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Expert Validation of the Green Competencies Model: Strengthening Sustainable Vocational Education

[1]Muh Abdul Latif, [2]Isma Widiaty*, [3]Ade Gafar Abdullah

Universitas Pendidikan Indonesia, Indonesia.

Email: [1] muhabdullatif1894@upi.edu, [2] isma@upi.edu*, [3] ade_gaffar@upi.edu

* Correspondence author

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ABSTRACT

The development of a green competencies-based model is an urgent need in supporting the integration of Education for Sustainable Development (ESD) into the vocational education curriculum. This research aims to validate the green competencies model through expert validation, to ensure its feasibility and relevance in supporting the vocational education curriculum. Forum Group Discussion (FGD) was adopted as this study tests the feasibility of the model. Content Validity Index (CVI) was used to analyze the expert feedback of each question. The results showed that the green competencies model plays a significant role in improving environmental awareness, technical skills, and sustainability values among the workforce and learners. The model received its feasibility value (1>0.83) and has been improved to perfect its construction elements as feedback for each criticism and suggestion, so it is ready to be used as a recommendation to be integrated in the vocational education curriculum. The development of this model is expected to be a guideline for vocational education institutions in developing ESD-based curriculum, as well as supporting the readiness of graduates to contribute to the green economy and create a sustainable future.

Introduction

[The economic sector is one of the main pillars of the sustainable development approach, which emphasizes the importance of the reciprocal relationship between the environment and the economy (Niekerk, 2020) (Telukdarie et al., 2024). In this context, the green economy concept is present to encourage sustainable development through practices that minimize environmental risks while improving human welfare (Puryandani & Syahadat, 2024). This concept requires industries

to adopt environmentally friendly practices, covering various sectors such as renewable energy, transportation, food, and tourism (Setiawan, 2017)(Raihan & Tuspekova, 2022).

Supporting this transition is the need for green jobs, jobs that support environmental and economic sustainability. Green jobs play a role in creating new employment opportunities, increasing economic growth, and protecting the environment (Sulich & Kozar, 2024). The role of Green Human Resource Management (GHRM) becomes very important in integrating green practices into human resource functions, such as green recruitment, training, and performance management (Tang et al., 2018). GHRM specifically emphasizes the development of green competencies, which include knowledge, skills, and attitudes to support organizational sustainability goals (Sulich & Kozar, 2024a)(Mirˇ, 2022).

The demand for a workforce with green competencies continues to increase, especially in supporting the transition to a green economy (Chamorro et al., 2023). The field of education, including vocational education (TVET), plays an important role in producing a competent workforce in this area. TVET is recognized as a key driver of sustainable development through the development of environment-based skills, competencies and values (UNESCO-UNEVOC's, 2019). However, this success requires the integration of a green-based curriculum that aligns with the principles of sustainable education (Corres et al., 2020)(Hawkes, 2023).

Green-based curriculum development aims to equip students with green competencies that are relevant to global needs, support the transition to a green economy, and strengthen Indonesia's competitiveness in the international market (Affolderbach & Affolderbach, 2020). This step is in line with the goals of the SDGs, particularly SDG 4.7, which emphasizes the importance of education for sustainable development (United Nations, 2015). To meet this need, it is necessary to develop a valid green competencies model framework as a guide for workers and prospective workers in the green industry sector. The development stage has been carried out but has not been validated by experts. Therefore, this study aims to conduct expert validation of the green competencies model to ensure its feasibility as a supporting tool for sustainable development.

Method

Forum Group Discussion (FGD) was adopted because this study tested the feasibility of the model (Yaakop et al., 2023). This is in line with the principles of the FGD approach such as; (1) Analyzing the problem, (2) Testing possible solutions; and (3) Seeking group consensus (Adekola, 2008). Steps that must be considered in FGDs shown on figure 1 (Adekola & Olumati, 2023):

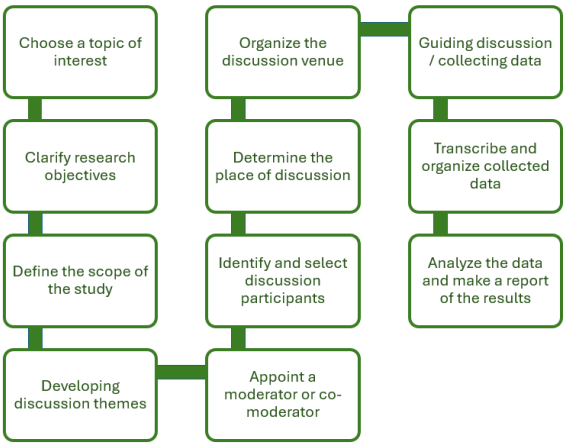

Fig 1: FGD Steps

FGD participants were selected based on various criteria to ensure a comprehensive representation of relevant stakeholders. These included curriculum experts, content/topic experts, policy makers from the VHS, curriculum departments from the VHS, teachers and the industry sector. The experts who attended from this invitation can be seen in detail in table 2 below:

