

METHODOLOGICAL REVIEW OF SUSTAINABLE LANDSCAPE EDUCATION RESEARCH

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1 ABSTRACT

The purpose of this study is to explore research possibilities with corresponding research methods for the future sustainable landscape education. Sustainable landscape education is an indispensable part of education working towards sustainability. However, we found limited numbers of current studies exploring sustainable landscape education. Thus, potential research elements of sustainable landscape education were summarized in the paper to help the researchers to organize their research ideas. And a methodological review is needed to help the researchers see the successes and weaknesses of the existing studies, and choose the suitable research methodology and approaches for their topics. A methodological review was carried out in the paper on the open access publications since 2000 that focused on sustainable landscape education and the relevant areas, such as Education for Sustainability, sustainable design education, and general design education. The reviewed materials were divided into two broad categories including theoretical research and empirical research, which further divided into three subcategories of qualitative research, quantitative research, and mixed method research. Several significant findings were presented as follows. To focus on the development of a new course, project, workshop or curriculum based on sustainable theories, the researchers can choose either theoretical research method or empirical research method, including the qualitative method or mixed methods. To focus on fundamental research about sustainable landscape education, the researchers can utilize either the quantitative method or mixed methods. Conducting fundamental studies on sustainable landscape education and using a fully integrated mixed-method study are the most challengeable and urgent.

1.1 Keywords

Sustainable Landscape Education, Research Methods, Methodological Review

2 INTRODUCTION

Sustainability and sustainable development have become a global concern in the recent years. On the one hand, the growing and changing nature of landscapes decide that landscape architecture is the possible medium of sustainability and resilience, which brings the increasing attention to sustainable landscape practice and education. As an essential field contributing to sustainability, landscape architecture needs to lead the changes of sustainable development. On the other hand, achieving sustainability is greatly associated with the leadership of education. As Paul Rowland said, "A sustainable society can only be attained through the combined efforts of all of society. That is why it is so important that higher education institutions take the lead in ensuring that all their graduates - the leaders, the teachers, the professionals, and a significant part of the workforce - have an understand of the challenges we face and the tools and dispositions to address those challenges to create a healthy, just, and sustainable world" (Johnston, 2013, p. x). Sustainable landscape education is an indispensable part of education working towards sustainability.

2.1 Sustainability

Our Common Future, also known as the Brundtland Report, a report describing the outcomes of the United Nations World Commission on Environment and Development put forth the most well-known concept of sustainability (Pearce, Ahn & Hanmiglobal, 2018, p. 39). "Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs." (Brundtland & Khalid, 1987, p. 43). Although that sustainability is hard to define in absolute terms, a possible definition will be used as follows for this paper. In general, sustainability means the capacity to be kept in existence or maintained indefinitely, in particular, the capacity to maintain the ability of social systems, economic systems, and environmental systems to support human life and well-being (Portney, 2015, p. 9).

2.2 Education for Sustainability

United Nations (UN) proposed sustainable development as a possible solution to global environmental problems and emphasized that education would benefit its progression (Brundtland, 1987). Education for Sustainability (EfS) is similar to Education for Sustainable Development (ESD), which is currently defined by United Nations Educational, Scientific and Cultural Organization (UNESCO) as follows. "ESD is a learning process (or approach to teaching) based on the ideals and principles that underlie sustainability and is concerned with all levels and types of learning to provide quality education and foster sustainable human development - learning to know, learning to be, learning to live together, learning to do and learning to transform oneself and society" (UNESCO, 2017).

In summary, it is important to carry out high-quality studies covering the field of sustainable landscape education for two reasons. First, sustainable landscape education directly impacts the graduates going into design practice and further influence the progress of sustainable development. Second, sustainable landscape education research can promote the development of sustainable design education and boost the exploration of Education for Sustainability.

To design more appropriate landscape architecture education programs to lead the changes in Education for Sustainability, research possibilities of sustainable landscape education need to be explored to inspire more creative studies and advance our knowledge of the area.

3 SUSTAINABLE LANDSCAPE EDUCATION: RESEARCH POSSIBILITIES

To figure out the studies that can be developed to help design sustainable landscape programs, we need to identify the potential research elements. Through reviewing the studies in the field of sustainable design education, Education for Sustainability, and general design education, we summarized the possible research elements, including potential research content, population, timing, and methods (Table 1).

