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# Enhancing students' key competencies for Sustainable Development in Chinese Technical and Vocational Education and Training (TVET): implications for TVET teachers

## Abstract

In the context of achieving China's Agenda 21 for Sustainable Development (SD), it is crucial for TVET to explore its own reforms to meet the increasing demand for green skills, and serve and promote sustainable development of the social economy. Zhang and Zhang (2012) point out that the significant tasks for TVET institutes, in addition to empowering students with theoretical knowledge and professional skills, more importantly, are developing students' competencies for SD. The aim of this article is to try to synthesize the existing literature and studies, summarize relevant information and available evidence to find factors that affect vocational students' competencies for SD in terms of teaching and learning process of TVET. The main findings identified the following factors that affect the learners' competencies to deal with sustainability: teaching concept deviating from talents and training goals for SD; current instructional methods and content do not promote student's competency for SD; the absence of comprehensive assessment. In response to these barriers and the demand of equipping students with key competencies for sustainability, practical advice and recommendations are offered for teachers to enhance their relevant competencies (instructional competency, hands-on competency, competency to plan, competency to act in concrete domains, competency to analyse and reflect the teaching and learning process, etc.).

*Keywords:* *Vocational Education Teaching and learning; Competencies for SD; Vocational Training and Sustainable Development*

## 1   Introduction

Compared with academic education, TVET was relegated to a second-class educational system in the past (Han 2009). The TVET is now considered as the key to stimulating economic prosperity as it can equip students with vocational skills which are vital for improving the quality of employment and promoting poverty alleviation (Bagale 2015).

On 19 February 2019, Chinese Ministry of Education held a conference on the reform of vocational education and introduced that in 2018, there were eleven thousand and seven hundred vocational colleges with a total of 26.855 million students in China, and every year, vocational education provides large numbers of skilled workers (such as carpenters, mechanics, technicians, masons, electricians) to society. TVET plays a vital part in cultivating technical personnel in a great variety of industries, as well as providing essential

human resources support for the country's economic growth and social development (Long 2014).

In the new era, TVET should correctly handle the relationship between its own value orientation and the sustainable development goals (SDGs) of the whole society. It is significant for TVET to explore its own reforms in order to maximize coordination with the rapid development of the green economy in a stable, sustained and long-term manner. In practice, SD requires people to take into account the responsibility of protecting the ecological and social environment when pursuing economic benefits.

In 1992, Agenda 21 was adopted at United Nations Conference on Environment and Development (in Rio de Janeiro, Brazil) and the SD strategy for human society was officially mentioned and proposed for the first time (UN 1992a). Since then, SD has begun to become the core concept of economic and social development and aroused extensive worldwide attention.

Aligned with the Agenda 21 of Rio de Janeiro, China's Agenda 21, as an action plan, was reviewed and approved at the 16th executive meeting of the State Council On March 25, 1994. The main content of this Agenda 21 involves: the overall strategy and policy of economic, social, and environmental sustainability, and specifically point out that "education is the key to promote SD and increasing individuals' competencies to solve environmental and development problems."

On June 1st, 2012, the National Report on SD of the People's Republic of China was released and aimed to take the scientific development as the main theme to achieve sustainable economic as well as social harmony and progress in China. Individuals, as practitioners and subjects of developmental purpose, the improvement of their overall quality is obviously the most critical element for implementing SD strategies.

The purpose of TVET is to equip the manpower with knowledge and skills required for their future jobs embedded in the socio-economic context and guarantee them successfully transition from education to working life. However, after students graduate from TVET, it is uncertain as to whether they possess competencies for SD and can truly develop their own potential and work creatively in their professional positions (Zhu & Deng 2013). These issues force the cultivation of vocational students' competencies for sustainability becoming an urgent problem that need to be solved (Jin, 2014; Yi, He, Luo, & Wang 2018; Zhu & Deng 2013). Thus, in the context of China's Agenda 21 for SD, TVET institutes need to rethink how to develop students' competencies recognized as crucial for SD.