Table 2. The experts

No	*Expert*	*Number*
1	Vocational Education Curriculum	2
2	Material	2
3	Curriculum (VHS)	1
4	Head of department (VHS)	2
5	Teacher	1
6	Industry Sector	2

Content Validity Index (CVI) was used to analyze the expert feedback of each question. CVI is suitable for use in reporting as it represents the content validity of the instrument (Mahmood et al., 2022). Content validity is the degree of relevance and representation of the elements of the assessment instrument to the constructs targeted for specific assessment purposes (Yusof, 2019). In this case, CVI analyzes the results of the assessment from experts in FGDs related to the model created. The steps in the CVI analysis are as follows (Yusof, 2019): (a) Prepare a content validation form, (b) Select an expert review panel, (c) Conduct content validation (d) Review domains and items (e) Give scores to each item (f) Calculate CVI.

Result and Discussion

Urgency development green competencies model

The view of curriculum experts is that the development of this model is an innovation and the

right step to answer the current challenges and green issues. Especially in the curriculum has reached the issue of blue curriculum. The expert then explained his view that the development of this green-based model must at least refer to the concept of blue curriculum:

When referring to the blue curriculum (green competencies) that is currently being researched, the implementation that will be carried out in VHS or vocational schools, there are 7 things that should be a concern, namely: Transforming educational spaces, Empowering education, Flexibility and hybridity, Students as central actors learning, Cooperation with community, Cross-cutting competencies, Glocal' Futures: Curricula Work Across Scale

Then the urgency according to the material expert is in line with what the curriculum expert said that the development of this model is in accordance with the latest trends and issues that are present in the educational environment, especially in TVET. Greening TVET is the focus of studies in various countries and not to forget in Indonesia. This model is a step towards that direction. TVET plays an important role in implementing green TVET in green jobs and skills so as to support the achievement of SDGs.

I am a member of the Green Education Partnership, which supports the integration of green skills into the curriculum. In January, UNESCO published the Green Skill Guidance for achieving sustainability goals, which covers aspects of knowledge, values, attitudes and abilities. The guidance also highlights the importance of developing a greening curriculum guidance, which focuses not only on hands-on skills, but also on the mastery of knowledge, in accordance with Bloom's taxonomy that includes cognitive, affective and psychomotor aspects. This issue is crucial to support global sustainability. Vocational education plays an important role in implementing green TVET in green jobs in each skill, for example in sustainable food processing workers must apply green skills.

Then the views of school representatives, which were represented by curriculum representatives, heads of expertise programs and teachers. They argue regarding the urgency where the green GC model is still not common, only a few VHS implement and focus on this issue. Even though this is an important part of supporting the SDGs, more concretely in competency development, especially in the field of mechatronics, this model is needed.

The urgency of implementing green competencies in VHS is still limited and has only become a concern in a few institutions. In fact, green skills oriented towards SDGs goals are very important to support sustainable development. For example, in the field of mechatronics, strengthening green skills can improve students' competencies in integrating sustainability principles into technology and work practices, making them more environmentally friendly and efficient. This demonstrates the need for broader development and implementation of green competencies at VHS to address

global challenges and support sustainability in various industrial sectors.

Although some activities or programs at school have led to the concept referred to in this model such as implementing a green environment program, especially in handling waste produced from practices such as in batik, textile and metal majors that produce waste.

Regarding environmental issues, our school has integrated this concern into the curriculum, especially in the Batik, Textile and Metal departments. In the textile department, for example, although it often produces waste, we have implemented waste disposal procedures so that it does not directly pollute the environment. Solid waste such as leaf waste is usually managed well. However, in the canteen there is still a lot of plastic use, and students are not fully aware of disposing of waste in its place-some even keep it in drawers. To address this issue, we focus on socialization related to environmental hygiene issues. One of the initiatives is the "take a few minutes to pick up trash" movement, which aims to raise students' awareness of the importance of protecting the environment around them.

Then the efforts or programs that are promoted such as making attractive waste disposal sites so as to improve students' attitudes and awareness to dispose of waste in its place.