Potential research content. Inside the landscape architecture programs, sustainable education research can be carried out for the program set up, program vision/mission statement, curriculum, course, workshop, etc. Courses in landscape architecture can be mainly categorized as the design studio, construction/technology, history/theory, and electives. The course type should be taken into account for

landscape education research design. For example, a research design focused on exploring the pedagogy of technology course will be very different from one focused on studio teaching.

Outside the landscape architecture programs, due to the multidisciplinary collaborative characteristic of Education for Sustainability, studies and changes at the university level can be an excellent chance to unite the strengths of different disciplinary. We can consider studies on majors or minors in sustainability, summer program grounded in sustainability, sustainability as the first-year experience, the certificate program in sustainability, etc. (Johnston, 2013, p. 14). Outreaching to local communities for sustainable education at the community level can also inspire interesting research designs. Studies focused on better engaging the landscape architecture programs at an upper level of Education for Sustainability and with broader audiences in local communities will create new changes inside the landscape architecture programs and possibly promote them.

Table 1. Identification of research elements for sustainable landscape education research.

Potential Research Content	Potential Research Population	Potential Research Timing	Potential Research Methods
Inside the program: program set up, mission statement, curriculum, course, workshop, etc. Outside the program: major or minor, summer program, first-year experience activity, certificate program, community education, etc. (Johnston, 2013)	Teachers Students (undergraduate; graduate) Designers Community members	Before the transition During the transition After the transition	Theoretical research Empirical research

Potential research population. The sustainable landscape education research can focus on teachers, students, designers, or community members according to various research content. When choosing the students as the research population, we need to be careful with the research decision on choosing either the undergraduate students or graduate students since their curriculum can be very different. A possible framework to evaluate learning outcomes of the students and community members will include awareness, knowledge, attitudes, skills, and participation (Johnston, 2013, p. 47).

Potential research timing. Promoting the landscape architecture programs means we would like to make changes. The timing of conducting studies to help with the transition can be before, during or after the transition. Before the transition, studies can be undertaken to explore the possible changing directions and instructions. During the transition, studies can be used to watch the process of change and suggest the adjustments. After the transition, studies can be used to evaluate the outcomes and provide new changing instructions.

Potential research methods. From previous research in the related areas, both theoretical research and empirical research has been applied. More details about the specific research methods will be discussed later in this paper.

When we choose and combine the suitable elements, we end up with a new research possibility and design. Summarizing the research elements of sustainable design education is giving us a tool pool to inspire new studies.

4 LIMITED CURRENT SUSTAINABLE LANDSCAPE EDUCATION RESEARCH

Theoretically, choosing and combining the suitable research elements we discussed above can lead to new research possibility and design in sustainable landscape education. The more different combination of research elements being found means the more saturated this area is covered by researchers. However, we found limited numbers of current studies exploring the field of sustainable landscape education. The reasons for insufficient sustainable landscape education research may come from three aspects.

First, the difficulties of finding the research gaps lead to the insufficient sustainable landscape education research. Current studies suggested narrow focuses which led to the fragmented research situation. The existing studies mainly focused on developing and testing a new sustainable landscape course, project, or workshop based on different pedagogy and theories. Also, very few fundamental studies were conducted to try to gain a general view of the sustainable design education field. These two situations make it hard for interested researchers to capture the big picture of current research and find the research gaps, which also caused the difficulties in conducting studies in this area.

Second, the difficulties of choosing the research methods and performing solid studies endanger the validity of existing studies and the possibilities of future research. On the one hand, corresponding research methods for different type of research topics have not been developed in the field of sustainable landscape education research. For example, the design studio is a significant kind of the landscape architecture teaching form. The products coming from the design studio can be very diverse and different from regular teaching products in other disciplines. We can see various methods were still in the exploration phase in the previous research to evaluate the sustainable landscape design studio. This is a common methodological difficulty in design education research. On the other hand, it seems like the systematic methodological training of research is missing from the landscape architecture field, which caused some flaws in the existing studies.