Teachers play irreplaceable and unique roles in aspects of guiding students' development and orientation as well as equipping them with a broad range of knowledge, attitudes, and vocational skills in adherence to SD. They are the crucial driving forces in creating empowered and globally-responsible individuals or citizens who can become active change agents for SD and thereby consciously follow the development rules between humans and nature. However, research in China reveals that the teaching and learning process in TVET

does not bring the expected teaching effects on furnishing students with competencies for SD maybe because TVET teachers are not well informed about SD, and cannot adequately supervise students in this process. To identify what teachers' competencies that are required to address the issue of the attainment of competencies for SD through TVET, this paper examines current situation in TVET institutions. This provides an opportunity to evaluate what are the barriers concerning the cultivation of students' competencies to deal with SD in teaching and learning exit. This analysis provides the evidence of what change should be achieved in terms of teaching and learning, and thus, enable this paper to suggests key competencies TVET teachers required to support teaching and learning for SD.

## 2    Essential characteristics of Education for sustainable development (ESD)

"The 2030 Agenda", adopted by the United Nations in 2015, launched a set of 17 Sustainable Development Goals (SDGs) to stimulate action over the next 15 years for people, planet and prosperity. Education is the most critical element for the realization of the 2030 Agenda (UN, 2015).

ESD has certain key features as outlined by Pavlova (2013), Jiang (2009), and the UNESCO (1983, 2009, 1992, 2015, 2017):

- is based on underpinning principles and values;
- Generally, cope with the coordinated, harmonious and consistent development among society, economy and environment;
- emphasizes life-long learning;
- highlights the core competencies required for SD (e.g. foresighted thinking, critical and systematic thinking skills);
- is multidisciplinary and largely depends on all disciplines to contribute to ESD;
- is largely led by meeting the increasing demand for green skills;
- involves formal and informal education;
- is locally relevant (i.e. if local environmental policies are compatible with (green) economic growth);
- create globally-responsible citizens, maintaining a sustainable standard of living, and enhance societal well-being.

## 3    What are competencies for SD?

Competencies for SD refers to relevant competences for dealing with a sustainability problem which our societies are now facing (i.e. poverty reduction, globalization, social cohesion) (Lambrechts, Mulà, Ceulemans, Molderez, & Gaeremynck 2013). This suggests that individual possessing competencies for sustainability are able to acquire, apply and innovate knowledge to achieve the goal of continuous and harmonious development of human and nature, as well as individuals and society.

de Haan (2006) developed a framework of "Gestaltungskompetenz" (shaping competence) which comprises a set of key competencies toward SD (22-25), as summarized by Adomssent and Thomas (2013, 4-6) :

- competency in foresighted thinking;
- competency in interdisciplinary work;
- Competence to create knowledge;
- participatory skills;
- competency in planning and implementation;
- capacity for empathy, compassion and solidarity;
- competency in self-motivation and in motivating others; and
- competency in distanced reflection on individual and cultural models.

Sleurs (2008) discusses competencies for SD which encompasses the following four competencies: System thinking; Values and ethics; Emotions; Action. According to Lambrechts et al. (2013), although different authors report on competencies for SD using different settings and perspectives, these competencies have similar characteristics: responsibility, emotional intelligence, system orientation, future orientation, personal involvement, ability to take action, etc.

Among these competencies, Adomssent and Thomas (2013) report that the most important ones are "Systemic thinking, anticipatory thinking and critical thinking" (4). German scholar Klaus Hahne (2008) believes that systems thinking skills, based on the concept of SD, determine the real actions that people take. System thinking skills can help students make choices in contradictory situations or conflicts of the economy, society, and ecology; as well as balance in complex relationships and diverse social groups to determine the correct direction of development (Xu 2013).

In the doing of the process for SD, individuls must have competencies in respect to very concrete fields, including strong theoretical foundation (subject-matter knowledge), high vocational skills with strong hands-on ablility, dealing with and developing the process based on experience, practice and reflections.

## 4 Why are TVE teachers particularly crucial for fostering students' competencies for SD?

Most of the students trained in TVET are first-line high-quality skilled talents in various jobs. TVET teaching staff can best support skills development of students as they are familiar with the labor market demand and industry needs. Vocational skills can help students produce quality and competitive goods with higher efficiency and it is therefore indispensable for poverty reduction and SD.

In addition, TVET teachers are not only significant in technology diffusion and dissemination through skills and knowledge transfer, they can also prepare and encourage various types of

skilled labor to contemplate, deliberate and reflect SDGs related content for appropriate application in their future professional practice.

Besides, teachers can review the TVET curriculum often by incorporating SD concepts and principle as well as giving due consideration to changes in the new technology. They can also be active change agents and role models for the SD agenda, disseminate SDGs related principles to the graduates who would, in turn, practice these principles in their future career (Chinedu, Wan-Mohamed, & Ajah, 2018).