Our school faces a similar problem with littering. To address this, we made attractive garbage cans, such as basketball hoop-shaped cans, so that students are more eager to dispose of garbage in its place. In addition, through the PKK (Creative Product and Entrepreneurship) subject, we integrate waste management programs, such as structured waste burning using water filters and pumps to reduce smoke. We also have a program where students bring in waste to be separated, crushed with a shredder, and resold. This program not only helps manage waste, but also provides entrepreneurial learning for students. The "Pengling" (Care for the Environment) extracurricular also plays an active role, especially in separating waste. In addition, Clean Friday activities are routinely carried out to keep the school environment clean. Efforts to integrate this model issue are still limited to

Then in certain subjects such as in P5 subjects (Projek Penguatan Profil Pelajar Pancasila) and IPAS subjects (Natural and Social Sciences). It already exists but this is not specific, it is formal and has not become a general policy of the curriculum developed.

In our school, the P5 subject (Projek Penguatan Profil Pelajar Pancasila) gives students the opportunity to learn through projects, such as processing used goods and mapping environmental issues. These projects are then integrated into other subjects, especially in assessments that cover aspects of students' work, attitude and behavior in dealing with waste. This approach helps students understand the importance of protecting the environment holistically. In addition, IPAS (Natural

and Social Sciences) subjects also discuss various environmental issues and solutions to overcome them. In addition, the school supports students' creativity through activities such as exhibitions and fashion shows that utilize used or recycled materials, as part of the effort to raise environmental awareness.

So it can be concluded that in the implementation of vocational education, especially in the vocational education curriculum, there is no clear and specific framework in implementing this green competencies model. Then finally the views of industry sector representatives who gave the view that this model is needed in the world of work, especially the automotive and batik industries. In the automotive industry, the waste produced is very dangerous if not handled, such as oil and automotive engine or body parts. This requires special handling so that the concept as expressed in this model is very relevant to be applied.

In the automotive industry, waste such as oil is a major concern. If not managed properly, such waste can adversely affect the community and cause the environment to become unhealthy. Proper waste management is very important to maintain sustainability and environmental health.

In addition, the batik handicraft industry also gave the same voice that the waste generated from the practice in the batik industry needs to be handled by people who have the ability as in this framework, especially those who comply with the procedures.

In the textile sector, the handling of waste such as wax has followed the prescribed procedures, such as storing it in buckets as directed by the leadership and following the Standard Operating Procedure in the Gurat Malam area. However, the main challenge is to raise workers' awareness to maintain cleanliness and comply with established procedures.

So it can be concluded, that this green competencies model is very important to be developed in the vocational education environment with many problems in environmental issues. In addition, vocational education is at the forefront because they will fill the pisis in jobs according to their fields that must have green abilities. Efforts to integrate this issue in learning are trying to integrate such as P5 IPAS. In addition, several regulations and projects have been implemented to overcome these problems. However, it still refers to the awareness of each individual..

Expert recommendation

The second discussion was related to the validation of the green competencies model where experts were given the opportunity to provide input related to the model that had been made. In this discussion, experts conveyed either directly or through writing in the notes provided. In this validation, experts were also given an assessment rubric in accordance with indicators containing 5

answer criteria. This validation explores suggestions from experts regarding the content and construct of the model that has been made.

Content Aspect

There are several reviews expressed in the content aspect such as whether the model created is relevant to the needs of the workplace, then whether the model created is in accordance with the learning objectives, then whether this model refers to international or national standards and whether this model is based on the latest knowledge and technology in the environmental field. From the aspect of relevance that this model is very relevant to the needs of today's workplace. Existing environmental issues are still crucial and require this model to address these issues. A small thing for example in the workplace in the automotive industry in handling environmental issues such as waste oil or unused automotive parts that must be handled otherwise this will have an impact on society as expressed by one of the speakers:

In the automotive industry, we usually work with waste in the form of oil or unused automotive parts. However, if the waste is not handled properly, it will affect the community and the output will make the environment unhealthy.

From the statement above that this model is very important, one of which is for technicians, a small example of the case above. As a technician not only capable of skills in the field of automotive technicians but must also have competencies, especially in green competencies. Then another case from the batik industry also expressed that this model is important, especially in managing waste generated after the production process such as in the textile industry:

In the textile industry, for the waste produced, for example wax, we provide buckets, then we make it a procedure to clean up the garbage or waste after finishing work, and this all has an Standard Operating Procedure (SOP).

The statement above states that the workplace already provides several procedures, especially in handling hazardous waste. This shows that the model created is relevant to the needs of the workplace, especially as a reference in preparing the workforce to be ready to work. In addition to the relevance aspect, this model is reviewed from the aspect of compatibility with the objectives of vocational education. This green competencies model must be in line with the objectives of vocational education where students are required to have aspects of competence in addition to aspects of knowledge and attitudes. The hope of this green competencies model can accommodate students in the knowledge aspects of attitudes and skills. This is in accordance with the statement from the expert that:

Vocational education today is not only skills on hand but also knowledge if it is related to Bloom's

taxonomy, namely aptitude, psychomotor and cognitive, including with regard to green issues, it is very important in these three aspects.