Third, some practical obstacles might cause the insufficient research situation. Former research showed several barriers to put Education for Sustainability into action, including lacking funding, lacking the training to assist staff, lacking integration in curriculum across disciplines, etc. (Thomas & Nicita, 2002, p. 485-486). These obstacles might apply to sustainable landscape education practice and research as well. This reason is predicted from past studies in the related areas, but it needs more research to confirm.

To solve the first kind of difficulties, we believe that the summary of the research elements for sustainable landscape education research (Table 1) can help the researchers to organize their research ideas.

However, for the second kind of difficulties, there hasn't been a systematic methodological review on sustainable landscape education research, or even on the Education for Sustainability, sustainable design education research area. This paper will focus on conducting a systematic methodological review on sustainable landscape education research and the related fields. We think a methodological review can help the researchers see the successes and weaknesses of the existing research, and choose the suitable research methodology and approaches for their topics.

To help with the future studies focusing on sustainable landscape education, we raise the research questions as follows. 1) What are the different types of research methods that used to explore sustainable landscape education and the relevant areas? 2) What successes are seen in the existing research with different research methods? 3) What weaknesses are seen as salient in the current research with different research methods? 4) What are the possible research methods for exploring sustainable landscape education in the future?

5 METHODOLOGY

A methodological review was carried out to explore the research questions. Study range included the open access publications since 2000 that focused on sustainable landscape education and the relevant areas, such as Education for Sustainability, sustainable design education, and general design education. According to the research methods, the reviewed materials will be divided into two broad categories including theoretical research and empirical research. This paper will focus more on the empirical research since it provides the way to examine the results of theoretical research. Empirical research category is divided into three subcategories as qualitative research, quantitative research, and mixed method research. In particular, the typical topics and the approaches used for those topics that will be reviewed in each category. The successes and weaknesses of each method and approach will be explored.

6 RESULTS

6.1 Theoretical research

Theoretical research is commonly used in the sustainable landscape education research and the related areas. In particular, researchers are interested in the development of a new course, project, workshop or curriculum based on theories. For example, Hayles and Holdsworth (2008) tried to embed sustainability into the core curriculum at RMIT University, Australia by developing module audits and action

learning workshop. Ahn, Kwon, Pearce, and Wells (2009) developed a course in sustainable construction for students in the USA and focused on the systematic course development approach divided into three stages including preparation, development, and improvement.

The other kind of the research focus using theoretical research is the discussion of putting an advanced pedagogy or problem-solving strategy into sustainable landscape education research and the related areas. For example, Turner (2009) proposed Advanced Systematic Inventive Thinking (ASIT) system as a strategy for sustainable design and education in Australia by using examples in the literature. Vodeb (2015) discussed to use the socially responsive communication design pedagogy to redirect the conditions of communication design education in Australia.

Through the review, we found that by using theoretical research, researchers can focus on the discussion of the theories or pedagogies related to the design education and sustainability, and the development process of the practical usage. That is the successful part of this type of research. However, the weakness of theoretical research in the sustainable landscape education research area is that the effectiveness of the newly developed course, curriculum or pedagogy is hard to tell without using empirical design to examine.

6.2 Empirical research

In the sustainable landscape education research and the related areas, empirical research includes three primary types of qualitative research, quantitative research, and mixed method research.

Qualitative research. Qualitative research is widely used in the sustainable landscape education research and the related areas as a way to explore the effectiveness of the newly developed sustainable course, curriculum or pedagogy. Thus, it is typically associated with case study as a specific approach to imply the freshly developed sustainable course, curriculum or pedagogy in a realistic setting and evaluate the effectiveness. This is the first feature of using qualitative research in the sustainable landscape education research and the related areas. Second, due to the unique learning outcomes and learning process of the design majors, the specific approaches researchers used are more diverse than qualitative research in other fields. The diverse approaches include exploring the blogging, drawings, documentary materials, interviews, focus groups, observations, field notes, participant diaries, video, audio (Lawson, 2010; McMahon & Bhamra, 2016; Nikezić & Marković, 2015). We can see that traditional qualitative approaches like interviews and focus groups are included. Moreover, drawings and other products coming from the design process and final presentations are utilized. So does some new forms of approaches associated with this new digital era like blogging. Some typical exemplars are selected and summarized in Table 2. Third, another feature is associated with multi-methods. That means most of the previous studies analyzed more than one kind of different research materials.

