections between learning materials and real problems, and display weak creativity and an inability to insert local sources into existing curricula (King, 1998; Zulfikar, 2009). It was supported by the finding that major source of information was a television, but not teachers or lecturers (see Table 1). This means that the subak system was still rarely incorporated into teaching and learning, although it could be a model of PBE for reconnecting global and local issues as well as between youth and their cultural heritage.

It is therefore important to develop environmental education with more prominent and realistic objectives, which can offer opportunities for students to explore the local environment through first-hand, experience-based challenges, and develop stewardship in active educational experiences (Oladele, 2010; Moncure & Francis, 2011). This learning should provide open-ended cases for dealing with the interconnections of agriculture and the supporting system of local social norms, culture, and even religion that are utilized for sustaining long-term rice cultivation.

The subaks (and other cultural landscapes with outstanding universal values) can reinforce the role of cultural traditions in our education system. The subaks are rich in cultural traditions, for example the concept of Tri Hita Karana and water temple networks. These traditions have led to higher than average harvest yields and improvement in sustainability through the ability to cope efficiently with ecological perturbations by connecting ritual, water irrigation schedule, and plant pest disease management (Lansing & Kremer, 1993; Lansing & de Vet, 2012). However, the decreasing trend of knowledge, attitudes, and experiences among Balinese teachers, student teachers and students (see Table 2, 3 and 4), making it urgent to develop an effective model of

PBE that can help the local community, especially youth, to participate in preserving their cultural landscape. This suggestion arose as a response to rapid environmental, cultural, and social changes on the island, which now jeopardizes the centuries-old subak system as an extraordinary future asset. Youth should not only become targets of education, but they also "must play a key role as caretakers and protectors of cultural heritage and join the fight against its trafficking and destruction" (Quin, 2016, p.3). The PBE should be able to engage youth in understanding and recognizing local cultural practices and knowledge system, and underpinned by the need to create a culture sensitive and sustainable environment.

Thus, a better understanding of cultural traditions provides opportunities for students and teachers to "bring their ways of knowing, beliefs and values, ceremonies, personal expectations, and narratives into the dialogue of the classroom" (Mueller & Bentley, 2009, p. 62). This includes opportunities to foster environmental sensitivity, develop knowledge, attitudes, skills, service-learning experiences, and outdoor recreation activities (Ernst, 2007). It also poses a challenge to teachers and students "to arrive at new understandings and how [*sic*] they participate in multimodal knowledge-production processes" (DuPuis & Ball, 2013, p.74). This will increase the interest of students and teachers to look at the cultural landscape heritage from a more holistic perspective when developing teaching and learning processes and educational curriculum to address sustainability (Sitienei & Morrish, 2014).

According to Pe'er et al. (2007, p.48), "as leaders of environmental change in schools, teachers need to believe in their ability to promote environmental change, to nurture that belief in their students." Engaging student teachers in active learning, such as developing learning modules and participatory mapping of subaks as traditional cultural landscapes, will inspire future teachers in a diversity of culture that can be invested for sustaining the diversity of human

lifestyles (Surata et al., 2014; 2015). By relocating curriculum into the local context, a contribution "to the development of diverse culture now being in the global monoculture purveyed by the market and the media" (Smith & Williams 1999, p. 8) will be achieved.

In summary, this study has identified new challenges for the education system in Bali (and may also other regions with a diverse local culture) to incorporate local place, culture, and community into school curriculum. We show that the subaks of Bali are of particular interest because of their sustainability in managing nature, human, and culture for more than a millennium. They are an appropriate focus for place-based environmental education. It is difficult to find a more efficient, fair, and environmentally system of modern irrigation systems than the ancient system of the subaks (Pratt, 2016).

Our finding that gender differences are not significant shows that both sexes have similar perceptions toward the subaks. Most data for this study were collected by questionnaires. Further studies with other methodologies, such as an interviews, observation or focus group discussion are needed to enhance the capacity of learners in understanding, assessing, and using their cultural traditions in environmental studies, and in the commitment to conserve place with universal outstanding values, namely cultural landscape heritage. We recommend developing a strategic plan for PBE that can contribute to the long-term sustainability of cultural heritage values (UNESCO, 2015). The finding of low knowledge and experiences scores but high score level for attitudes may be useful in designing place-based of environmental education curriculum that reflects knowledge and skills concerning local sustainable practices, cultures, and values. Existing learning resources, such as the Museum of Subak and the Geopark Batur Museum

should be incorporated into the plan, as means of educating students and youth to the sustainable environmental management established by the subaks.