The above statement shows that the green competencies model is important in preparing students to reach the three aspects that are the basis of vocational education.

In addition, it is concrete that this model is very relevant to some of the learning objectives that already exist in several fields of expertise in vocational high schools as stated by experts:

Incidentally, in terms of environmental issues, it is included in the environmental concentration to be implemented in our school. Because some points are relevant to the objectives of vocational education, especially in our field, namely textiles. In our school, (Batik, textile and metal) in the textile department often releases waste, but we also have procedures for waste disposal so that it is not directly disposed of into the environment.

Then in detail, some aspects have been included in the subjects in the curriculum as stated by the expert:

In our school there is a P5 subject. In this maple, it is taught to make projects on how to process used goods, make mapping related to environmental problems. Usually this is also an implementation in other subjects on environmental assessment. Assessing work, assessing attitudes and behavior of waste handlers. In addition, there are also IPAS (Natural and Social Sciences) subjects in these subjects there are some that are conveyed related to environmental issues. to overcome the problem. Yesterday there was also an exhibition and fashion show of used or recycled materials.

From some of the points that have been described regarding the suitability aspects of the green competencies model, it appears that this model has a strong fit with the objectives of vocational education. This is because vocational education aims to prepare individuals to have skills that are relevant to the world of work, including aspects of sustainability and environmental responsibility. The next aspect to note is that the model must refer to both national and international standards. The issue of green competencies is a global concern that is being discussed by many researchers today. Therefore, this concept refers to international standards as stated by the following experts:

Green TVET was created to guide vocational education institutions in the world to green education in Indonesia. This is because to achieve the SDGs, and vocational education plays an important role in implementing green TVET in green jobs in each skill, such as for example in sustainable food processing workers must apply green skills. Green TVET model, green campus, green curriculum, green community, green research and green culture. This Green issue is very relevant to several international programs and policies that are carried out, especially related to the SDGs.

The expert view through the above statement shows that the green competencies model is

currently a global issue and refers to international standards such as the SDGs policy which is being examined by many researchers.

Finally, the content aspect relates to that this model is based on the latest knowledge and technology in the environmental field. In this case, this model has shown an alignment with the latest knowledge and technology.

When referring to the blue curriculum (green competencies) that is currently being researched, the implementation that will be carried out in VHS or vocational schools, there are 7 things that should be a concern, namely: (1) Transforming educational spaces; (2) Empowering education; (3) Flexibility and hybridity; (4) Students as central actors of learning: (5) Cooperation with community; (6) Cross-cutting competencies; (7) 'Glocal' Futures: Curricula Work Across Scale: The curriculum is an important thing or point to implement something, for example according to competencies and KKNI so that there must be limitations in learning outcomes.

This green competencies model already refers to concepts such as the blue curriculum which is currently the focus of researchers, especially in the concept of vocational education curriculum. This makes it even stronger that the green competencies model is worth using. However, this green competencies model has not fully accommodated the existing problems, such as some experts pointing out that the model does not touch several important aspects such as:

The clean water crisis is a major concern in the context of environmental issues and environmental awareness. We usually use groundwater so that is a big concern.

In this case, the context that appears in the model is only related to air pollution, not mentioning pollution such as water, soil and others.'

Construct Aspect

The construct aspect reviews several things related to the construct of the model that has been made, as for several things such as clarity of description, there are specific and measurable indicators or criteria, whether the model can be implemented, whether there is a clear relationship between one competency and another and finally the structure and sequence of competencies in the model is logical and supports learning. First, regarding the description contained in this green competencies model, is it clear and easy to understand? The description of each component must be clear and understandable. Some experts mentioned in this aspect that some descriptions should be explained in more detail:

Points can be further described for clarity

From this statement, the description of several components in this model needs to be described in more detail to make it clearer, such as:

Innovation is very important in this competency point, maybe what is meant by innovation here is like recycling waste to become a product.

It is clearer that the description of each component is more specific as in the competency of innovation, it must lead to activities such as solving environmental problems. The next important aspect of the construct is whether the indicators or components in the model are specific and measurable, here are some experts giving responses such as;

The description is further reduced with more specifics to be applied in VHS. For example, communication can be reduced to several more specific things, for example oral, writing, listening etc.

Based on the above statement that the model must be described specifically as in communication skills, it is more described in detail because communication is not only speaking but there is oral communication, writing, listening and listening.