Utilizing qualitative research in sustainable landscape education research and the related areas can help explore the effectiveness of the newly developed sustainable course, curriculum or pedagogy based on theories. This is one of the successes of using qualitative research in the related fields. The other success is that qualitative research can make the most usage out of the unique learning outcomes and learning process of the design majors. Diverse qualitative approaches not only help to better explore the topics in sustainable landscape education research and the related areas, and also show more possibilities in the methodology fields. However, the methodological weaknesses come from the combination of qualitative research and the characteristics of the design major as well. From the exemplars, we can see that how to deal with the relationship between different research materials become the biggest challenge. The results coming from analyzing different research materials, as well as the interactions between the analysis of different research materials should be equally paid attention to.

Table 2. Summary of key features of qualitative research in related fields.

Exemplar	Area (Topic)	Approaches	Methodological successes	Methodological weakness	Conclusions helpful for future research
McMahon & Bhamra (2016)	Sustainable design education (Visualizing collaborative	Case study, including using focus groups, observations, blogging, field	This study tried to include the voices from all participating parties	The description on how the analysis of different kind of qualitative data	The visual timelines can be useful to map the sustainable educational

	experiences for sustainable design education)	notes and participant diaries from two projects in Ireland, Netherlands, and USA	(planners, facilitators and designers).	connect to each other is not very clear.	experience of participants and facilitators.
Nikezić & Marković (2015)	Sustainable design education (Place-Based education in the architectural design studio)	Case study, including analyzing and reviewing student work from an architectural design studio in Serbia	This study associated students' design concepts and the review of student works with sustainability implementation	Examining an interaction between the analysis of student work and the review system may bring the research to a deep view.	The study proved that "place-based education" is helpful to promote the responsibility for sustainable development in architectural teaching.
Lawson (2010)	Sustainable design education (Changing pedagogic codes in landscape architecture class learning sustainable development)	Case study, including analyzing student drawing from a landscape architecture course in Australia	The study used a creative visualizing code modalities to analyze the students' drawing.	This study claimed to have a multi-method design including drawings, interviews and documentary materials, but only focused on drawing in the paper.	The study suggested allowing students to choose the knowledge to be learned is beneficial for learning, which is not specific for Education for Sustainability.

Quantitative research. Quantitative research is rarely utilized in the sustainable landscape education research and the related areas. There are only two previous studies used quantitative research in the related areas found in the literature. From the exemplars in Table 3, we can see that the quantitative research is associated with fundamental studies in the related areas, which means the researchers used quantitative research are more interested in examining the common opinions and knowledge of the topics on a large group of people. Different weaknesses have been seen in the two studies. The study from Christie, Miller, Cooke and White (2013) had a high response rate covering 6% of the entire university teaching workforce of Australia. However, the instrument had a narrow focus on frequency of using teaching methods for Education for Sustainability. The study from Thomas and Nicita (2002) had a very small sample size. Except for those, the common weakness of the two studies is that they both didn't conduct a pilot study to improve their instrument. The successes of these two studies are that they both came up with a lot of interesting conclusions, which can be further tested in the future research or served as a foundation for future instrument development in the sustainable landscape education research and the related areas.

Table 3. Summary of key features of quantitative research in related fields.

Exemplar	Area (Topic)	Approaches	Methodological successes	Methodological weakness	Conclusions helpful for future research
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Christie, Miller, Cooke & White (2013)	Education for Sustainability (Environmental sustainability in higher education)	An online questionnaire to faculties in Australia	Fundamental research covered 6% of the entire university teaching workforce of Australia across different disciplines.	The research had a narrow focus on frequency of using teaching methods for Education for Sustainability.	Critical thinking, lectures, tutorials, discussions and team work are the most commonly used teaching methods for Education for Sustainability in Australia.
Thomas & Nicita (2002)	Education for Sustainability (Sustainability education and Australian universities)	An questionnaire to faculties in Australia	The survey instrument contained a lot of open ended questions, which brought more values to the small sample size answers.	The study had very small sample size, leading to the questionable reliability and validity.	The study suggested several obstacles for Education for Sustainability in Australia, including lacking funding, lacking the training to assist staff, lacking integration in curriculum across disciplines.

