

Pattern of student education in realizing literacy of recycling's principle

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Abstract. The essence of Industrial Engineering science is to contribute in transforming the way of thinking and working of business systems and economies. Industrial Engineering study program at Universitas Pelita Harapan has been trying to complement the gap between theoretical teaching and real practice. The ways to educate students so they are more receptive to the principle of recycling is through theoretical teaching in class, research and real practice. Students and lecturers are also invited to a real practice in realizing their involvement in community recycling and social programs through two programs of continuous study, namely Kaizen Environmental Recycling Class Project (2016-2017) and *UPH Cintai Bumi* program (2018). It is found that 10 lecturers and 148 students involved in the first program, the amount of waste collected in the recycling is 1,075.1 kg and 528 people reached through the external publicity coverage on Facebook with three publications. From the second program, it is found there are 41 types of electronic waste or 307 pieces were collected, and with 7 external publications on *Peduli Sampah Cintai Bumi* Facebook, it can reach 765 people. Furthermore, the project that was previously embedded in the production system class as an obligation for all IE student, now become a voluntary and independent project organized by student association (HMTI). This means, there is a change in the behavior of students, who previously participated in the recycle program mainly because of the obligation, now they do it voluntarily and independently.

1. Introduction

The essence of Industrial Engineering science is to contribute in transforming the way of thinking and working of business systems and economies. The main activity of the industrial sector is to manage the processing of input into a qualified output, which is processed effectively and efficiently. Knowledge without practice, real involvement, and learning through experience and independence, will not be able to provide a meaningful cultural revolution. Industrial engineering science is not neutral, but it can involve from the beginning to the process with various intentions and possibilities by taking different forms, inviting its students to slow down and learn to see reality, to examine the errors of the industrial system and its success, to see the values and the purpose of the industrial science role for a sustainable society model.

Industrial Engineering (IE) study program at Universitas Pelita Harapan has been trying to complement the gap between theoretical teaching and real practice. The ways to educate students so they are more receptive to the principle of recycling is through theoretical teaching in class, research and real practice [1]. Students are equipped with detailed theoretical knowledge about the concept of



lean industry that can strengthen the awareness of students to recognize the waste arise in the industrial process, which gives an impact on the environment. Students are also encouraged to know real condition through research, so they can realize and understand more about business and economic patterns that have not been built on the principle of recycling [2]. Moreover, students and lecturers are also invited to a real practice in realizing their involvement in community recycling and social programs through two programs of continuous study, namely Kaizen Environmental Recycling Class Project (2016-2017) [3] and UPH Cintai Bumi program (2018) [4].

The programs mentioned previously refer to the ecological principles of Capra, through the principle of interdependence, meaning the behavior and existence of each participant in both programs will determine the existence and development of the program as a whole [5]. Through the principle of recycling, it means how the waste collection programs that contain both business and economic aspects are able to run more environment-friendly, that is how the waste is disposed of and collected can be used as energy/material that will be absorbed by other communities for their lives. It is realized that the two previous principles can only be done sustainably, if there are principles of partnership and cooperation among participants. Principle of flexibility means both programs are open to change, flexible to alteration in the form and development of its network, without losing its identity. Through the principle of diversity, meaning both programs accept and absorb the aspirations and influences from outside the program, they receive aspirations both from cross-disciplinary and other internal units/institutions.

According to Gregory Dees (2001), social entrepreneurship is a combination of the passion of a social mission with an image of business-like discipline, innovation, and determination commonly associated with. For social entrepreneurs, the social mission or mission-related impact becomes the central criterion, not wealth creation [6]. According to Mair, Robinson and Hockerts (2006), "the concept of social entrepreneurship (SE) is, in practice, recognized as encompassing a wide range of activities: enterprising individuals devoted to making a difference; social purpose business ventures dedicated to adding for-profit motivations to the nonprofit sector; new types of philanthropists supporting venture capital-like 'investment' portfolios; and nonprofit organizations that are reinventing themselves by drawing on lessons learned from the business world" [7]. Social innovations are defined as new ideas (products, services and models) that simultaneously meet social needs and create new social relationships or collaborations. In other words, they are innovations that are both good for society and enhance society's capacity to act [8]. From some of the above definitions, it can be deduced that social entrepreneurship can be interpreted as an entrepreneurial activity that has the main goal for social benefits.

