Chapter 16
Futures-Focused Teaching and Learning of Climate Change: An Exploration into Students' Perceptions of the Climate Future

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Abstract In recent years, a number of environmental and science educators have advocated the use of futures scenarios to aid learning (Kopnina in *Journal of Environmental Education* 45: 217–231, 2014; Liu in *International Journal of Science Education* 41: 1038–1051, 2019; Lloyd et al. in *Teaching Science: The Journal of the Australian Science Teachers Association* 56: 18–23, 2010). Specifically within the context of climate change education where the future plays a central role, developing descriptive scenarios or storylines of possible future climates seems to be a promising alternative approach to developing students' foresight and empowering them to take climate action. This chapter focuses on a futures-focused teaching module seeking to systematically lead students to explore, examine, and create future scenarios under climate change. A writing activity in the final phase of the module requires students to describe in a narrative way a carbon-neutral future of their familiar local environment. This module was developed and taught as an integral part of an elective, semester-long, undergraduate course on climate change intended for all majors in a public university of southern Taiwan. Drawing on data collected through the implementation of the teaching module over two consecutive semesters, this chapter presents how this module helped to gain insight into students' thoughts about what constitutes a sustainable future and to improve their perceptions of and attitudes toward the future of climate change.

Keywords Futures scenario · Climate change · General education · Student attitudes

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16.1 Introduction

Climate change is one of the few environmental problems where the future plays a central role. The main work of the Intergovernmental Panel on Climate Change (IPCC) has been focused precisely on drawing up the most probable futures scenarios for assessing the potential impacts of climate change (Change, 2007, 2013, 2014). These scenarios portray future events or phenomena based on the best contemporary assumptions about possible changes. They are physically self-consistent and plausible, providing convincing evidence that effective mitigation and adaptation action must be taken in order to avoid the worst outcome (global warming of +6 °C) while considering unavoidable, minimal future change (+2 °C) (Change, 2007). Futures scenarios have been valuable tools for climate scientists in the evaluation of potential regional impacts and response options. The narrative format of these scenarios can strengthen the presentation and interpretation of important scientific findings by bringing futures alive and making the impact of climate change more compelling and relevant (Pahl & Bauer, 2013). In recent years, several environmental and science educators have advocated the use of futures scenarios and visioning to aid learning (Hicks, 2012; Kopnina, 2014; Liu, 2019; Lloyd et al., 2010; Paige & Lloyd, 2016).

One good example of using futures scenarios as educational tools is a unique video campaign initiated prior to the 2014 UN Climate Summit by the World Meteorological Organization, a specialized agency of the United Nations. Well-known television weather presenters from different parts of the world were invited to imagine a weather report from the year of 2050 based on the visions of the newest IPCC report. A collection of futuristic weather forecasts for several countries or regions was created and released in videos, which successfully attracted heavy media coverage and generated several hundred thousand views on YouTube (https://www.youtube.com/watch?v=65ScX7kNR_g). Based on the most up-to-date climate science, these videos drew a compelling picture of what life could be like on a warmer planet. They are imaginary but realistic.

Developing descriptive scenarios or storylines of possible future climates is a promising approach to addressing climate change because their narrative informational style provides more immersive experiences and illustrates the implication of climate change for real-life events (Arnold, 2018). It makes climate change more tangible and brings out insights that might be overlooked in data-driven informational reports (Braddock & Dillard, 2016; Green & Brock, 2000; Morris et al., 2019). The strong potential of narrating the future climate is to convey risk more effectively than presentations of facts and numbers (Shepherd et al., 2018). Moreover, turning ideas and findings about possible future pathways into stories can be helpful in communicating uncertainty inherent in climate change knowledge, which is one of the biggest barriers to taking mitigation or adaptation action, because uncertainty implies a benefit of waiting for greater certainty and, thus, becomes a justification for postponing action (González-Gaudiano & Meira-Cartea, 2010; Poortinga et al., 2011).

Envisioning of the future, or futures thinking, has been recognized as a key element in environmental and sustainability education (Bishop and Hines, 2012; Hicks & Holden, 1995a; Inayatullah, 2008; Kopnina, 2012) and considered very relevant to science education (Jones et al., 2012; Liu, 2019; Lloyd et al., 2010). Looking to the future and creating mental images of what the future might be like are characteristics and capacity that are unique to human beings. These self-created images emerge as hopes, fears, and expectations and, thus, influence what people feel is worth doing in the present and are among the causes of present behavior (Bell, 2006; Hicks, 2002, 2012). The information conveyed in the future images or visions can be categorized into what could happen or possible futures, what is likely to happen or probable futures, and what ought to happen or preferable futures. Envisioning preferable futures is especially important because, according to Hicks (2007), they serve as guiding stars and give us something to aim for.