Mixed methods research. By examining the research methods used in the literature, we found that mixed methods were rarely used in the research published in peer-reviewed journal articles. Instead, mixed methods were more widely used in doctoral dissertations aiming for fundamental research (Hakky, 2016; Bohannon, 2014; Koo, 2012; Smith, 2010). We think this phenomenon relates to the challenges of conducting mixed methods, particularly the following three. First, mixed methods research is relatively new to the researchers. Second, mixed methods research is time- and resource-consuming. Third, mixed methods studies are quite challenging to describe in one journal article adequately. Since doctoral students are more likely to be exposed to mixed methods research and tend to have more time to complete a more detailed and in-depth study, a mixed methods methodology is a more appropriate option for them. There is one kind of exception to use mixed methods in the peer-reviewed journal articles, which is associated with evaluation. Similar with using qualitative research, we found some scholars used mixed methods to evaluate sustainable design workshop and pedagogy (Albert, von Haaren, Vargas-Moreno & Steinitz, 2015; Ayer, Messner & Anumba, 2016).

Due to the above reason, we selected three exemplary dissertations and an exemplary article (Table 4, Table 5). Specifically, we tried to use the key components of the mixed-method models to compare the mixing and methodological approaches reported by the researchers, which is unique for mixed methods.

Mixing is "the linking, merging, or embedding of qualitative and quantitative strands of a mixed methods study" (Creamer, 2017, p. 245). From the key components in Table 4, first, we can see that the primary purposes of mixed methods in design education were triangulation and enhancement. Triangulation means the researchers in these fields are trying to "enhance validity by using different kinds of data to measure the same phenomenon" (Creamer, 2017, p. 29). Enhancement means the researchers in these fields are seeking "for wider and deeper understanding" (Creamer, 2017, p. 29). Second, we can tell that different researchers have different priorities depending on how they would like to address their research questions. Third, most researchers conducted sequential and multiphase research to use the former phase of data collection and data analysis to lead to the next phase's sampling procedure.

Table 4. Summary of key components of mixed methods research in related fields.

Exemplar	Area (Topic)	Approaches	Rationale	Priority	Timing
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Hakky (2016)	Sustainable design education (Design for sustainable behavior in interior design education)	In the USA. Phase 1 Qualitative-Website information collection Phase 2 Quantitative-Survey Phase 3-Qualitative-Interview	Triangulation	Qualitative	Multiphase
Albert, von Haaren, Vargas-Moreno & Steinitz (2015)	Sustainable design education (Evaluating the sustainable landscape workshop about scenario-based planning)	Evaluation in Germany and Italy. Phase 1 Quantitative-Survey Phase 2 Qualitative-Interview and observation	Enhancement	Quantitative	Sequential
Bohannon (2014)	Design education (Community engagement in landscape architecture education)	In the USA. Phase 1 Quantitative-Survey Phase 2 Qualitative-Interview	Enhancement	Quantitative	Sequential
Smith (2010)	Design education (Student experiences in the design studio)	In the USA. Phase 1 Quantitative-Survey Phase 2 Qualitative-Interview	Enhancement	Quantitative	Sequential

Table 5. Summary of mixing feature and methodological evaluation of mixed methods research in related fields.

Exemplar	Mixing features by stage	Methodological successes	Methodological weakness	Conclusions helpful for future research
Hakky (2016)	Design: qualitative and quantitative research questions Data collection: nested sampling; the interview protocol was developed based on the findings of the survey Data analysis: no mixing Meta-inference: conclusions from comparison of the qualitative and quantitative results	Quantitative and qualitative strands confirmed the similar findings when the researcher tried to compare the results; nested sampling; the interview protocol was developed based on the findings of the survey.	The study was not fully mixed and there was not enough emphasis on the value-added.	Faculty members are likely to accept Design for Sustainable Behavior integrating into interior design area.