2. Method

This study aims to know whether the pattern of education delivered so students are more receptive to the principle of recycling, is already able to involve them with various intentions and possibilities to take different forms of participation, while still referring to the ecological principles of Capra. The research conducted is an exploratory research. The research method consists of 4 stages: literature survey, recycling program evaluation, result and discussion, and summary. The framework of this research can be seen in Figure1.

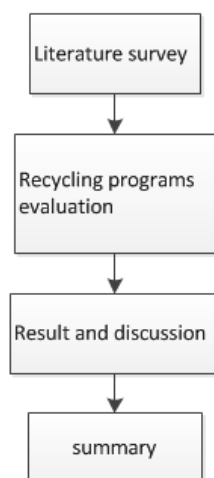


Figure 1. Research framework

3. Literature survey

Based on previous research regarding the prospects of managing e-waste in Indonesia, there were several findings [9]. The survey result shows that 77% of the respondents have heard about e-waste issues from somewhere, but only 8% recycled their old electronics. The main reason they did not recycle their e-waste due to the lack of information and education regarding e-waste management and its impact to the environment [9]. According to Capra, engagement with projects in which their actions have consequences generates in students a strong motivation and emotional connection [5]. Moreover, Capra claims that project-based learning not only provides students with important experiences (co-operation, mentorship, integration of various intelligences) but also makes for better learning [5]. According to Pike, et al., college and universities should take the lead in the sustainability movement, so that they can increase public awareness concerning environmental issues [10]. Their research conducted at Francis Marion University, USA, shows that student living in campus apartments significantly reduced their waste stream, when given recycling bins and some education about recycling [10]. According to Kaplowitz, et al., based on the results from a web-based survey ($n = 3896$, $RR1 = 24.9\%$), it was found that communication efforts for recycling programs should focus more on messages concerning *what*, *how*, and *where* to recycle rather than messages on *why* to recycle [11]. Based on the research conducted by Izagirre-Olaizola, et al, the main internal factors which lead university students from Spain and USA, to participate in recycling activities are motivations, perceived consumer effectiveness, environmental knowledge and gender [12].

4. Recycling program evaluation

Based on the above literature survey, it can be concluded that a real-life project is needed to increase student awareness of recycling activities. Since theoretical environmental knowledge is not enough to generate strong motivation in students to recycle. Therefore, since 2016, Industrial Engineering Department UPH conducted two recycling programs, which have been embedded in class project, as follows:

1. Program of Kaizen Environment Recycling Class Project (2016- 2017). Based on interviewed with Mr. Tukidi, founder of Gawe Rukun waste bank, Tangerang, it is found that the waste bank never get profit, and sometimes the administrators were disappointed because of unrealized commitments from donors to help empower their community. Gawe Rukun waste bank is a pioneer of waste bank in Tangerang city. Since the source of fund for operational cost are self-supported, then the increase both in the number of members and in the amount of waste deposit is very important for the sustainability of this community. The initiative taken by UPH Industrial Engineering

Study Program began to become a member of Gawe Rukun waste bank Tangerang. Innovation that has been made to create a synergy between teaching and learning activities in the classroom with community service activities, involving students and lecturers, is through the program KAIZEN Environmental Recycling Class Project. The activity is divided into 6 phases. The first phase, is the exploration with the Gawe Rukun waste bank, Tangerang. Secondly is educational phase (educate students and lecturers about waste bank). Thirdly is the implementation of the collection of paper waste, plastic bottles and aluminium cans in the classrooms (#B535, #B536, #B537) and laboratories (Industrial control system and Center of Industrial Technology) through the “KAIZEN Environmental Recycling Class Project” Program (can be seen in figure 2 and 3). The forth phase is observation phase from party of the waste bank to the place of waste collection at UPH industrial engineering study program. The next phase is creating the MOU (memorandum of understanding): all the waste collection from the UPH industrial engineering study program will be used for the empowerment of community Gawe Rukun waste bank or Forum KOMPOS Tangerang, which located in Gawe Rukun waste bank. The phase of waste depositing into Gawe Rukun waste bank will be the final phase (Figure 4). Social media technology is used for both internal publication (Instagram) by student association of industrial engineering (HMTI UPH) and external publication (Facebook) by the association of Peduli Sampah Cintai Bumi to educate the community (can be seen in figure 5) [9]. The challenge faced is more internally, namely it is difficult to educate non-industrial engineering students to put the trash in place properly and not littering the place of collection (dedicated to collect bottles and plastics) with other stuff.