The next aspect that is no less important is whether this model can be easily implemented, in this context the implementation of the model is into the vocational education curriculum. Some experts argue related to this starting from such urgency;

After the existence of this model, the next stage needs to be; (1) Development of environment-based curriculum; (2) Development of environmentally friendly support systems; (3) Development of environmentally friendly school management.

It is important that this model can be integrated into the vocational education curriculum. With this model, the next hope is that;

The urgency of the green competencies framework in the vocational curriculum equips students to be aware of the environment in which they live comfortably. So that they have a responsibility to themselves and the environment aware of sustainable living is not stuck to problems and continues to innovate with existing problems.

This green competencies model is very important to be developed in the vocational education environment with many problems in environmental issues. In addition, vocational education is the spearhead because they will fill the pisis in jobs according to their fields that must have green abilities. Furthermore, the construct aspect in this model model is whether there is a clear relationship between one competency and another. Some experts argue that the competencies in green competencies are closely related to each other as stated;

Green awareness can be applied first so that it will have an impact on behavior that will change. Currently there are many elective subjects, and environmental awareness can also be an elective subject. electrolyte worm water waste is fertilized into trees so that trees die. The available elective

subjects are only based on, for example, Javanese language, etc. Maybe it can be added with environmental awareness With regard to the environment, there is a lot of human-generated waste such as banners that are disturbing and difficult to recycle. Innovation is very important in this competency point, such as recycling waste into products. This is a combination of awareness and behavior Awareness first, then it becomes a habit.

Some of the opinions above are indicators that the competencies in this model are related. Finally, in the construct aspect, an important concern is the structure and sequence of competencies in this model, whether it is logical and supports learning. Some experts argue related to this such as;

There are several things in these competencies that can be made into 1 family. Actually, knowledge, value, ability, attitude. For example, attitude with awareness becomes one. commission norma With Latintable production Latintable production with ratings ratings special communicatepespes compatible home vulnerability stand Severing home skills enter list him ty provide him ty (1) Green awareness is more about values, attitudes and habits, it does have an impact based on example. (3) Green Knowledge. In the OECD, there are 3 knowledge, namely discipline knowledge that masters science in its field, interactive knowledge, namely how a person relates his knowledge to other fields of science. The third is practical knowledge, knowledge that is practiced or implemented in life. Green Skills, Skills focuses on communication, which is to convey the importance and communicate green skills. But not only one way communication, but there must be 2-way communication that can make others aware of the importance of green skills. Green Behaviors, Changes in behavior, especially in the goal of greening.

Based on some of the statements above, some experts commented, especially in terms of the structure of the existing competency sequence, such as the need for structural changes in aspects, for example combining 2 aspects into one aspect such as awareness with attitude, knowledge with ability. Even additional aspects are recommended such as.

The question is, how will all these points be implemented so that all competencies become a single unit that strengthens. All must be based on religious/spiritual competencies. The reference of the founders emphasizes that education must increase faith and piety. Must be sourced from the truth.

The spiritual competencies aspect is recommended to be an additional aspect to complete the integrity of this green competencies concept because basically education today must be sourced from the truth.

From the various statements above, after reviewing both aspects, it can be concluded that overall both the content and construct of this model are suitable for implementation, especially as a reference for workers and prospective workers. Although some things are important notes from

some suggestions that must be improved such as;

1) Description needs to be explained further

2) Some components need to be explained more specifically

3) Some aspects of the dimensions should be combined because they have the same family such as awereness with attitude and knowlage with abilities.

Content Validity Index

In the FGD, participants were given the opportunity to assess in a questionnaire related to the aspects that were being assessed. As for some of these aspects such as Content Validation and Construct Validation, the content validation aspect has items and construct validation has 5 items with 5 alternative assessment scales. The data results were analyzed using the content validity index, the results of which can be seen in table 3 below.

Table 3. Results of content validity index calculation

No	*Aspect*	*Proportion relevant*	*I-CVI*	*Description*
1	The model is relevant to the current needs of the industrial sector	1	1	
2	The model is in line with the objectives of vocational education	1	1	
3	The model is in line with applicable international or national standards	1	1	
4	The model is based on the latest knowledge and technology in the environmental field	1	1	
	Content Validation (S-CVI/Ave)		1	Valid
1	The description contained in the model is clear and easy to understand	1	1	
2	The indicators or evaluation criteria listed are quite specific and measurable	1	1	
3	This model can be implemented easily in VHS	1	1	
4	There is a clear connection between one competency and another in this model	1	1	
5	The structure and sequence of competencies in this model are logical and support effective learning	1	1	
Construct validation (S-CVI/Ave)			1	Valid
Overall model validity (S-CVI/UA)			1	Valid

The validity of a model depends on the number of experts who give an assessment, while in the research the experts involved were 7 people, based on (Lynn, 1986) six to eight experts at least get a value of 0.83. As for the overall model (S-CVI / Ave) get a value of 1> 0.83 and declared valid.