Thus, TVET teachers become extremely important to achieve the SDG by imparting their SDG-related ideas, skills, and attitudes to students in order to meet societal market needs, thereby impacting on economic development and the broader contribution to societal progress and wellbeing.

## 5   Methodology

Taking other reviews of research literature (Ismail, Nopiah, & Rasul 2017; Liu 2019) as a guide, determining the inclusion criteria is critical for conducting this synthesis review. First of all, articles published between 2009 and 2019 were searched in three predominant database systems of China: CNKI, VIP and WANFANG DATA. Furthermore, the following terms or keywords were used to conduct the search: 'TVET', 'students', 'competence', 'competency' 'Sustainability' 'Sustainable development' 'Teaching and Learning', 'Barriers' or 'Issues'. Titles, abstracts, background and conclusion were retrieved, and articles were screened to be included if they were related to the proposed issues regarding the students' competencies for sustainability in teaching and learning in Chinese TVET institutions.

A total of 57 publications, which met the aforementioned criteria, were yielded in our preliminary list through this electronic search. Besides, this review only focuses on teaching and learning fields for secondary and higher vocational colleges because teaching is the main way of training talents, which is directly related to the cultivation of students' competencies for SD (Wang, Zhang, Zhao, & Fang 2018).

Thus, the title, abstracts and scope of the articles, which are relevant to the teaching and learning in TVET were examined. Two individuals separately searched, check all the required information, and through this second check, we finally gathered 33 papers in this review, while the rest of the publications were discarded.

## 6   Result and Discussion

The main findings obtained which were observed to affect the vocational students' competencies for SD are as follows: teaching concept deviating from talents training goals for SD; current instructional methods and content do not promote student's competency for SD; the absence of comprehensive assessment.

## 6.1 Teaching concept deviating from talents training goals for SD

In the process of talent training in China, teachers of higher vocational colleges mainly pay attention to a specific technology or skill education, while ignoring development of students' competencies for sustainability (Chu & Li 2014; Ding 2015; Jin 2014; Li 2012; Lin 2015; Liu 2017; Si 2016; Wang, Zhang, Zhao, & Fang 2018; Zhang 2014; Zhang & Li 2013; Zhou 2018). For example, Cui (2018) and Ding (2015) reported that most vocational colleges take the initiative to use the employment rate as a guiding indicator, and therefore increasing numbers of TVET teachers are taking "empowering students with the Job Skills" as the main goal in the talent training program, while other aspects such as theory-study, comprehensive development of students become insignificance or even neglected. The direct impact of this is that some courses that improve the overall quality of students are gradually compressed or even reduced (Cui 2018; Long 2014), and numerous VET colleges do not offer courses related to cultivation of students' competencies or skills necessary to deal with SD (Cui 2018).

This one-sided view of the "employment-oriented" concept (too much emphasis on job adaptability) (Jin 2014; Zhou 2018), paying special attention to various "skill competitions" (Wang, et al., 2018), as well as order-orientated talent-training model (Cui 2018; Li 2012; Qi & Zhong 2015) are the embodiment of the lack of competences of SD of higher vocational students.

Practice has proved that outstanding talents trained in higher vocational education, not only possess high skill with strong hands-on ability, but also shows their professional ethics, strong theoretical foundation, as well as their achievements in the interdisciplinary and cross-industry context ( Zhou 2018).

## 6.2 Current instructional methods and content do not promote student's competency for SD

Whether the goal of student's competency for SD can be achieved is closely related to the professional teaching content and instructional design (Yang 2015). However, the cultivation of students' competencies to deal with sustainability has not penetrated into the teaching content of TVET (Luo 2017).

As mentioned above, teachers are more concerned with the basic requirements of students' employment (Wang, et al. 2018) and attach too much importance and value to the improvement of students' vocational skills (Cui 2018), while ignoring the cultivation of students' competences for SD and ability needed for long-term development in their TVET Teaching and Curriculum (Li 2012; Luo 2017, Wang, et al. 2018).