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Table 1. Participants' rating of information sources as contributing to their knowledge of subak

Information Source	Participant Category			*Sig.*
	Teacher (n=147)	S. Teacher (n=248)	Student (n=274)	
	Mean	Mean	Mean	
Television	3.30	2.44	2.73	***
Close family (e.g. parent or brother)	3.11	2.40	2.89	***
Teacher/lecturer	2.46	2.41	2.68	NS
Internet	2.02	2.48	2.03	**
Newspaper/magazine	3.25	2.01	2.01	***
Book/module	2.68	1.94	2.33	***
Traditional art performance	2.30	1.85	1.87	**
Community leadership	2.72	2.18	2.05	***
Government leadership	2.30	1.71	1.77	***
Radio	2.32	1.69	1.73	***
Overall information source	2.64	2.11	2.21	***

NS, *, **, *** Non-significant or significant at $P = 0.05$, 0.01, or 0.001, respectively, using one-way ANOVA test. Rating choices were a 5-point of Likert-type scale ranging from 1 (never), 2 (forget), 3 (rarely), (4) often, 5 (very often).

Table 2. Teacher, student teacher and student scores for knowledge categories

Knowledge Topic	Participant Category			Sig.
	Teacher (n=147)	S. Teacher (n=248)	Student (n=274)	
	Mean	Mean	Mean	
History of subak	2.43	2.04	2.30	*
Tri Hita Karana	2.95	2.72	2.51	*
Subak as a cultural heritage	3.21	2.92	2.80	***
Subak as a cultural core of the Balinese	3.54	3.43	3.05	***
Role of subak in preserving land and water	3.49	3.20	3.11	*
Role of subak in conserving biodiversity	3.26	2.77	2.56	***
Role of subak in promoting rural economies	3.23	2.67	2.54	***
Role of subak for local entrepreneurship	3.00	2.53	2.77	**
Role of water temple networking	3.42	2.64	2.77	**
Subak as a democratic organization	3.22	2.45	2.20	***
Overall knowledge	3.27	2.79	2.70	***

NS, *, **, *** Non-significant or significant at $P = 0.05$, 0.01, or 0.001, respectively, using one-way ANOVA test. Scale: 1 (don't know), 2 (not sure), 3 (know but can't explain to others) to 4 (know and can explain to others).

Table 3. Teacher, student teacher and student scores for attitudes

Attitudes	Participant Category			Sig.
	Teacher (n=147)	S. Teacher (n=248)	Student (n=274)	
	Mean	Mean	Mean	
I care about subak	3.96	3.60	3.95	***
I am interested in raising awareness toward subak	4.09	3.74	3.56	***
I am interested in receiving more information about subak	4.15	3.96	3.62	***
I am interested in preserving subak	4.10	3.74	3.55	***
Government should be responsible for the preservation of subak	4.43	4.30	4.30	NS
Schools should be responsible for the preservation of subak	3.40	3.58	3.16	*
Schools do enough in the preservation of subak	3.20	2.91	2.98	NS
Subak are useful for environmental education	4.31	4.26	3.87	***
I must play a role in the preservation of subak	3.75	3.58	3.22	***
Human behavior threatens the sustainability of subak	4.25	4.23	3.60	***
Overall attitude	3.96	3.82	3.58	***

NS, *, **, *** Non-significant or significant at $P = 0.05$, 0.01, or 0.001, respectively, using one-way ANOVA test. Scale: 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), to 5 (strongly agree).

Table 4. Teacher, student teacher and student scores for categories of experiences

Experiences	Participant Category			Sig.
	Teacher (n=147)	S. Teacher (n=248)	Student (n=274	
	Mean	Mean	Mean	
Visit Ulun Danu Batur Temple	3.59	2.84	2.93	***
Visit Batur Lake	3.64	3.17	3.31	*
Visit Tirta Empul Temple	3.84	3.09	3.44	***
Visit Gunung Kawi Temple	2.60	1.92	2.65	***
Visit Taman Ayun Temple	3.51	2.42	2.65	***
Visit Jatiluwih Rice terraces	2.36	1.99	1.93	*
Visit Batukaru Temple	2.60	1.72	1.78	***
Visit Tamblingan Lake	2.65	1.79	1.66	***
Visit Subak Museum	2.15	1.26	1.76	***
Visit Batur Geopark Museum	1.85	1.31	2.11	***
Attend lectures on subak-related topics	1.73	1.47	1.66	NS
Help farmers working in the fields	2.52	1.61	1.90	***
Use organic fertilizer in farming	3.14	2.34	2.60	***
Work together with members of subak	2.51	1.54	1.93	***
Discuss subak with friends or family	2.89	1.87	2.03	***
Overall behavior	2.77	2.02	2.29	***

NS, *, **, *** Non-significant or significant at $P = 0.05$, 0.01, or 0.001, respectively, using one-way ANOVA. Scale: 1 (never), 2 (one time), 3 (two times), 4 (three times) and 5 (four times or more).

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