Improvements Model

The following are the results of improvements suggested by experts, especially in the construct aspect. As for the structure of the results of the improvement of the green competencies model can be seen in Table 4 below.

Email : joves@mpv.uad.ac.id
Website : http://journal2.uad.ac.id/index.php/joves

Table 4. Improvements Model Green Competence

Dimension	*Subdimension*
Green Attitude	Awareness of the impact of air pollution
	Environmental awareness
	Awareness of environmental issues
	Awareness in environmental protection
	Attitude towards the importance of environmental education
	Attitude towards caring for the environment
	Attitude towards the importance of environmental protection
	Respect for nature and society
Green Knowledge	Knowledge related to compliance with law and order and environmental sustainability regulations
	Knowledge related to environmentally friendly issues
	Knowledge related to recycling
	Understanding of the natural environment
Green Abilities	Able to provide solutions to environmental problems
	Able to take responsibility for environmental sustainability
	Able to access waste treatment facilities
	Able to access sustainability service system
Green Skills	Communication skills
	Innovation skills
	Analytical thinking skills
	Leadership skills
Green Behaviour	Actions to protect the environment
	Behavior for environmental conservation
	Reuse and recycle behavior
	Behavior to produce environmentally friendly products

After being improved, some aspects, especially some dimensions, were merged, such as the green awereness dimension with attitude into the attitude dimension. The decision to determine the name of this dimension is based on Bloom's taxonomy relating to knowledge, attitudes and skills. Then the researcher combines the 4 largest subdimensions of the two so that each new dimension has 8 subdimensions except the dimensions of green skills, green abilities and green behavior which have 4 subdimensions. The results of the improvement are also found in the description of the definition of each dimension and subdimension of the green competencies model that is more advanced and specific. The following is presented the results of the improvement of the definition of dimensions and subdimensions of the green competencies model in the following tables 5-9:

Table 5. Descriptions of The Green Knowlage Dimension

Dimension/Subdimension	*Description*
Green knowledge	Refers to knowledge related to the environment, which includes concepts and their relationship with nature and ecosystems, personal awareness, curiosity and ability towards the natural environment.
Knowledge related to compliance with law and order and environmental sustainability regulations	Understanding of laws, regulations, and policies governing environmental conservation and the importance of complying with these rules to maintain ecosystem sustainability (Queen et al., 2024).
Knowledge related to green issues	An understanding of practices and technologies that support environmental sustainability, such as renewable energy, energy efficiency, and environmentally friendly products (Queen et al., 2024)(Japhet, 2022).
Knowledge related to recycling	An understanding of the process and importance of recycling materials to reduce waste, conserve resources, and reduce negative impacts on the environment (Japhet, 2022)
Knowledge of the natural environment	Knowledge of ecosystems, biodiversity, and the interactions between living things and the physical environment that sustain life on earth (Wu et al., 2016).

Table 6. Descriptions of The Green Attitude Dimension

Dimension/Subdimension	*Description*
Green Attitude	Psychological tendencies that evaluate perceptions and beliefs about the natural environment, with a focus on preservation.
Attitude towards the importance of environmental education	A positive view and appreciation of the importance of environmenta education as a tool to increase awareness and knowledge of environmenta issues..
Environmental stewardship	A genuine and active concern for the condition and sustainability of the environment, and a desire to contribute to its protection and preservation.
Attitude towards the importance of environmental protection	Belief in and commitment to the importance of protecting the environmen from damage and efforts to promote actions that support ecologica sustainability.
Respect for nature and community	Appreciation and respect for the beauty and value of nature, and for the role of communities in maintaining the balance of ecosystems and local culture
Awareness of air pollution impacts	An individual's or community's understanding of the negative effects of air pollution on human health, the environment and quality of life. This includes knowing air quality alerts and air quality perspectives(Mirabelli e al., 2020)
Environmental awareness	Concern and understanding of the importance of maintaining and preserving the environment for human well-being and ecosysten sustainability(Miñan-olivos et al., 2023)(Wusqo et al., 2022)(Kencanasar et al., 2019).
Awareness of environmental issues	Pengakuan dan pemahaman terhadap isu-isu lingkungan yang dihadapi seperti perubahan iklim, pencemaran, dan deforestasi, serta dampaknya terhadap kehidupan (Miñan-olivos et al., 2023)(Wusqo et al. 2022)(Kencanasari et al., 2019).
Awareness in environmental protection	Willingness and proactive action to protect and care for the environmen through sustainable behaviors, policies and practices. This includes recycling, reducing waste, and participating in conservation efforts (Miñan olivos et al., 2023)(Wusqo et al., 2022)(Kencanasari et al., 2019).