Figure 2. The collection site at classroom

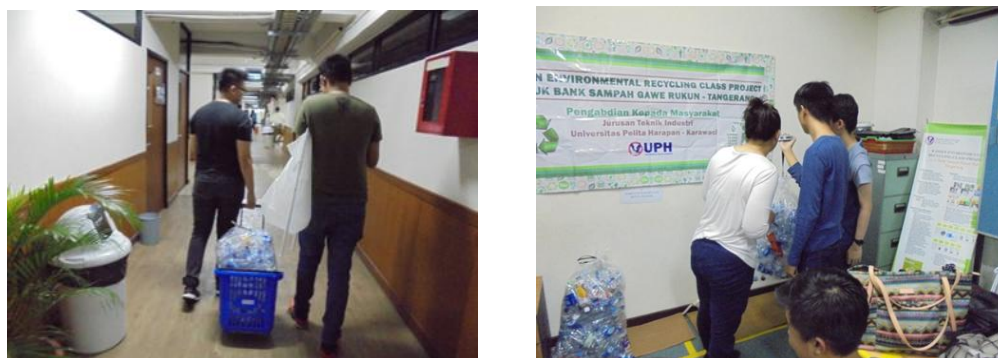


Figure 3. Students involved in the collection and weighing process



Figure 4. The first waste deposit to Gawe Rukun waste bank in 2016

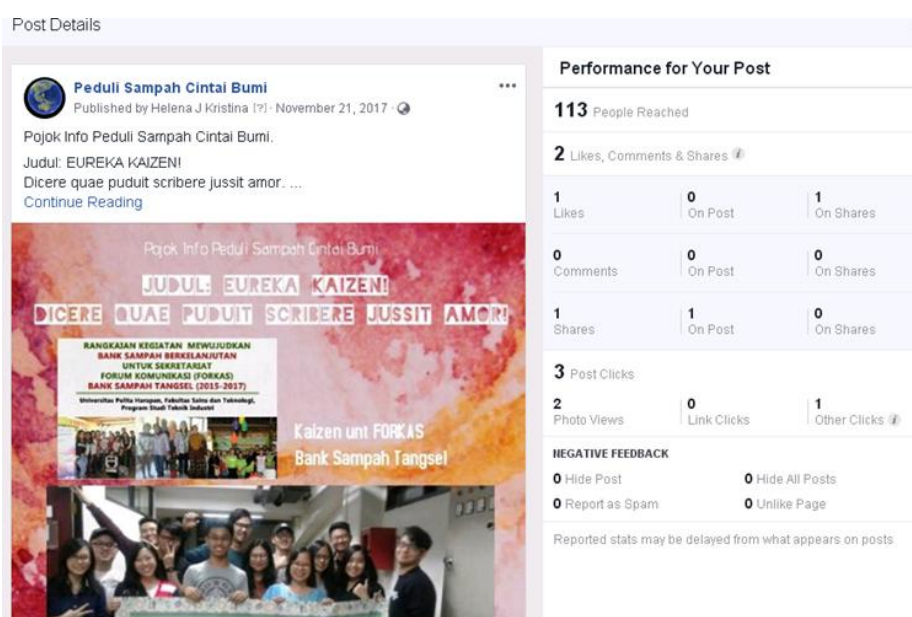


Figure 5. A student activity posted in FB *Peduli Sampah Cintai Bumi*

2. Program of *UPH Cintai Bumi*: Start-up pilot project of Social Business “Peduli Sampah Cintai Bumi” (Jan - May 2018). This is a pilot project of collecting small electronic waste (figure 6) to pioneer a saving mini-cooperative (*koperasi simpan*) for scavengers’ children at Bintara Bekasi waste stall (figure 7), targeted by Community Service Bureau (*Biro Pelayanan Masyarakat (BPM)*) LDD KAJ. This program is an initial model that is expected to be able to develop student's interest to do social entrepreneurship startup, through the opportunity to be a topic for S1 thesis (*skripsi S1*). The innovation of this program is the success rate of electronic waste collection through friendship network and relations among UPH students, and the ability to establish relationships with two community partners (Berlian waste bank and BPM LDD KAJ). The initiative undertaken is to

establish an organization structure of inter-study program that involves student volunteers and lecturers. From this, it is expected to be able to widen the network for the success of this program. During implementing the program, the use of social media technology for internal and external publications via the website of UPH Cintai Bumi [4] and an external publication on Facebook Peduli Sampah Minta Bumi to educate the society [9]. The low commitment from participants who joined in the project becomes the internal problem that is faced from the program.