In the teaching and learning context, having students envision futures and construct their own futures scenarios can help to elicit and communicate speculative thoughts and imaginative ideas about future developments (Liu & Lin, 2018; Nordensvard, 2014; Paige & Lloyd, 2016). More importantly, students are given the opportunity to get engaged in envisioning the future by connecting future possibilities to their current lifestyles and community choices and by contemplating the meaning of decision-making and action in light of their future envisioning. It is expected that such engagement will enhance students' futures thinking competency and develop their positive attitudes toward climate futures.

Effective futures-focused teaching and learning of climate change is urgently needed, especially at the university level, where students are preparing to become professionals and decision-makers in different workplace settings and communities. However, research on such teaching and learning practices is very limited (Hicks, 2012; Slaughter, 2008). In the educational context of Taiwan, teaching and learning of futures is limited to futures studies as a discipline for higher education; futures thinking or visioning as an integral element in science and environmental education is still under-researched.

16.1.1 Student Perceptions and Attitudes toward Climate Futures

A limited number of studies have evaluated how young adults perceive their future in the warming world (Feldman et al., 2010; Li & Liu, 2021; Pfautsch & Gray, 2017; Wachholz et al., 2014). These studies revealed that university students were generally disconnected and disengaged from the topic as well as had weak conceptual understanding of climate change. Pfautsch and Gray's (2017) analysis of benchmark data from Australia showed that, while university students' self-rated understanding of global warming was generally high, their factual knowledge was low. Few students recognized that global warming was already happening and that it was mainly caused

by human activity. The most prominent emotions were fear, sadness, and anger; there was a lack of self-awareness in defining and taking effective actions to mitigate global warming. For example, despite recognizing the importance of taking mitigative action, more than half of the students ($N = 123$) did not think they could personally contribute to the process (Pfautsch & Gray, 2017).

Li and Liu (2021) had similar findings in their recent study with several cohorts of Taiwanese university students. These students demonstrated a relatively high level of self-rated understanding compared to their actual understanding. While recognizing the urgency of climate change issues, many students were pessimistic about making positive changes for the future and, in turn, showed disengagement in climate action. Even after participating in a semester-long, climate-related course, there was little improvement in their actual understanding and action-related perceptions. Limited conceptual understanding and negative futures-related views seem to be key reasons for the repeatedly detected large gap between environmental awareness and action among Taiwanese students (Chou et al., 2013; Hsu & Lin, 2015; Pan et al., 2017). These observations with university students could be interpreted as evidence for an alarming shortcoming in higher education in terms of providing sustainability-literate graduates. Particularly, the literature addressing the affective domain suggests that some researchers have recommended a focus of instruction on fostering a sense of hope and efficacy in climate change education (Li & Monroe, 2019; Liang & Tseng, 2020; Tayne et al., 2021). The futures-focused teaching and learning that engage students in exploring future possibilities and connecting these possibilities to their real-world environments and activities has great potential to achieve such goals (Costanza & Kubiszewski, 2014; Fletcher, 2019; Hicks & Holden, 1995b).

16.1.2 Futures-Focused Teaching and Learning

Futures envisioning or futures thinking is not a spontaneous or intuitive process but rather an important ability to be developed (Jones et al., 2012). McKim et al. (2006) developed a futures thinking model for the purpose of facilitating and exploring students' thinking about specific science and environmental topics and their futures. This model provides a framework for guiding students in a logical sequence toward (a) an understanding of the current situation, (b) an analysis of relevant trends, (c) identification of the drivers underpinning relevant trends, (d) identification of possible and probable futures, and (e) selection of preferable futures. Specific questions are designed for each component to support students' inquiry into and thinking about the given topic. The five sequential components act as scaffolds to help students systematically explore and think about futures.