Table 7. Descriptions of The Green Skills Dimension

Dimension/Subdimension	*Description*
Green skills	Green skills are the application of theoretical knowledge competencies into practice in environmental conservation and sustainability activities.
Communication skills	The ability to convey information, ideas, and feelings effectively and clearly, both orally and in writing, as well as to listen to and understand messages from others. Conveying ideas and information orally is a form of verbal communication that involves the ability to convey ideas, thoughts, or messages to others through spoken words. While conveying ideas or information in writing involves organizing and conveying ideas, thoughts, or messages through written words, for example, writing invitations in posters, blogs to writing in papers. Understanding written material involves the ability to read, analyze, and interpret text well. This includes understanding the meaning of words, sentences, and ideas conveyed in a piece of writing. Active listening involves paying full attention to the speaker in order to understand, interpret and respond well to what is being said. It is more than just hearing; active listening involves mental and emotional engagement with the message being conveyed (Handayani et al., 2020)(Zulfadly et al., 2021).
Innovation skills	The ability to create new ideas, solve problems in creative ways, and implement innovative solutions that can improve processes, products, or services especially in environmental issues.
Analytical thinking skills	The ability to analyze information, identify problems, critically evaluate data, and make decisions based on logic and evidence.
Leadership skills	The ability to motivate, guide and direct others in achieving a common goal, and to take initiative and responsibility in a variety of situations.

Table 8. Descriptions of The Green Abilities Dimension

Dimensi/Subdimensi	*Deskripsi*
Green abilities	Green abilities are an individual's ability to integrate knowledge and skills in the natural environment to solve environmental challenges.
Ability to provide solutions to environmental problems	Ability to identify, analyze, and design and implement effective solutions to address environmental issues.
Ability to take responsibility for environmental sustainability	Awareness and ability to take actions that support environmental sustainability and preservation, and minimize negative impacts on nature.
Ability to access waste treatment facilities	Ability to know and utilize available services and technologies for safe and efficient waste treatment.
Able to access sustainability service systems	The ability to know, understand and use services and infrastructure that support sustainable practices in various aspects of life.

Table 9. Descriptions of The Green Behavior Dimension

Dimensi/Subdimensi	*Deskripsi*
Green Behaviour	Behavior that causes employees to work sustainably, conserve resources, prevent others from engaging in environmental degradation, initiate actions to protect the environment and stop environmental damage.
Actions to protect the environment	Concrete steps taken to prevent environmental damage, such as reducing the use of hazardous chemicals, keeping the environment clean, and supporting nature conservation.
Behavior for environmental conservation	Sustainable habits and practices to maintain and preserve the environment, such as saving energy, planting trees, and reducing waste.
Reuse and recycling behavior	Habits of reusing items that can still be used and reprocessing used materials into new products to reduce waste and use of natural resources.
Behavior to produce environmentally friendly products	Efforts in the production process to create goods that have minimal negative impact on the environment, such as using renewable materials, efficient production processes, and reducing emissions and waste.

Discussion

The FGD results get some important responses to be discussed as in the first discussion related to the urgency of model development. In this discussion, all experts gave their views, starting from curriculum experts who said that this development activity was very meaningful for current developments. Green competencies if associated with the curriculum then refers to the concept of green curriculum or now already at the stage of blue curriculum. This development is one of the supports towards the blue curriculum (UNESCO, 2022). Material experts strongly support this model because it supports the application and challenges in Green issues, especially in TVET which is currently an important part in various countries including education in Indonesia. That is because to achieve the SDGs and vocational education plays an important role in implementing green TVET in green jobs in each skill, such as for example in sustainable food processing workers must apply

green skills. This is in line with the concept described in the guidelines made by UNESCO-UNEVOC (UNESCO, 2024).

The school representatives gave opinions regarding the urgency where the green GC model is still not common, only a few SMKs have implemented and focused on this issue. Even though this is an important part of supporting the SDGs, more concretely in developing competencies, especially in the field of mechatronics, this model is needed. Although some activities or programs in schools have led to the concept referred to in this model, such as implementing green environment programs, especially in handling waste produced from practices such as in batik, textile and metal majors that produce waste. Then the efforts or programs that are promoted such as making attractive landfills so as to increase the attitude and awareness of students to dispose of garbage in its place.