Literature shows that traditional, teacher-centred pedagogical approaches are still dominant in the classroom instruction in quite a few of TVET institutes and hinders the development of students' practical ability (Du & Mao 2017; Wang & Chen 2012; Xiong 2013; Yan 2016). The foundation of higher vocational students is weak and they lack motivation to learn (Ding

2015; Zhang, 2014) and those students are characterized by poor learning habits, low interest in learning, poor self-management and self-learning ability (Li 2015; Lin 2018; Xiong 2015; Yan 2016; Zhang 2014; Zhang 2014; Zhang & Li 2013). This Traditional didactic instruction cannot stimulate students' passion to show a more initiative, active, engaging style of learning. Thus, students passively receive lectures' course content and PowerPoint presentations, and the degree of student participation in the learning process is low (Lu 2018). Neglecting "student-centred" teaching means and methods limit students' ability to "discover, propose, and solve" problems independently (Luo 2017). This is not in line with the objective requirements of vocational education students' competencies for SD in the new era.

### 6.3 The absence of comprehensive assessment

When teachers evaluate the true level of a learner in daily teaching activities or in the workplace where students are trained, they lay emphasis on outcome assessment. Evaluation and judgment are too often only focusing on the knowledge component (Zhou 2018). The lack of "formative assessment" as well as being indifferent to the development of students' non-intellectual factors (Zhou 2018) will inevitably lead to the evaluation results lacking rationality and therefore problematic for evaluating students' competences for SD (Du & Mao 2017). Chu and Li (2014) report that at present, the evaluation system of higher vocational students' competencies for SD is imperfect (also non-standard) and almost no factors closely related to competencies for SD included in the scope of the evaluation.

Through analysis and feedback, teachers should make objective case evaluations on students' performance, identify progress aspects, provide special training and guidance on inadequacies, and promote the improvement of students' professional ability and competences for SD through repeated evaluation and training (Zhou 2018).

## 7 Recommendations

Competencies is hardly comparable with knowledge acquisition, and cannot be taught (Barth, Godemann, Rieckmann, & Stoltenberg, 2007) or communicated (Adomssent & Thomas, 2013). But competencies are viewed as learnable through practical experience (Hartmann, 2017). This leads to the question how to acquire SD competencies. In response to the above problems, the following measures are proposed for TVET teachers to enhance students' competency acquisition towards SD.

### 7.1 The method of reflection levels

"The theory and method of reflection levels" developed by Hartmann (2005, 2017) is a beneficial tool for teachers to analyse, plan, design and develop complex learning situations (i.e. How to produce a product according to the demands of customers or how to design a sophisticated workpiece of specific material) which can provide plentiful opportunities for the development of competencies of their students (Hartmann 2017). Method of reflection level is associated with the analysis of the actual working processes, and engaging in the work

activities and each step of reflection helps vocational students to gain and accumulate practice experience. Thus, this model is especially conducive to fostering students' critical thinking skills.

Hartmann (2017) implies that competencies are growing in the learning process (e.g. participation in new tasks at work) rather than passively receiving it (See Figure 1). Teaching on the bases of the theory of reflection levels is centered on a (more or less) complex situation and involves a carefully planned learning process, even provide detailed guidance with specific explanations and sufficient instructions to learners. The objective of this theory is to analyze complex situations, to structure them in respect to their conditions a.s.o. Therefore it as a methodological component, that could be focused on teaching processes, so that it can be used to maximize the likelihood that whenever an individual is asked to perform assigned tasks or learn something new, the teacher already systematize and construct suitable learning situations to make the learner's challenges more visible and learning more efficient. The design of learning situations needs to be well thought out, build upon learners' prior knowledge as well as their existing competency levels, and then move to cultivate learners' higher-level competencies.

"The method of reflection levels", enabling a learner to be able to deal with complex, unfamiliar situations, be able to act upon reflection, respond to emergencies or diagnose the problems, and make the corresponding decisions. In the case of cooperative work process, it is also concerned that participants are able to carefully negotiate the results of the work, take on responsibility, offer their individual skills, take into account ethical standards when acting, as well as to be able to shift and adjust their behavior accordingly in order to meet customers' needs, expectations or even changing demands on the products, despite any personal conflict such as different perceptions, ideas, desires between individuals.

This, however, requires that participants must possess the capacity to distance themselves from the work done, be able to reflect on the process from the outside, provide constructive feedback and understand/know what is necessary in the next moment, such as method, procedure, and communication elements involved (Hartmann 2005; 2017).