Compared to other college-level topics, effective communication is essential to successfully teaching climate science. Studies have found that students often continue to hold insufficient or erroneous ideas and undesirable perceptions on this topic even after formal instruction (e.g., Kirk et al., 2014; Li & Liu, 2021). People perceive climate change issues as distant or of little relevance to their lives often because the

risks of climate change are often described through quantified relationships instead of actual observed events. The benefits of using futures scenarios—telling stories about changes in a real-world context—have been researched by several communication psychologists. They suggest that engaging in exploring and creating futures scenarios can help reduce superficial understanding of and psychological distance to climate change (Lee et al., 2020; Morris et al., 2019; Winterbottom et al., 2008) mainly for its immersion and perspective-taking effect (Pahl & Bauer, 2013).

Lloyd and his colleagues (Lloyd, 2011; Lloyd et al., 2010) synthesized approaches to developing futures scenarios in the domain of futures studies and suggested an integral model that is suitable for the teaching and learning context. It includes six steps to support students in creating and writing futures scenarios: decide on the key question for the scenario, know the present and the past of the system of interest, identify the fields of change and the actors, select the most important fields of change and actors, identify the scenarios to be developed, and describe the scenarios and bring them to life. In this study, the above futures thinking and futures scenario models were adapted and synthesized to form an instructional framework that guides the development and implementation of the futures-focused teaching module for undergraduate students in Taiwan.

16.2 This Study

This paper addresses a futures-focused teaching module (8 hours) that was specially developed for university general education in Taiwan with the purpose of enhancing students' futures thinking on climate change. It was intended for all majors and suitable for integration into general science and environmental courses. The teaching module consists of a series of lectures, films, and in-class activities to introduce the concept of scenario development and analysis in general as well as specific to the climate change issue. The module is finalized by a writing activity that requires students to independently create and write their own futures scenario in response to a contextual prompt. The prompt encourages students to imagine and articulate a carbon-neutral future in their familiar surroundings. This teaching module was implemented over two semesters (one class per semester) and explored student perceptions and attitudes toward the future of climate change in the teaching and learning context. This study sought to understand students' expressions of futures thinking through their written scenarios and the assessment of whether and how the futures-focused instruction affected their attitudes toward climate futures.

More specifically, this study was guided by the following research questions:

1. How do undergraduate students envision desirable climate-related futures as expressed in their futures scenario writing?
2. What are the effects of futures-focused learning on students' attitudes toward the future of climate change?

16.2.1 Participants

The study was conducted in a research-oriented public university in southern Taiwan. The university has been engaged in fostering civic and environmental education; it is known for its interdisciplinary and transdisciplinary general education program. Within the general education context, a futures-focused teaching module was developed as an integral part of a semester-long climate change course intended for all majors. The data of this study came from the implementation of the module over two semesters. In the first semester, 116 students enrolled in the course (Class A); 82 agreed to participate in the study and completed the required assignments and surveys. After minor modifications, the module was taught in the second semester (Class B), where 104 students were enrolled and 82 agreed to participate in the study. The participating students ($N = 164$) were in their second to final year of their programs, representing a wide range of disciplines in the science, engineering, management, and humanity domains. They can be regarded as a reasonable representation of this university's student population.

16.2.2 The Teaching Module

The teaching module consisted of lectures, films, group discussions, classroom activities, and online assignments based on pedagogical models on futures thinking and scenario development (Jones et al., 2012; Lloyd, 2011; Lloyd & Wallace, 2004). The goal was to systematically encourage students to think more critically and creatively about the future of climate change using a 6-phase teaching framework (Table 16.1). Students were introduced to futures scenarios as an exploration and communication tool at the beginning of the instruction (Phase 1) and were guided to explore the climate change issue following a logical sequence. Although instructional framework is linear in nature, the actual teaching process involved a combination of two phases or backward-and-forward movement. For example, in one teaching session, students were introduced to four possible emission pathways for the future climate as revealed by the Intergovernmental Panel on Climate Change (IPCC) (2007, 2013) and, more specifically, what changes were projected according to these pathways in the local environment as explored by the Taiwan Climate Change Information Platform (https://tccip.ncdr.nat.gov.tw/). In addition to looking into the meaning of these four possible futures (Phase 5), students were encouraged to think about critical factors and drivers that may influence the development toward a specific pathway (Phase 4). A writing assignment was included in the final phase where students visualize the IPCC future scenario with radically reduced greenhouse gas emissions, eventually declining to net zero around or after 2050. This activity used contextualized prompts to support students in reflecting on what specific changes would lead to a desirable vision of their current living environment.