Efforts to integrate the issues of this model are still limited to certain subjects such as in P5 subjects (Pancasila Student Profile Strengthening Project) and IPAS subjects. It already exists but this is not specific, it is formal and has not become a general policy of the curriculum developed. So it can be concluded that in the implementation of vocational education, especially in the vocational education curriculum, there is no clear and specific framework in implementing this green competencies model. This is in line with research conducted by (Makinde & Rafiu, 2020) which states that in the implementation of TVET, the incompatibility of the curriculum with the SDGs concept will cause the potential of TVET in supporting this concept. Then this is also discussed in (Mustapha, 2017) they state that there are still several obstacles in the implementation of vocational education that supports green sustainability, one of which is the slow response of educational institutions in creating an appropriate curriculum.

Industry sector representatives argue that this model is needed in the world of work, especially the automotive and batik industries. In the automotive industry, the waste produced is very dangerous if not handled, such as oil and automotive engine or body parts. This requires special handling so that concepts such as those expressed in this model are very relevant to be applied. These results are in line with research (Ismail et al., 2019) that this study emphasizes the need for skilled technical workers in the automotive industry to have green competencies, including knowledge of sustainable practices, environmental regulations, and environmentally friendly technologies, to increase productivity and customer satisfaction while contributing to sustainable development.

In addition, the batik handicraft industry also gave the same voice that the waste generated from practices in the batik industry needs to be handled by people who have capabilities such as those in

this framework, especially those who adhere to procedures. This is in line with the view of (Shofari et al., 2022) that the batik industry needs green competencies such as waste management, sustainable production techniques, and environmental impact assessment. These skills are essential to increase productivity while minimizing pollution and ensuring compliance with environmental standards, as highlighted in the Green Productivity approach. In addition, other views agree with this such as (Hatammimi & Gunawan, 2023) the need for sustainable practices in the batik industry, emphasizing the importance of developing green competencies related to production waste management, responsible consumption, and compliance with Green Industry Standards to reduce environmental damage.

The second discussion was related to the validation of the model which was carried out with a mechanism delivered directly in the form of criticism and suggestions as well as in the form of an assessment where experts filled in the rubric that had been given. Curriculum experts and material experts agree that based on the construct there are several dimensions that have intersections so that they can be combined into one dimension such as the dimensions of green attitude and green awerenes are the realm of values. This is in line with research (Ogiemwonyi et al., 2020)(Ogiemwonyi et al., 2020), which states that green attitude and green awerenes are indeed related to the realm of values, because they reflect individual concern for the environment, influenced by personal values such as self-transcendence and openness to change, which guide behavior and attitudes towards ecological problems. Then in the description to be explained further. This is in line with the exposure of curriculum experts recommending the existence of new competencies that are important to be embedded in this model, namely spiritual competencies.

Expert references emphasize that education must increase faith and piety and be sourced from the truth. This is in line with the opinion of (Ogiemwonyi et al., 2020) that spiritual competencies in green competencies include personal spirituality, spirituality in professional practice, and eco-spirituality, which collectively increase an individual's knowledge, confidence, and willingness to act sustainably, fostering a deeper connection with environmental management and responsible action for sustainability. Moreover, spirituality is one of the seven competencies for sustainability proposed in this study, emphasizing authentic concern for others (Mahmood et al., 2022).

After discussing the responses and input, the experts' discussion related to the Likert scale-based model feasibility assessment with reference to the two main assessments, namely content and construct, stated that the designed model was valid with a value of (1>0.83) (Yaakop et al., 2023)(Yusof, 2019). This makes the green competencies model worthy of reference. The comments related to the content are relevant and appropriate but the construct still needs improvement. The

model was redesigned as feedback to suggestions from experts. In terms of contractual improvements related to the merging of dimensions, namely between the attitude dimension and the awerenes dimension because it is considered to have the same aspects so that in the end the green competencies model consists of green knowlage, green skills, green attitude, green abilities and green behavior (UNESCO, 2024).

Conclusion

This model has gone through the stages of expert validation through FGDs regarding its feasibility (1>0.83) and has been improved to perfect its construction elements as feedback for each criticism and suggestion, so it is ready to be used as a recommendation to be integrated in the vocational education curriculum. This model can be used by vocational education graduates to serve as a reference in developing green competencies in order to fulfill the needs and requirements in the world of work. The green competencies model guides graduates by instilling five main competencies namely green knowlage, green skills, green abilities, green attitudes and green behaviors along with the sub-competencies of each competency. Then this model is equipped with a description of each element that makes it easier for users to understand the indicators in each dimension in the model. This development is closely related to the philosophy of vocational education, especially in the philosophy of lifelong education, educational transformation and sustainable education. So that it can contribute to supporting the SDGs program, especially in the aspect of quality education (SDGs 4). This model is expected to be a reference, especially in developing student competencies in the implementation of vocational education in Indonesia which can increase the competitiveness of graduates to work in the labor market, and answer challenges and changes towards green TVET.

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