Albert, von Haaren, Vargas-Moreno & Steinitz (2015)	Design: qualitative and quantitative research questions Data collection: nested sampling Data analysis: no mixing Meta-inference: conclusions from combinations of the qualitative and quantitative results	The study successfully used mixed methods to perform an evaluation for a sustainable pedagogy.	The study was not fully mixed and there was not enough emphasis on the value-added.	The sustainable landscape workshop advanced students' understanding and skills for collaborative, scenario-based landscape planning.
Bohannon (2014)	Design: qualitative and quantitative research questions Data collection: nested sampling; the interview protocol was developed based on the findings of the survey Data analysis: no mixing Meta-inference: conclusions from combinations of the qualitative and quantitative results	Nested sampling; the interview protocol was developed based on the findings of the survey.	The study was not fully mixed and there was not enough emphasis on the value-added.	Barriers for transforming community engagement work into scholarship included a lack of theoretical grounding and insufficient methodological training. Participating faculty believed that community engagement was largely valued at the university level but less at the departmental level.
Smith (2010)	Design: qualitative and quantitative research questions Data collection: nested sampling Data analysis: no mixing Meta-inference: no mixing	Nested sampling.	The study was not fully mixed and there was not enough emphasis on the value-added.	The study revealed that the studio environment played a minor role in the influence of student interests; student curiosities were affected more by travel, internships, family, and non-studio courses.

From the approaches in Table 4, we can see that website information collection, survey, and in-depth interview were the most commonly reported methodology approaches. To clarify, website information collection was dealing with research focuses on the mission statement, course requirement, credit hours, etc. (Hakky, 2016). Surveys reported in the studies were mostly focusing on the general state of the education in specific fields, including definitions and attitudes, while the interviews were mainly exploring the definitions, attitudes, perceptions, and thinking about barriers and challenges (Hakky, 2016; Bohannon, 2014; Smith, 2010).

From the mixing features in Table 5, we can see to what extent the mixed methods research are mixed in four stages - design, data collection, data analysis, and inference. First, most researchers developed both qualitative and quantitative research questions which involved mixing in the design stage. Second, most researchers used nested sampling, which means they selected the follow-up interview participants from whom showed their interests for being interviewed in the survey. That represents mixing in the data collection stage. Another sign of mixing is that some of the researchers used their findings of the survey to help them develop an interview protocol. Third, mixing reported in the inference stage were the research conclusions coming from either comparison or combinations of the qualitative and quantitative findings.

The methodological successes of using mixed methods reported in the reviewed research are as follows. First, the successful part is reported that quantitative and qualitative strands confirmed the similar findings when the researcher tried to compare the results (Hakky, 2016). Second, survey became an efficient way to help the researchers sample the participants for the follow-up interview (Hakky, 2016; Bohannon, 2014; Smith, 2010). Third, the findings of the survey helped the development of interview protocol (Hakky, 2016; Bohannon, 2014). For example, Bohannon (2014) raised an interview question directly related to the survey result: "61% of surveyed faculty indicated that community engagement provides opportunities for scholarly work and publication. Does this seem about right to you? What do you think is the relationship between community engagement and scholarship?" (p. 190) Fourth, as reported, the survey provided an overall understanding of the topic, and follow-up interview provided "a more in-depth understanding of the results from the first phase of the study" (Bohannon, 2014, p. 164).

The methodological weaknesses of using mixed methods we see as salient to address are as follows. First, none of the studies that claimed to use mixed methods were fully integrated, which means none of them intentionally mixed the qualitative and quantitative strands of their studies throughout each of the design, data collection, data analysis, and inference stages. The main problem is the mixing in the data analysis stage. Most researchers reported their analysis processes and results in qualitative and quantitative strands separately, even though some of the researchers did the analyses concurrently, which still cannot be considered as mixing since no data transformation had been seen. Second, there is not enough emphasis on the value-added from using mixed methods in the reviewed research. "Value-added is an element of methodological transparency where the insight, inferences, or conclusions that are produced by the use of mixed methods are explicitly identified" (Creamer, 2017, p. 248).