Table 16.1 Instructional framework of the futures-focused module (Jones et al., 2012; Lloyd, 2011; Lloyd & Wallace, 2004)

Phase	Topic	Content
1	Introduction to futures scenario approach	– The concept of future or futures – What is the futures scenario? (Using the Weather in 2050 video example) – How are futures scenarios developed and used?
2	Exploring current situations	– Public understanding and perceptions of climate change – Gaps between perceptions and action
3	Identifying relevant trends	– What changes are illustrated in scientific findings (e.g., IPCC) globally and locally (Taiwan)?
4	Identifying factors or drivers underpinning the relevant trends	– What events or actions have likely led to the increase of global warming? – What events or actions may likely help to adapt or mitigate it?
5	Identifying possible futures	– Meanings of IPCC scenarios in the real-world context
6	Clarifying desirable futures	– Reflecting and evaluating different future possibilities under climate change – Creating and narrating a desirable future scenario

The futures-focused instruction totaled eight hours during the last four weeks of the course; it was taught by the author. To avoid any conflict of interest, all data were sorted and analyzed only after the course was completed and final student grades were submitted.

16.2.3 Data Collection

Data were collected from students' final assignment (i.e., the futures scenario writing), and pre-instruction and post-instruction surveys, which assessed possible changes of students' attitudes toward the future of climate change.

16.2.3.1 Futures Scenario Writing

Futures scenario writing was used in the final phase of the module as an assessment activity where students were required to construct and write independently a futures scenario that specifically depicts a positive, carbon-neutral future based on what they learned and believed. In order to help students create a scenario connected with their lifeworld, a writing prompt was provided:

> Imagine you are in the year of 2050. You may be in Taiwan or overseas. Your child(ren) may have grown up, or you may have stayed DINK or single. You are probably already a senior level professional. One day, you receive an invitation from the NSYSU University Alumni Association for the celebration of their "Carbon-Balanced Campus." You are happy to pay a visit. What do you think you'll see or experience on this day? Please write down the scenario to describe your visit to the carbon-balanced campus of your home university in 2050.

In the second semester, the prompt was modified by shifting the focus from the university campus to an apartment complex. As both contexts were familiar settings for the students, it is possible to capture the commonalities and differences of how they envision sustainable futures across settings. In the case of the apartment complex, students were asked to describe their everyday life if they were to live in a carbon-balanced apartment complex of 2050.

16.2.3.2 Pre- and Post-instructional Surveys

Data were collected from pre-instruction and post-instruction surveys designed to assess students' attitudes toward the future of climate change. They are identical surveys, consisting of three sets of two-tier questions to probe students' feelings of hope (Q1), confidence to make positive changes (Q2), and willingness to take action for change (Q3). Each question started with a 5-point Likert-type item, followed by an open-ended *why* or *how* question. The higher numerical response of the first-tier indicates a more positive attitude toward climate change. The final assignment of the futures scenario writing and the pre-post surveys were all web-based and completed in the classroom.

16.2.4 Data Analysis

Students' scenario texts were content-analyzed for the purpose of finding key characteristics of desirable climate futures in their familiar environments. Two experienced coders were involved in the recursive review of students' writings. The writings were randomly divided into four subgroups ($n = 41$ each). The two coders independently read all texts of the first subgroup and wrote down as many words or phrases as necessary that described features of a desirable future environment (i.e., a university campus or apartment complex). Their lists of features were then compared and discussed in a consensus meeting where adjustments were made and a single set of features was developed and grouped into themes. Using the revised list, the two coders independently coded the next subgroup and discussed the results in the following consensus meeting to resolve all differences. This procedure was repeated for the third and fourth subgroups. Eleven themes were derived from the 164 students' narrative texts (Table 16.2). This analysis revealed that a student's writing typically included more than one theme. These themes were examined qualitatively and quantitatively.