This competence-orientated method can be combined to embed SD in the curriculum, and helps to identify learning opportunities and design learning situations focusing on attaining relevant key competencies to deal with SD.
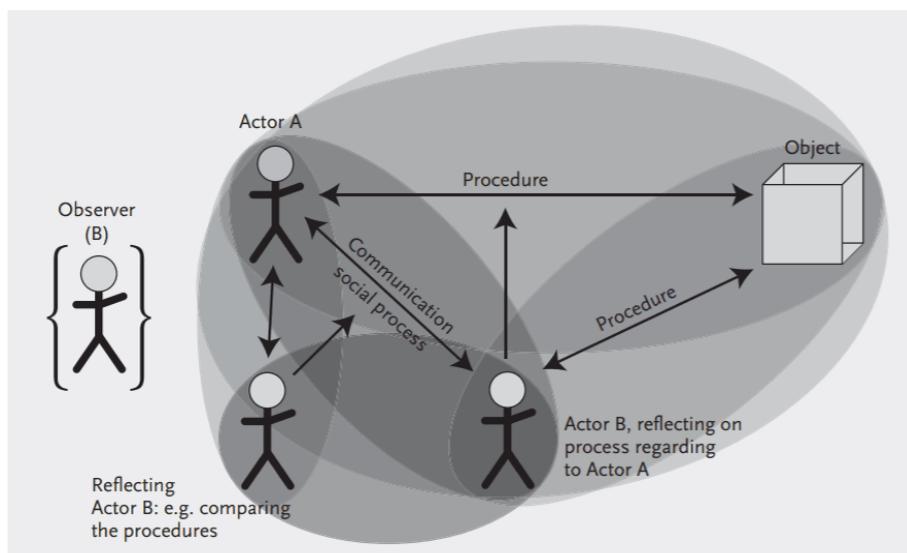
Figure 1:    "The method of reflection levels" (Hartmann 2017)

Based on this reflection level model, it will be easier for TVET teachers to organize effective teaching and learning processes, which involves building certain sustainability-related competencies of students. The improvement of cultivating students' competencies for SD is an accumulation process and the application of reflection level model can be mastered through a short period of teacher training and practice.

## 7.2    General didactic considerations

Lambrechts et al. (2013) cite study of Sluijsmans (2008), and enumerate certain types of methods, techniques and strategies for teachers to foster students' necessary competencies to deal with sustainability:

−   interactive methods: group discussion, brainstorming, role play, etc.;
−   action-oriented didactic: project-based learning (i.e., collaborative real-world projects) (Wang 2017; Yi, He, Luo, & Wang 2018; Zhang 2014), the facilitation of a workshop, learning through internships, solving real local environmental problems, etc.;
−   research methods: bibliographic research, case studies, and problem analysis, etc.

These methods and strategies can also be combined or linked to better help teachers embed SD in the curriculum, reducing the gap between knowledge and practice. (Lambrechts et al. 2013).

In addition to, Ng, Lam, Ng, and  Lai (2017) present that "blended learning" also subtly improve students' self-management of their studies (enhancing their learning motivation and self-regulation learning ability), form a "community of practice", and nurture  their participatory skills because such learning provide opportunities for students to 'prepare theories related contents outside class time by watching online videos or pre-assigned instructional materials and engage in group discussion and tutorial in class'(268).

### 7.2.1  Teaching assessment

Teachers should adopt diversified assessment methods, respecting learners' uniqueness and differences in individual development and providing opportunities for students to evaluate their own learning and review, assess or grade the work of a peer. This self-assessment, self-perception and peer evaluation can capture learners' insights on finding inadequacy to practice their critical-thinking, which help students to monitor their own learning processes.

Lambrechts et al. (2003) report that competencies cannot be evaluated by non-current and isolated learning outcome, and suggested the following three steps of the evaluation in guiding learners' learning process.

- feed-up: make assessment criteria explicit and transparent for learners, give examples
- feed-back: provide sufficient feedback to learners
- feed-forward: offer students guiding information on how to go further in the learning competences process.

### 7.2.2  *Elaborately planned project*

It has been proved that the project-based teaching is effective in TVET teaching (Pavlova & Chen 2019；Sun & Liu 2012; Zhou 2018). Bell (2010), Baysura, Altun, and Yucel-Toy (2015) as well as Frank, M. and Kordova, S. (2009) state that 21st-century competencies such as critical thinking, problem-solving skills, and system thinking can be acquired via project-based learning. Carefully planning projects concerning training students' competencies for SD is the key to the successful implementation of the project (Zhou 2018). The project should reflect on a given number of competencies for SD. At the project design phase, it is significant for TVET teachers to think about the following questions:

What do these competencies for SD mean for the students?

