

Teaching Material Supplements Based on Local Genius in Biology Learning

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Abstract. The Education for Sustainable Development (ESD) agenda is a challenge for countries in the world, including Indonesia. The multidisciplinary approach and interconnectivity between subject matter and socio-cultural contexts that characterize ESD is a challenge. This is because so far most of the learning in Indonesia is still running partially. Indonesia and Bali in particular have cultural values that are relevant to ESD. The purpose of this study is to analyze the relationship between local wisdom and local genius in learning. 2) Analyze the integration of teaching material supplements for the local genius values of the Balinese people in the Biology learning process. This research is a qualitative descriptive study that examines local wisdom learning materials that can be used as a supplement to biology teaching materials. The results showed that: 1) Local genius is a more specific basic framework to be used as a teaching material supplement, but it has universal values so that it can be implemented anywhere as long as it has the same conditions. 2) As for biological material that can be integrated with values local genius of Balinese people, namely, Classification/Taxonomy, Plant Physiology, Ecology, Digestive System, Excretion System, Reproduction System, Immune System, Conservation, Human Anatomy Physiology. These learning materials are very useful in developing supplementary teaching materials, modules, and books that are relevant to students' environments, especially in Bali. In addition, this material can also be used as a reference for other ethnobiological research in learning to realize ESD agenda.

INTRODUCTION

The Education for Sustainable Development (ESD) agenda is a challenge for countries in the world, including Indonesia. ESD does not only offer an environmental education agenda but also is broader to socio-cultural factors, political quality and human quality, democracy, democracy (1). That is, ESD focuses on an education system that is multidisciplinary and aims to improve the quality of human life in balance with the environment. As an illustration, to find out students' understanding of multidisciplinary systems or interrelationships, students must be able to connect ecological, economic, political, and social systems in their environment.

Multidisciplinary ESD practices will at least be faced with two paradigms that become social challenges in education (2). First, the perception of school as a place to live, where real-life situations and students' perspectives on life are discussed. Second, the opportunity for students to shape the learning process as a work situation so that they can practice responsibility and see themselves playing a role in their environment. Furthermore, based on these two paradigms, Posch in Rauch (2) formulated several questions about the existence of education in facing these social challenges. First, how can schools convey to students that they are important actors in social life? Second, how can schools combine the processes of transfer, assessment, and application of knowledge and create an appreciative, critical, and reflective attitude towards knowledge? Third, how can schools contribute to social development where rules and norms are becoming increasingly important? Fourth, how can schools create a collaborative atmosphere between students?

The answers to these questions will be quite difficult to find in the context of education in Indonesia because most of the implementation of education in Indonesia is still partial. Interconnectivity has not been developed optimally between the subject matter received by students at school and the context of their socio-cultural life. Suryana (3) said that most of the learning systems in Indonesia until now are still too oriented to mastery of theory and memorization. Students are not guided consciously and plan to relate the theory they learn to real-life contexts. This will then cause the knowledge received to be less meaningful and further away from the realization of the ESD agenda.

As a starting point for realizing the ESD agenda in education in Indonesia, it is necessary to systematically integrate learning materials in schools with the local socio-cultural context of students. This integration can be in the form of various forms of learning tools, one of which is teaching materials. This is also supported by UNESCO

(4) which explains that the implementation of ESD can be in the form of subject matter. Teaching materials are a set of subject matter that are systematically arranged so that they display complete competencies that must be mastered by students during the learning process (5). Furthermore, by using teaching materials, students are expected to be able to gain holistic knowledge of a subject matter.

In the context of education in Bali, various cultures are relevant to ESD so that they can be part of the integration between subject matter and the socio-cultural context of students. One of the relevant subject matter and culture is biology and *Tri Hita Karana*. Biology is the science of living things and their environment. Meanwhile, *Tri Hita Karana* is the three causes of happiness in life. It consists of three components, namely spiritual (*parhyangan*) which is defined as the relationship between humans and God, social (*pawongan*) which is defined as the relationship between humans and others, and natural (*palemahan*) which is defined as the relationship between humans and the environment (6). Based on this understanding, biology and *Tri Hita Karana* have principles that are relevant to ESD. Hermawan & Susilo (7) also support this statement because *Tri Hita Karana* correlates with environmental literacy which is part of ESD.