Table 16.2 Coding categories of student scenario writings about desirable futures

Theme	Features	
1	Green transportation	Wide use of bicycles, e-scooters, electric cars, public transport, or any vehicles powered by green energy
2	Zero plastic waste	No/few plastic bags, use of eco-friendly materials, recycling or reuse of materials
3	Greening	More parks, gardens, street trees, and flowers
4	Collective environmental action	Environment-related activities, policies, or decision-making as a group
5	Renewable energy and energy efficiency	Use of renewable resources such as wind, solar energy, biomass, etc. to produce power, and energy-saving technologies
6	Low-carbon food	Eating organic food, no/little meat, locally produced food
7	Green architecture	Buildings with natural lighting, energy-saving equipment, green roof or walls
8	Green technology	Apart from energy, all eco-friendly technologies, materials, or devices such as aquaponics and water recycling systems
9	High-technology	General advancement or prevalence of technologies
10	A clean, comfortable, or beautiful environment	Positive feelings or impressions of the surroundings such as cleanness, beauty, and comfort
11	Self-sufficient and simple lifestyle	Living simply, growing one's own food, and exchanging goods with others

Regarding the pre- and post-instruction surveys, quantitative data from the three Likert questions were analyzed using univariate frequency distributions and bivariate analysis (i.e., *t*-test and correlation test) to examine the changes over the instruction. Student responses to the open-ended questions generally consisted of short sentences (e.g., *With a little effort from everyone, there is hope.*) and were categorized by the same coders together. The results were used to provide more in-depth information about their choice for the first-tier question.

16.3 Results and Discussion

RQ1 How do undergraduate students envision desirable climate-related futures as expressed in their futures scenario writing?

The students in two classes were asked near the end of the futures-focus instruction of climate change to create a futures narrative to depict a local environment where carbon emission has been dramatically reduced in 2050. The story setting for Class A

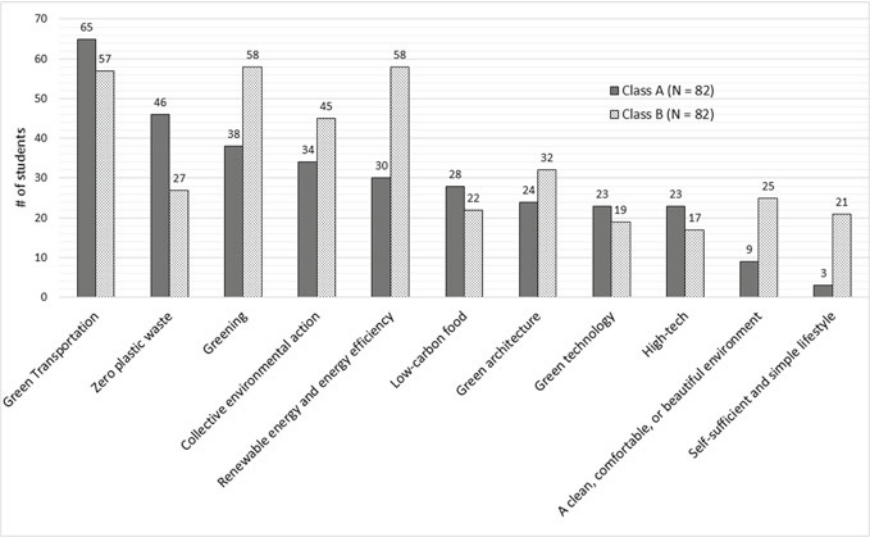

Fig. 16.1 Themes characterizing desirable future local environment as expressed in students' scenario writing regarding climate change

was the university campus and for Class B an apartment complex; both were familiar local environments for the students. Content analysis of the students' written products revealed a total of 11 themes. These themes represent what students perceived to be important or interesting for the desirable future environment under climate change. Figure 16.1 shows the number of students mentioning each theme for both classes.

The most prominent theme of student futures scenarios was *green transportation,* mentioned by 79% of Class A students and 70% of Class B. Pertinent to this theme, students described wide use of carbon-free vehicles (e.g., cars and scooters powered by solar energy) and public transportation. Another prominent theme covered in student writings was *greening*, especially for Class B (70%). They often portrayed a future apartment complex surrounded by gardens, ponds, or even small forests where people can enjoy the natural environment while living in a concrete jungle. *Renewable energy and energy efficiency* was also a common theme, especially for Class B (70%). In their future scenarios, they depicted the use of solar, water, or biomass energy to power homes and public places as well as technologies to save electricity and water.

The next frequently mentioned themes were *collective environmental action* (41 and 55%, respectively, for Class A and B) and *zero plastic waste* (56 and 33%). The collective action refers to joint efforts of people in the community to protect the environment; for example, one Class A student (AS22) wrote about seeing "a lot of students cleaning the beach" on the day of visiting the campus. A Class B student (BS67) described the residents of the community as "taking turns to take care of the garden." The zero plastic waste theme was indicated when students wrote about the disappearance or reduction of plastic waste due to the replacement of plastic bags

and containers (especially used for food) by environmentally friendly materials or to the implementation of certain policies (setting a quota for waste disposal) that helps to reduce waste.