7 DISCUSSION

Through the review, we noticed one interesting phenomenon about the research of sustainable landscape education, sustainable design education and Education for Sustainability. It seems like the researchers and high education facilities in Europe and Australia are more interested in these areas. In the USA, the researchers are more concerned about general design education instead of emphasizing the sustainability. We associated this phenomenon with the history of the movement of Education for Sustainability. After the United Nations started promoting sustainability and introducing the concept of sustainability to universities through its International Environmental Education Programme from 1975 to 1995, many governments showed their support (Christie et al., 2013). Those supports included the Higher Education Funding Council for England's action plan *Sustainable development in higher education* (HEFCE, 2005); the UK Government report, *Securing the future: delivering the UK sustainable development strategy* (HM Government, 2005); the Australian Government's *Living Sustainably: The Australian Governments National Action Plan for Education for Sustainability* (Commonwealth of Australia, 2009). All these reports proved that Australia and Europe are the ones participating in the movement of Education for Sustainability earlier responding to United Nations' promotion. We think that the research heat regarding sustainability is significantly related to earlier government promotion and support. The government funding might play a role in this, but we need more research to prove this prediction. Except for exploring reasons for this phenomenon, we think raising attention to sustainable landscape education and the related areas in the USA is more urgent and essential.

The other phenomenon discovered in this study is that the theoretical research has very close relationship with the empirical research in sustainable landscape education research and the related areas. That is because the theoretical research and empirical research in these areas both focused on the development of a new course, project, workshop or curriculum based on sustainable theories and pedagogy. Although the theoretical research emphasizes on the discussion of the theories and the development process of the practical usage, the empirical research can be seen as the follow-up step of using empirical design to examine them with qualitative multi-methods or mixed methods. In this sense, a lot of the current theoretical studies have potentials to transform into empirical research by taking them one step further. Thus, the topics of the current theoretical studies can be seen as the potential focus of the future empirical research in these areas.

8 CONCLUSIONS

Different from the research situation in Australia and European countries, the sustainable landscape education research in the USA is insufficient. Current studies had narrow focuses on developing and testing a new sustainable landscape course, project, or workshop, which led to the fragmented

research situation. Very few fundamental studies were conducted to try to gain a general view of the sustainable design education field. Thus, researchers are hard to capture the big picture of current research and find the research gaps. To solve this problem, more fundamental studies on sustainable landscape education need to be carried out to understand the general situation of the sustainable landscape education research in the USA and improve the fragmented research situation.

To focus on the development of a new course, project, workshop or curriculum based on sustainable theories and pedagogy, the researchers can choose either theoretical research method or empirical research method for sustainable landscape education research. The choice will depend on if the researchers would like to focus on the developing process or the evaluation. In particular, the corresponding empirical research methods for this kind of study can be either the qualitative method or mixed methods. Due to the unique learning outcomes and learning process of landscape architecture, diverse approaches include exploring the blogging, drawings, documentary materials, interviews, focus groups, observations, field notes, participant diaries, video, and audio can be used (Lawson, 2010; McMahon & Bhamra, 2016; Nikezić & Marković, 2015). Once the multiple kinds of research materials are utilized in the studies, the interactions between the analysis of different research materials should be equally paid attention to just as the results coming from analyzing different research materials.

To focus on fundamental research about sustainable landscape education, the researchers can utilize either the quantitative method or mixed methods. In the quantitative studies, instrument development should be emphasized. Conducting a pilot study to improve the instrument will be a good idea.

In the previous studies, mixed methods were chosen for the rationale of triangulation or enhancement. Sequential and multiphase mixed methods were commonly designed to use the former phase of data collection and data analysis to lead to the next phase's sampling procedure and the development of instrument or protocol. Those are the methodological successes.

Through the review, we find that conducting a fully integrated mixed-method study are the most challengeable since the researchers need to intentionally mix the qualitative and quantitative strands of their study throughout each of the design, data collection, data analysis, and inference stages. Especially for the mixing of data analysis and inference stages, no previous example has been seen in the sustainable landscape education research or the related areas. On the one hand, no data transformation was reported in the previous research. To overcome this problem, the researchers should use qualitzing and quantizing analytical strategies in the data analysis stage to address the mixing. Specifically, the researchers can try to summarize the results from quantitative instruments in narrative form, and transform qualitative data into a quantitative format (Creamer, 2017, p. 247). On the other hand, there is not enough emphasis on the value-added from using mixed methods in the reviewed research. In the future research, the value-added from using mixed methods needs to be paid attention to.

Discussion and conclusions from this study will be helpful for the researchers to find research possibilities with corresponding research methods for the future sustainable landscape education research.

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