Figure 6. Some electronic wastes collected



Figure 7. A representative child received a saving book

5. Result and discussion

The process of monitoring and evaluation of the Kaizen Environment Recycling Class Project program is conducted after the completion of the activity and the result is reported to Center of Research and Community Development (LPPM UPH). The indicators of the success of this program in three activities are the number of participants of the students and lecturers involved, the amount of waste collected both in kilogram and rupiah, and the number of people can be reached through the publication on Facebook. It is found that 10 lecturers and 148 students involved in the program, the amount of waste collected in the recycling is 1,075.1 kg or equal to IDR 1,401,300 during 27-week period with 12 collections. Furthermore, as many as 528 people reached through the external publicity coverage on Facebook with three publications. From similar study conducted at Francis Marion

University, USA, it was found that through 11 collections during 7 week-period, the total recyclable material was 661 kg [10]. Group A, who has received weekly recycling education and individual recycling bins, had 382 kg of recyclables. Meanwhile group B, who only received the bins, had 279 kg of recyclables. This result showed that the presence of education and bins did significantly reduce the waste stream [10].

Moreover, the understanding level of students regarding recycling process in this study was measured through the assessment of their project report. There were two types of report, namely the preliminary report and the final report. For the preliminary report, there were 8 categories of assessment (table 1). Based on Table 1, it is known that the average achievement level of each group for all categories of assessment is 57.8%. It was also found that for category 7 (VSM) and 8 (plastic label), no group could completely meet the requirement. Meanwhile, at the end of the project, each group had to submit final report. The final reports were assessed by using 9 categories. The assessment categories include lean and green concept; Kaizen theory; 5S; plastic bottle recycling process; collecting process; simple recycling process; value stream mapping; waste identification and proposal of kaizen project improvement. From table 2, it can be seen that the average achievement of each group for the nine assessment categories is 87.5%. That means that most aspects of recycling process could be understood quite well after the students finished the project. Furthermore, the project that was previously embedded in the production system class as an obligation for all IE student, now become a voluntary and independent project organized by student association (HMTI). This means, there is a change in the behavior of students, who previously participated in the recycle program mainly because of the obligation, now they do it voluntarily and independently.

Table 1. Assessment on students' preliminary project report [13]

Preliminary report									% achieve-ment	
No.	Category	Group								
		1	2	3	4	5	6	7		8
1	Idea of developing work methods or work system					√	√	√		37.5%
2	Costof producing 1 plastic bottle	√	√	√	√	√	√	√	√	100%
3	Materials needed to produce 1 plastic bottle	√	√	√	√	√	√	√	√	100%
4	Energy needed to produce 1 plastic bottle		√		√	√	√		√	62.5%
5	Energy needed to recycle 1 plastic bottle	√		√	√	√		√	√	75.0%
6	Costof recycling 1 plastic bottle	√	√	√	√	√	√	√		87.5%
7	Value stream mapping of plastic bottle production									0%
8	Discussion of plastic label									0%
		average								57.8%

Table 2. Assessment on students' final project report [13]

Final Report										% achievement
No.	Category	Group								
		1	2	3	4	5	6	7	8	
1	lean and green concept	√	√		√	√	√	√	√	87.5%
2	Kaizen theory	√	√	√	√	√		√	√	87.5%
3	5 S (seiri, seiton, seiso, seiketsu, shitsuke)	√	√	√	√	√	√	√	√	100%
4	Plastic bottle recycling (discussion and analysis)	√	√	√	√	√	√	√	√	100%
5	Data and discussion on <i>collecting process</i>	√	√	√	√	√	√	√	√	100%
6	Data and discussion on simple recycling process	√	√	√		√	√	√	√	87.5%
7	Value stream mapping and discussion	√	√	√	√	√	√	√	√	100%
8	Waste identification	√		√			√		√	50%
9	Proposal of Kaizen project improvement		√	√	√		√	√	√	75%
average										87.5%

Meanwhile, for UPH cintai bumi program: Start-up pilot project of Social Business “Peduli Sampah Cintai Bumi”, the process of monitoring and evaluation of the program is done through publication on *UPH Cintai Bumi* website as well as *uphcintaibumi* instagram (figure 8 and 9).