Other common themes included *green architecture* (buildings with good air circulation), *low-carbon food* (emphasizing vegetarian diet or local food), *green technology* (ecologically engineered devices for recycling used water), and *high-technology* (advanced technology in general and virtual reality technology widely used for online communications). Two themes, *a clean, comfortable, or beautiful environment,* and *self-sufficient and simple lifestyle*, seemed to be more context-specific as considerably more Class B students mentioned these themes compared to Class A. Student BS26 wrote about the environment: "Inside of the compound, there is a sense of simplicity. It is simple but complete in every detail." For the *self-sufficient and simple lifestyle*, students typically described a community life where people have primary relations among themselves and work together on small gardens or farms inside their apartment complex. Table 16.3 shows an example of student text and its coding.

These themes represent important or interesting characteristics of a desirable future as perceived by the students. More themes covered in one response would indicate that the student considers a wider scope of changes that need to take place. We counted the number of themes each student covered in her/his response to examine the scope of student envisioning of desirable, sustainable futures. As shown in Figure 16.2, the majority of the students included three to six themes in their

Table 16.3 Example of student narrative writing and corresponding codes/themes

On that day [of my visit], I will find out that the school has completely banned diesel locomotives from entering the campus, and there are more services of MRT [city subway] and electric buses. We take the MRT to the campus. After entering the campus, the originally red-brick buildings are now covered by solar panel and tree walls. There are more trees on the campus, and a lot of cooling resting places. Many students are discussing their coursework and eating outdoors. It is very comfortable and laid back. We are taken to visit the university power plant with many installations. The school is able to generate enough electricity for itself. Moreover, all students can contribute to the generation of power because as long as they walk around the campus, all electronic pedals on the ground will collect and convert [mechanical] energy into electricity. There are also many climate- and energy-related courses and departments, increasing people's willingness to contribute to these issues! (AS10)	Green transportation Green architecture Greening Renewable energy and energy efficiency Collective environmental action

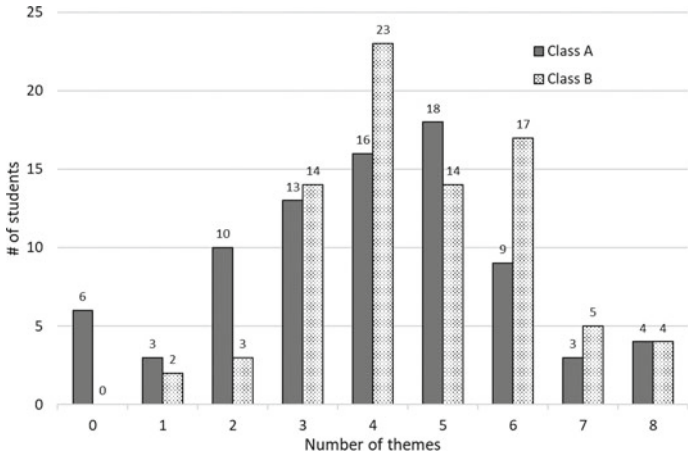

Fig. 16.2 Student distribution of the number of themes mentioned in the student narrative

scenario. The average number of covered themes for Class B ($M = 4.65$, $SD = 1.57$) was higher than for Class A ($M = 3.94$, $SD = 1.98$). This difference is likely associated with the context students were given to describe the future. Although the campus environment is familiar to students, it is more confined to learning-related activities compared to the household environment.

RQ2 What are the effects of futures-focused learning on students' attitudes toward the future of climate change?

Three sets of two-tier questions regarding attitudes toward climate futures were asked prior to and immediately after the futures-focused instruction. Analysis of pretest and posttest first-tier student responses showed overall significant gains (Table 16.4) in students' feelings of hope (Q1) and confidence about making positive changes (Q2). Although students' willingness to take climate action (Q3) did not change significantly, it is likely due to the high scores on their pretest ($M = 4.26$ and 4.28, $SD = 0.699$ and 0.805 for Class A and B, respectively) thereby leaving little room for drastic improvement on the Likert scale.