In practice, the *Tri Hita Karana* culture needs to be defined in a simpler form, namely local wisdom and local genius. As it is known that culture is a complex thing, it is very easy to experience multiple interpretations. Therefore, this definition becomes an important thing so that in the process of integrating the subject matter in schools with the socio-cultural context there is no misunderstanding. For this reason, this study aims to 1) define the relationship between culture, local genius, and local wisdom in learning and 2) analyze Balinese local genius that can be integrated as a supplement to biology teaching materials to support the ESD agenda.

METHODS

The method used in this study uses a descriptive qualitative literature review method by referring to reference sources relevant to the context of local genius in biology learning. By integrating findings and perspectives from many empirical findings, a literature review can address the research question with a power that no single study has (8).

RESULT AND DISCUSSION

The linkage between Local Wisdom and Local Genius

In the dictionary sense, local wisdom consists of two words: wisdom (wisdom) and local (local). Echols & Syadily in Sartini (9), local means local, while wisdom is the same as wisdom. Generally, the local wisdom (local wisdom) can be understood as the ideas of local(local)that are wise, full of wisdom, good value, embedded, and followed by members of the community. Meanwhile, local genius is a cultural identity, identity, or national cultural personality which causes the nation to be able to absorb and cultivate foreign culture according to its character and abilities (10). Furthermore, Geriya in Sartini (9) reveals that local genius is human wisdom that rests on the philosophy of values, ethics, methods, and traditional institutionalized behavior. Local wisdom in the 21st century is a guide to thinking in developing multicultural education in Indonesian elementary schools, and if local wisdom exists in everyday life, the Indonesian people have carved out the beauty of behaving in civilization itself (11). Teaching character education in the higher education based on local wisdom could be conducted by integrating values and aesthetics in the course, internalizing positive values to students, habituation and training, providing example and model, creating characterized-situation based on local wisdom, and civilizing. Value-based vision of study program or campus can be achieved through educational strategy formulation including value habituation, value role model, value internalization, value integration in learning, and cultural value (12). Furthermore, recent study found that there was a positive and significant correlation between problem-solving skills (PSS) and communication skills (CS) when lecturers apply Local Wisdom-Based ELSII Learning Model (LWB-ELSII) as an alternative solution in improving students' performance (13).

Local genius is a value that is considered good and true so that it can last a long time and even become institutionalized. Thus, it can be concluded that the actual local genius is part of the local wisdom that exists in the local community. Local genius is the values, ideas, procedures, techniques of the local community that are endemic and do not exist in other regions but have universal values and can be applied anywhere according to the context. The relationship between knowledge, local wisdom and local genius is shown in Figure 1.

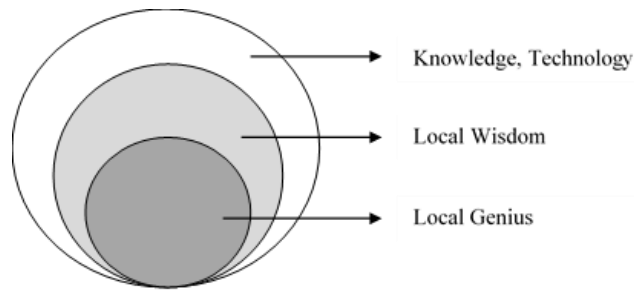


FIGURE 1. Relationship between Knowledge, Local Wisdom, and Local Genius

Although Local genius is endemic or exists only in certain areas, its scientific values or truth can be universally applied in the same context. Like *subak*, *subak* is one of the products local genius of the Balinese people, only in Bali. However, *subak* in its application can be implemented in various parts of the world that have irrigation systems in their rice fields.

Integration of Contextual Learning Model with Values Local Genius Balinese in Biology Learning Process

Integration of Contextual Learning Model with values local genius of Balinese society not only through suitable learning environment conditioning but also by paying attention to teaching materials that are following characteristics the local genius. In general, *Tri Hita Karana* is the grand local genius theory as a basis for other local genius values in Bali. *Tri Hita Karana* comes from the root word *Tri* which means three, *Hita* which means happiness, and *Karana* which means cause. Thus, *Tri Hita Karana* can be defined as the three causes of happiness in humans (14–18). *Tri Hita Karana* consists of three underlying aspects, namely *pawongan* (social harmony), *palemahan* (ecological harmony), and *parhyangan* (theological harmony).