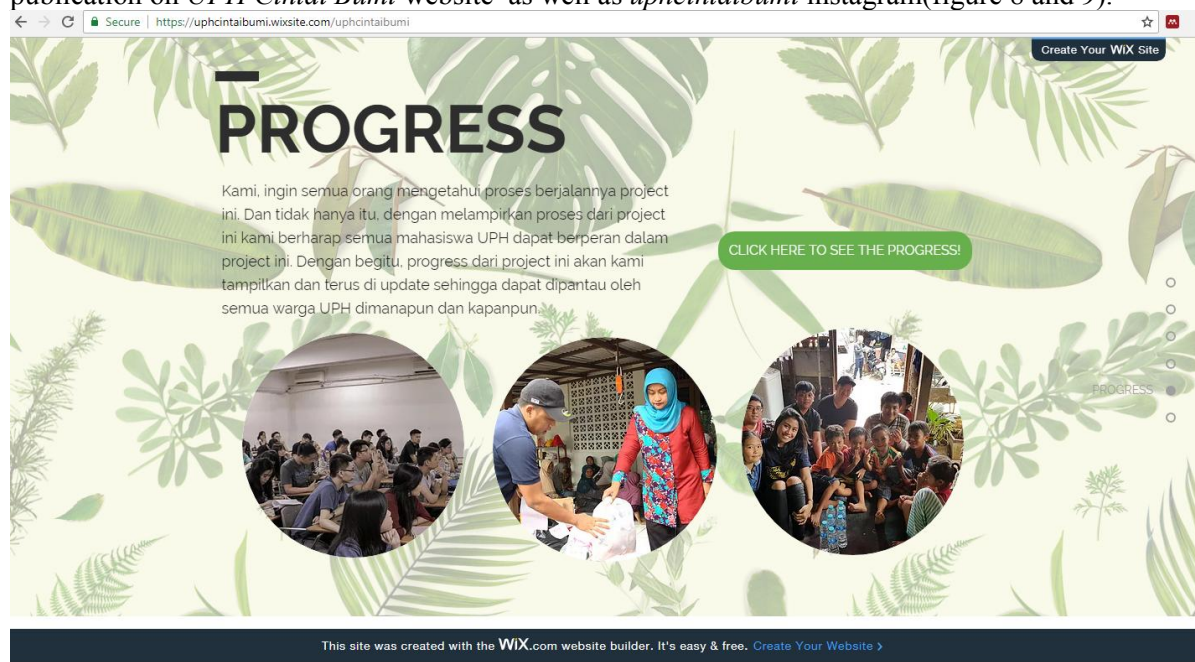
**Figure 8.** UPH Cintai Bumi website



Figure 9. UPH Cintai Bumi instagram

The performance indicators for this program are the types and amount both in pieces and rupiahs of electronic waste collected for recycling, and number of people reached through the publication on Facebook. From this program, it is found there are 41 types of electronic waste or 307 pieces were collected, the amount of saving due to this collection is IDR 280,600, and with 7 external publications on Peduli Sampah Cintai Bumi Facebook, it can reach 765 people. The number of e-waste collected in this study exceeded the number of e-waste from previous study conducted by Utama (2012) [14]. In the previous pilot project called "Donate and Win", Utama used drop box to collect e-waste from faculty members, staff and students during the UPH festival events in 4-day period. The publication was mainly utilizing posters, banners, flyers, social media (facebook), e-mails. The number of end-of-life (EOL) mobile phone collected was only one during the event. But after UPH Festival event, another 13 EOL mobile phones were collected basically through personal network. This study result showed that networking was very important in achieving project goal.

From both projects, students can learn ecological principles of Capra including networks and interdependence. According to Capra, networks is very important since "sustainability is not an individual property but a property of an entire network", thus each part of network has its own contribution to the project [5]. Furthermore, the interdependence principle is also applicable since no individual can exist in isolation, therefore sustainability always involves a whole community [5].

6. Summary

The pattern of education that has been delivered through two recycling programs that are practical, though not perfect, but the ecological principles of Capra can live in it. The pattern is also able to make students to be involved with various intentions and possibilities to take different forms of participation. The understanding level of students regarding recycling process in this study was measured through the assessment of their project report. The average achievement of each group for the nine assessment categories is 87.5%, that means that most aspects of recycling process could be understood quite well after the students finished the project. Moreover, there is a behavior change in student regarding recycling activities. Previously they joined the Kaizen Environment Recycling Class Project due to obligation, but now they do it voluntarily and independently through student

association: HMTI. This program also able to inspire UPH Service Learning Community (SLC) to do the same through its CIRCLE program.

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