Pearson correlations were computed to determine the associations between score changes of these questions. The pair-wise results indicated significant positive correlations among the three changes, meaning that a student who has a larger increase in their feelings of hope is more likely to have more gains in confidence about making positive changes as well as willingness to take climate action and vice versa (Table 16.5). This result conforms with previous findings that hope and efficacy are important factors that influence people's action or inaction on key environmental challenges (Li & Monroe, 2019; Liang & Tseng, 2020; Tayne et al., 2021).

The second-tier questions asked students to explain the reason for or explicate the meaning of their responses to the first-tier questions. The qualitative analyses of these responses revealed a series of factors justifying their Likert choices. Results of categorization of students' reasons for feeling hopeful or not about the future of

Table 16.4 Results of the pair sample *t*-test analysis before and after instruction

		Pretest		Posttest					
	N	*M*	*SD*	*M*	*SD*	*T*	*df*	*p*	Cohen's *d*
Q1: I feel hopeful about the future of climate change									
Class A	82	3.21	0.913	3.77	0.821	4.136	81	< 0.001	0.65
Class B	82	3.48	0.906	3.67	0.832	1.747	81	0.084	0.22
Total	164	3.34	0.916	3.72	0.826	4.260	163	< 0.001	0.44
Q2: I think that I am able to help reduce climate change									
Class A	82	3.42	1.006	3.73	0.903	2.186	81	0.032	0.33
Class B	82	3.59	0.929	3.82	0.739	2.158	81	0.034	0.28
Total	164	3.50	0.969	3.77	0.824	3.048	163	0.003	0.30
Q3: I am willing to take action on climate change									
Class A	82	4.26	0.699	4.34	0.652	0.841	81	0.403	–
Class B	82	4.28	0.805	4.29	0.676	0.145	81	0.885	–
Total	164	4.27	0.752	4.32	0.662	0.742	163	0.459	–

Table 16.5 Correlations between score changes in three questions (posttest–pretest; $N = 164$)

				Correlations	
	M	SD		Change Q1	Change Q2
Change Q1	0.38	1.137	*r*	–	–
			p		
Change Q2	0.27	1.153	*r*	0.365	–
			p	< 0.001	
Change Q3	0.05	0.842	*r*	0.237	0.340
			p	0.002	< 0.001

climate change (Q1) are shown in Table 16.6. *Action taken to combat the problem* and *awareness of the problem* perceived to be increasing (or lacking) in their communities were the two most important factors of their feelings of hope (or no hope) and even more so after instruction. More students in the posttest felt that there is a social consensus on the importance of climate change and taking action to tackle it; thus, it is hopeful for climate future. Interestingly, several student responses fell into the categories of *science and technology* (whether or not science and technology will be advanced enough to solve the climate change problem) and *seriousness of the problem* (whether or not the problem is too serious to solve), but the corresponding number dropped considerably after instruction. A few students believed that there exists an inherent *conflict between the environment and development*; therefore, they were not hopeful about the future. The number of student responses in this category also decreased after instruction. Other 'reason' categories included *human intelligence* (whether or not humans are intelligent enough to solve the climate change problem),

Table 16.6 Categories of student responses to second-tier question of Q1 (reasons for feeling hopeful/not hopeful about the future of climate change)

Category	Class A ($n = 82$)		Class B ($n = 82$)	
	Pretest	Posttest	Pretest	Posttest
Action taken to combat the problem	27	38	19	21
Awareness of the problem	22	26	31	40
Science and technology	16	8	22	9
Seriousness of the problem	14	8	17	7
Conflict between the environment and development	10	4	8	5
Human intelligence	5	4	7	4
The Earth's resilience	4	11	0	1
Governmental efforts	2	1	12	8
Human nature	0	2	3	4
The climate course	0	2	2	1
Other	0	0	3	3

the Earth's resilience (whether or not the Earth system is resilient enough to prevent a collapse), *governmental efforts* (whether or not the government is making enough efforts), *human nature* (such that humans are focused on short-term benefits), and *the climate course* (referring to participating in a climate-related course). The category of other reasons contains responses that were unclear or did not fit into any other category.