The ability of science literacy can be improved by taking into account the characteristics and potential of students, and the development of teaching materials, which is accordance with student learning environment (19). The following (Table 1) describe biology learning materials that can be integrated with Balinese local genius aspect:

TABLE 1. Integration Local genius material in Biology Learning Material

No.	Learning Material	Local Genius	<i>Tri Hita Karana</i> Aspects
1	Classification/Taxonomy	<i>Tri Premana</i>	<i>Pawongan dan Palemahan</i>
2	Plant Physiology	<i>Tumpek Uduh</i> "meme pertiwi, bapa akasa" <i>Surya Raditya</i> (Photosynthesis) <i>Yadnya</i>	<i>Pawongan, Palemahan, and Parhyangan.</i>
3	Ecology	<i>Kertamasa</i> "meme pertiwi, bapa akasa"	<i>Parhyangan, Pawongan, and Palemahan</i>
4.	Digestive System	<i>Megibung</i>	<i>Pawongan</i>
5.	Excretion System	"Upas"	<i>Pawongan, Palemahan</i>
6.	Reproduction System	<i>Upacara megedong gedongan</i> (Fertilization) <i>Menek kelih/Raja Sewala</i> (Gametogenesis)	<i>Pawongan, Parhyangan, Palemahan</i>
7.	Immune System	<i>Tradisi Mekotek, upas</i>	<i>Pawongan, Parhyangan, Palemahan</i>
8.	Conservation	<i>Tumpek Kandang</i> <i>Tumpek Wariga</i>	<i>Pawongan, Parhyangan, Palemahan</i>
9.	Human Anatomy Physiology	<i>Dasendria</i>	<i>Pawongan, Parhyangan, and Palemahan</i>

First, when studying the characteristics of living organisms or taxonomy of living things from the simplest up to the classification of the five kingdoms proposed by Whittaker can be inserted supplement local genius as follows: Life comes from the encounter *sukla* and *swanita* produce three types of life (*Tri Premana*), namely:

1. *Stavira* (Plants): which was created first by *Hyang Widhi* who only has *eka pramana* (*bayu/energy*);

2. *Janggama* (Animal): the second created by *Hyang Widhi* who has *dwi premana* (*bayu* and *sabda*) with the ability to move and speak.
3. *Manusa* (Human): the third was created with three abilities, namely *bayu*, saying *idep* so that humans can move voices and think (20,21).

Second, integration of local wisdom values with contextual models related to hormonal material in plants physiology. When the ceremony *Tumpek Uduh* is believed as a ritual of worshiping plants, namely *Lord Sangkara*, which falls on 25 days before *Galungan* day, Hindus carry out the ritual of injuring trees with knives or sharp weapons with the following mantra: "*Kaki kaki, dadong dadong nyanan nyangra rahina galungane mangde mebuah ngeed, ngeed ngeed*" (while scratch the tree)(22,23). The scientific value contained in it, namely *kaki* which means grandfather and *dadong* means grandmother. Balinese people realize that phylogeny or the evolutionary line of plants existed earlier than humans, so they are called *kaki* or *dadong*. Trees that are injured by using a weapon or knife will activate the tourmaline hormone. Tourmaline acid is a plant hormone that plays a role in the cell regeneration process when the plant is damaged or injured. The tissue will form callus (undifferentiated tissue) on damaged or injured tissue. The principle of the relationship between light intensity and agricultural plant productivity associated with the photosynthetic process is empirically recognized by farmers in the concept of *ngenyatin* (ie leaving the paddy fields of rice plants to dry until they break open), to stimulate rice to grow faster. Scientifically, sunlight can change acidic soil due to waterlogging to neutral after the water is dry (but still humid), so that the photosynthesis and respiration processes in rice roots can take place optimally.