Are these competencies for SD likely to be achieved by the students?

How to guide students to achieve these competencies for SD in their teaching methods?

What learning activities will students engage with in order to develop these competencies for SD?

How to assess whether students have achieved these competencies?

If the project that includes dealing with community issues or local environmental problems and cooperation with a partner (for example, enterprise) in practice, learners can learn real-world (authentic) challenges, tasks, and benefit from the collaborative partners' experiences and expertise.

Project design should potentially have multiple levels. 'A project does not need to be highly complicated and complex but the simple and quick project may not be enough to provide students with a constructive investigation' (Liu 2019, 7), which drives learners' in-depth inquiry, involves their new understandings, and eventually foster their competencies.

*7.2.3   Establish the concept of lifelong learning for students.*

Strengthening the attitude of lifelong learning in students (Gao 2014; Si 2016; Zhao, Liu, & Zhao 2015). This type of learning has become a need in addressing social and environmental issues for human development in today's knowledge-based, high-tech society and putting it into practice is necessary to help students keep up with the pace of the times (Zhang & Zhang 2012). Lifelong learning is described as crucial for the achievement of SDGs, such as responsible consumption and production; decent work and economic growth; gender equality; health and well-being; and climate change mitigation (English & Carlsen 2019).

## 7.3   Strengthen cooperation with Enterprises

School administrators of TVET should strengthen cooperation with enterprises (Li 2015; Qi & Zhong 2015; Wang & Chen 2012; Xiong 2013; Yi, He, Luo, & Wang 2018; Zhu & Deng 2013; Zhao 2015; Liu & Zhao 2015) and encourage in-service teachers' rational flow between enterprises and colleges on a regular basis to keep subject knowledge up to date, gain enterprise-based expertise, cultivate hands-on ability, and understand talents quality requirements of enterprises (Chen 2016). Then, according to local green economic structure and industrial green development, as well as talents demand of enterprises, TVET teachers need to re-examine and reorient subject system and teaching content towards sustainability, develop knowledge, skills, perspectives, and values relevant to SD (Lambrechts et al. 2013; Lin 2015), and develop a systematic, integrated curriculum to serve local businesses and green economies (Xiong 2013; Shi & Meng 2016).

Overall, in order to empower students with specific knowledge, skills, and aforementioned competencies to solve problems related to SD (i.e. long-run economic growth, taking into account the environmental resource scarcity, damage and destruction), teachers must have instructional competency (Hartmann 2005), possess subject-matter knowledge, use appropriate teaching skills, participate in designing appropriate learning situation and create an atmosphere which is conducive to student-centered learning. For TVET teachers, realistic, hands-on experience and competency are also required to guide vocational students' practical training process. Besides, to face the challenges in the perform the task of teaching, TVET teachers must have competency to acquire new knowledge and skills, competency to plan, competency to implement plans and act in a forward-looking manner, competency to analyse, reflect and develop the teaching and learning process (de Haan 2010; Hartmann 2005; Rauch & Steiner 2013).

## 8   Conclusion

TVET is a primary supplier of the labor force of nations (Chinedu, Wan-Mohamed, & Ajah, 2018) and TVET teachers are key persons in developing those numerous workers' knowledge, skills, values and capabilities required for SD. TVET teachers must have competencies such as instructional competency, hands-on competency, competency to plan, competency to act in concrete domains, competency to analyze and reflect the teaching and

learning process, etc., which will, in turn, help students to acquire competencies towards SD. It is difficult to meet the SDGs without recognizing the roles, functions and contributions of teachers in the process of empowering students with competencies for SD, especially their modern teaching methods.

This paper focuses on dealing with students' competences for SD on the part of teachers. Actually, how to successfully and effectively equip student with competencies to deal with sustainability not only depends on the teachers' teaching concept relevant to SD, didactical approaches, and assessment methods, but could also depend on a number of other factors. These are including the students in the class (for example, the foundation of higher vocational students, their learning motivation, and self-management ability, etc.), the equipment involved in the teaching and learning process, policy formulation and safeguard mechanism concerning SD, as well as the surrounding environment. In practice, this study will help vocational schools understand the current situation of enhancing students' key competencies for SD and try to provide evidence for vocational colleges to take reformation and transformation. For the future, researchers could make further efforts on exploring how a citizenry's key competencies for SD will affect the performance of living in harmony with nature in the vocational education context.

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