Student explanations of why they feel able or unable to make a positive change for the climate future (Q2) were more focused on two categories (Table 16.7). The belief about *whether or not individuals can make a difference* is one major factor of their confidence or lack of confidence. When they believe that there is much good one person can do to the world, they are also confident about themselves being a catalyst for positive change. Another major 'reason' category is *focused on what I can do*, where students seemed to gain their confidence by taking personal

Table 16.7 Categories of student responses to second-tier question of Q2 (reasons for feeling able/unable to help reduce climate change)

Category	Class A ($n = 82$)		Class B ($n = 82$)	
	Pretest	Posttest	Pretest	Posttest
Whether or not individuals can make a difference	56	41	53	37
Focused on what I can do	32	35	45	42
Having related knowledge or skills	7	7	11	11
Environmental policies and technology	2	3	3	1
Shared responsibilities	1	4	7	8
Other	0	7	0	5

action to reduce their carbon footprints. A smaller number of students attributed their confidence to *having related knowledge or skills*, indicating the importance of educational efforts. Other categories such as *environmental policies and technology* (as external factors to enhance or reduce their confidence in making a positive change) and *shared responsibilities* (the sense that everybody shares the responsibility to deal with the climate change issue) were also derived from several student responses.

The second-tier question following student willingness to take action for change (Q3) asked for clarifications of actions they are willing to take or reasons why they are not willing to take action. The willingness to take action responses outnumbered the unwillingness to take action, as the vast majority of the students were either very or somewhat willing to take climate action. The climate actions that students frequently reported being willing to take (Table 16.8) are focused on three categories: *saving energy and water* (set air conditioner temperature at a reasonable level), *low-carbon transportation* (prioritize public transport over cars or scooters), and *reducing (plastic) waste* (use reusable shopping bags). A smaller number of responses were related to *low-carbon food* (eat locally), *green manifesto* (reducing one's own carbon footprint), and *participation in climate activities (or donation).* Regarding reasons of unwillingness to take action, students tended to believe that *sacrificing personal quality of life* is necessary when taking climate action. Prior research has shown that conflating taking personal action with decreasing one's quality of life is common among undergraduate students and likely to act as a barrier to climate action (Li & Liu, 2021).

Table 16.8 Categories of student responses to second-tier question of Q3 (what action they are willing to take/reasons for not willing to take climate action)

Category	Class A ($n = 82$)		Class B ($n = 82$)	
	Pretest	Posttest	Pretest	Posttest
Action that students are willing to take				
Saving energy and water	39	29	36	28
Low-carbon transportation	29	30	20	30
Reducing (plastic) waste	26	37	34	28
Low-carbon food	8	12	8	5
Green manifesto	7	7	5	9
Participation in climate activities (or donation)	5	2	13	3
Green consumption	3	2	6	2
Renewable energy	1	1	0	1
Learning to be professional	1	1	4	1
Reasons for students not willing to take action				
Sacrificing personal quality of life	2	0	5	6
Little clue what to do	1	0	0	0
Likely wasted efforts	1	0	0	2

16.4 Conclusion

A futures-focus teaching module was developed and implemented to facilitate university students' understanding of and engagement with climate change. A writing activity was included as the final assignment to have students create and narrate their own desirable futures scenarios of familiar local environments (university campus or apartment complex). We used students' scenario writings and pre-post testing over two consecutive semesters of teaching to gain insight into students' thoughts about what constitutes a sustainable future and how this instruction contributes to the improvement of students' attitudes toward the future of climate change.

Analysis of student writings indicated that toward the end of the futures-focused learning students were able to relate desirable, sustainable futures to several characteristics (themes) in a real-world context. The results indicated a wide range of relevant actions and choices, individually and collectively in private and public spheres. For example, many students described green transportation (e.g., electric cars, scooters, buses, solar vehicles) as a dominant feature on future streets. They may likely support this development as a consumer and as a voter. These student-generated scenarios are not spontaneous or intuitive products but rather reflective thinking supported by the learning sequence of futures topics on climate change, including the futures scenario approach, current situations, relevant trends, factors or drivers behind these trends, possible futures, and desirable futures. Comparing the pretest and posttest survey results, student perceptions of hope and confidence in combating climate change showed significant improvement after instruction. The reasons they gave for feeling hopeful or not indicated that their perceptions of public action and awareness are influential. Their feeling confident or not about making positive changes reflected the major factor of whether or not one believes that individual efforts are manageable and meaningful. Another encouraging observation is that students expressed relatively high levels of willingness to take action both before and after instruction, indicating overall positive action perceptions in higher education.

We present this study in response to the need to integrate futures thinking into climate change education. The futures-focus teaching and learning along with the scenario writing approach can be extended and refined for different instructional purposes and contexts. Furthermore, qualitative features of students' futures scenarios can provide the basis for development of assessment tools that are quantifiable and suitable for a larger sample.

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