Furthermore, in the perspective of the local genius of the Balinese people, the sun has a high position in the community's belief known as *Surya Raditya*. In this context, the Balinese people believe that the sun is the source of all sources of energy and life in this universe. So that priests or *sulinggih* in Balinese society routinely worship the sun god on a priority scale during the morning before sunrise and is known as the *Surya Sewana* ceremony. Scientifically, this ceremony means that in the process of photosynthesis, which provides nutrition for all living things, it is always triggered by electrons that come from the photolysis process from sunlight. Furthermore, the process of photolysis of water will be discussed in a special topic, namely photophosphorylation in plants.

On the other hand, as photoautotroph organisms that can make their food, plants have an extraordinary role through the process of photosynthesis. From the perspective of *Tri Hita Karana*, namely ecological harmony, it is closely related to the term "*Meme Pertiwi, Bapa Akasa*" which is the place we step on (land or land) as Mother, and the sky we see is our Father. (24). This Balinese philosophy means that land or land as our mother always provides physical, chemical, and biological needs for plants. Physically, soil or land is the foundation or substrate where plants grow. Chemically, the intake of nutrients needed by plants can always be met by the soil or land, both in the form of macronutrients and in the form of micronutrients. And further biologically, there is an interaction between plants and other living things in the form of symbiosis, competition, predators, and others that can create harmony in the form of a food chain or web chain in an ecosystem. On the other hand, the sky as a father means that the sky always protects plants by providing sunlight and oxygen as one of the main components needed in the process of photosynthesis. This meeting of the Father (space) and Motherland (land/land) will give birth to life. Scientifically this is very relevant to the concept of photosynthesis which requires sunlight and oxygen from space and nutrients from the soil/land to create life.

From the perspective of *yadnya*, which is a sincere sacrifice made by plants, then what plants do in the process of photosynthesis can also be called the main *yadnya* because it supports all life on earth. Plants process something less valuable, namely soil, dirt, micro-organisms of living things, and other inorganic compounds into something very valuable, namely oxygen and carbohydrates that can support life on Earth. Even the waste or garbage from plants can still be used for the plants themselves as fertilizer, as well as for other organisms.

Third, farmers in Bali are also familiar with the system of mass paper in maintaining the optimal nitrogen and carbon cycle for plant growth, especially rice (*Oryza sativa*). *Kerta Masa* is a rule or technique for managing rice fields from the start, when sowing rice seeds, planting rice, harvesting rice to entering rice, into the barn. The mass paper also contains regulations for the provision of certain types of rice (*pengalapan*) to be planted simultaneously. *Kerta Masa* also organize various ritual ceremonies that must be performed from sowing rice until harvest. When the harvest is going to be carried out a ceremony is called *ngusaba nini*. To control pests and repel disease is called languishing. Thus, it can be concluded that the material in learning biology using contextual learning models is very suitable to be integrated with the values local genius of Balinese society. The integration of the contextual learning model with the local genius of the Balinese people in the learning process not only builds awareness and concern from students but also teachers as facilitators in the learning process who inevitably have to master this. Furthermore, the implication of this will be a multi-effect, not only good for the learning process, preservation of cultural values, but also character building which is very important to maintain national identity and personality.

Fourth, the *megibung* procession in Bali has a social context in addition to strong traditions attached (25,26). The *megibung* tradition is held to build a sense of togetherness and the strength of friendship and brotherhood. All *megibung* participants are the same, no one is rich or poor and no one is educated or uneducated (25). From a biological perspective, *megibung* is a culture that teaches Balinese people to eat together and chew food slowly

and gradually. Chewing food gradually and slowly aims to respect other individuals who participate in participating in *megibung*. This scientifically will facilitate the peristaltic movement of participants in swallowing food.

Fifth, the *upas* material in biology learning is material related to the excretory system and the immune system. *Upas* in Balinese society is defined as a disease of immune system disorders or toxins found on the skin. Usually, *upas* can be caused by dermatitis and skin allergies (27). In the *rare usada lontar*, symptoms of *upas* experienced by children are found, as for the *upas* disease as follows:

1. If the child feels weak without energy, it is called *upas tawun* disease;
2. If there are visible red lines on the fingernails of the child it is said to have *upas hyang* disease;
3. If the child's fingernails appear to have blood clots, it is said to be infected with *upas warangan* disease;
4. If the child's eyes look yellow and slightly reddish, it is called *upas dewe* disease;
5. If the child experiences nausea or vomiting, accompanied by nausea, shortness of breath, the disease is called *upas uyak* disease;
6. If the child only feels nauseous and feels nauseous, it is called *upas silali* disease

Sixth, In Balinese Hindu culture, there is a special ceremony called *menek kelih* or *raja sewala*. This ceremony is a ceremony performed on teenagers when the child reaches adulthood which aims to ask *Hyang Semara Ratih* to be given a good way and not mislead the child as mentioned in this ceremony as a *menek deha* ceremony (*raja sewala*) (28,29). In the mythology of *Hyang Semara Ratih*, which is a pair of gods and goddesses as a symbol of love full of desire and loyalty, and sacrifice. The story is told in *Lontar Cundamani II*. During the ceremony, the parents will pray for the son and advise that he has grown up from childhood so that there is a greater responsibility on him. At this time, parents also provide an understanding that there have been physical changes as a result of sex hormones in men with the characteristics of developing secondary genitals such as a heavier voice, growing mustache, and hair in certain areas, chest growing to be broader.

Seventh, the *mekotekan* tradition is a tradition that generally resides in Badung village, this ritual is held with the aim or as a procession of rejecting Bala, protecting from disease, and asking for safety. The hereditary inheritance from the ancestors of the Munggu villagers, especially Hindus, the procession is always routinely carried out from generation to generation by the next generation or residents every 210 days, exactly 10 days after the *Kuningan Day*. (30). The *mekotekan* tradition carried out by the Munggu village community is closely related to the psychological aspects that can increase a person's immunity.

Eighth, *tumpek kandang* is a ritual performed by Hindus to worship God in his manifestation as Lord *Siwa Pasupati* or *Sang Hyang Rare Angon*. The implementation of the *tumpek kandang* ceremony is not only shown to the animals in *bhuwana agung*, but also to the animals in *bhuwana alit* (31). The implementation of *tumpek kandang* implies that humans must always preserve the animals that exist in their natural surroundings. Using or utilizing certain animals means also participating in conservation and preservation efforts.

Ninth, *dasendria* means ten senses found in humans, but in *Lontar Tuttur Kumara Tattwa*, *dasendria* is defined as ten passions which means that if the ten senses in the body are misused it will become a passion that causes humans to be reborn (*punarbhawa*). *Dasendria* consists of the *Panca Bunddhindria*, in this case controlling the five senses of taste, namely: 1) *Caksundria* (stimulus of sight; the sense of eye), 2) *Srotendria* (stimulus of hearing; the sense of ear), 3) *Ghranendria* (stimulus of smell; the sense of smell) nose), 4) *Jihwandria* (stimulus of taste, the sense of the tongue) and 5) *Twakindra* (stimulus of touch; the sense of the skin), while the *Panca Karmendria*, in this case, is controlling the five senses of locomotion, namely: 1) *Garbendria* (move of the mouth), 2) *Panindra* (moves on the hands), 3) *Padendria* (moves on the feet), 4) *Payundria* (moves on the organs of release) and *Upasthendria* (moves on the genitals). This classification is very relevant to the classification of the sensory system possessed by humans (32–34).

CONCLUSION

The conclusions from the description of this article can be formulated as follows: 1) Local genius is part of local wisdom that exists in the local community. Local genius is the values, ideas, procedures, techniques of the local community that are endemic and do not exist in other regions but have universal values and can be applied anywhere according to the context. 2) The values of local genius in the contextual model of biology learning can be integrated into various types of topics, namely: Classification/Taxonomy, Plant Physiology, Ecology, Digestive System, Excretion System, Reproduction System, Immune System, Conservation, Human Anatomy Physiology.

The suggestions that can be conveyed in this article can be formulated as follows: 1) It is very important to research further regarding the implementation of contextual learning models based on local genius to improve students' higher-order thinking skills, namely critical and creative thinking. 2) For teachers who are new to applying this contextual learning model, should anticipate the obstacles that might arise, especially for students who have low learning motivation. The encouragement of teachers as facilitators and motivators is very important to increase self-confidence and student learning outcomes.

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