Development of Engage, Research, and Present (ERP) Instructional Model to Promote HOTs and 21st Century Moral Values: A Fuzzy Delphy Method

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Abstract. Higher order thinking skill (HOTs) and 21stcentury moral values are pivotal skills to be mastered by college students in todays' digitalized era. This study,therefore aims to develop am an instructional model called Engage, Research, and Present (ERP) model. This provides opportunities for college students owning HOTs and 21st moral values. The Fuzzy Delphi Method (FDM) was employed to determine consensus among a panel of several experts. They come from educational and psychological experts (i.e. researchers) and teachers who have experience at least 10 years. They should evaluate the ERP model encompassing 12 sub phases. Five sub-phases are included in Engage and Research, and two sub-phases encompassed in Present. Based on FDM approach, ERP instructional model provides several activities identified facilitating HOTs and 21st century moral values in science and social science learning.

Keywords: HOTs, 21st Century Moral Values, ERP model, Fuzzy Delphi Method

1 Introduction

One of the important activities in the teaching and learning process for college students is to acquire Higher Order Thinking Skill (HOTs). HOTs becomes one of the essential skills that should be included in the learning outcomes process in university [1]. HOTs therefore needs to be implemented in the teaching and learning process [2, 3] because students are able to face challenges and problems in their daily life when they master HOTs [4]. This argument is based on the fact that HOTs comprises scientific reasoning [5, 6] in which it is a crucial skill in solving daily issues. In addition, in the context of cognitive aspect, HOTs places the highest level of skill for critical and evaluative thinking, decision-making, problem-solving, and transfer to other situations [2, 7].

Despite emphasizing HOTs, the teaching and learning process should also emphasize character education. As we know, life becomes complex and it is easily affected the negative value as an impact of globalization era and technology development. In other word, the role of environment is crucial in shaping the character of the next generation. The development of information and technology then provides an effect on the change of environmental conditions. According to this situation, it is important to infuse positive character in the teaching and learning process [8, 9]. Many studies [10-12] revealed that learning process

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could embed positive character for students. Indeed, this also aims to avoid a negative value or character from a real situation.

Character encompasses the ways of thinking and taking action owned people for life, team work in family, society, and country [11-13]. Several typical characters that should be owned students, for instance, 21st moral value [13]. They encompass: (1) showing the way of creative thinking and doing, (2) presenting the interest in lifelong education, (3) having the capability of learning to face problems, having the competence of being selective communicator, (5) having the courage to take risks, (6) having the capability of being hard work, (7) having the integrity of being honest and responsibility, and (8) showing the feeling of attention, tolerance, and flexible.

According to the previous argument of benefits of HOTs and 21st moral values, there is a need to design an instructional model in college or university that facilitates students to obtain HOTs and character education needed to face problems in 21st century. The type of instruction has to accommodate the aspects of HOTS and 21st moral value both in natural and social science learning. This study, therefore, aims to explain an instructional model in which it trains HOTs and 21st moral values for college students.

2 Methods

This study utilizes Fuzzy Delphy Method (FDM) that is by Kauffmann and Gupta [14]. This method is effective to acquire the agreement among several arguments in which these focuses on the group deal [15]. FDM is also effective in giving feasibility decisions of a learning phase [6]. In this present study, FDM is implemented as an analytic method in the deciding phase and sub-phase of an instructional model that is designed by an expert. The phase and sub phase arranged are based on the learning outcomes that encompass HOTs and 21st moral values. This instructional model consists of three phases that comprise *Engage*, *Research*, and *Present*. Moreover, each phase has several sub phases. The phase of *Engage* and *Research* consists of five sub phases while the phase of *Present* has two sub phases (see Table 1).

Table 1. Description of Phase (P) and Sub Phases (SP) Developed-Instructional Model.

No	Phase (P)		Sub Phases (SP)
1	Engage	1	Reading local wisdom based phenomena
		2	Identifying the phenomena
		3	Writing the research question
		4	Reviewing related literature
		5	Creating the map of investigating stage
2	Research	1	Formulating hypothesis
		2	Doing investigation
		3	Analyzing data and doing discussion
		4	Concluding the discussion
		5	Writing report
3	Present	1	Making mind mapping of research activities
		2	Presenting the research result by using mind mapping

There are ten experts in this study. The minimal number of experts who can be participants are ten [16]. Those experts consist of the experts of psychology and educators and teachers who have ten years of teaching experience. Those experts as participants of this study complete the questionnaire. FDM questionnaire developed consists of twelve items by combining Likert scale and fuzzy numbers. The number of questions is based on the number of sub-phase in the learning model designed. Then, the participants fill in the questionnaire and the researcher analyses the data. Data analysis is done in four stages.

The first step is dose by deciding the linguistic scale in which it uses Likert scale by adding three fuzzy numbers (m_1, m_2, m_3) that they have a scale of 0 - 1. The linguistic scale can be seen in Table 2. Three fuzzy numbers are used to solve the problems for each participant so it has a triangulation fuzzy number. The second step is by counting the average score of fuzzy number ($\overline{FN}$) in each participant respond in the stage of ERP instructional model. The third step is by counting the threshold value (d) for deciding the agreement level among the participants by using the equation (1). The participants (experts) can be stated in the same agreement if the value is $d \leq 0{,}2$ and the percentage (%) is $\geq 75\%$. If it is found in that condition, it can be stated that the stage status (S) is Acceptable (A), the rest is Unacceptable (UA). The fourth step is by giving the rank (R) to phase and sub phase of instructional model designed. This rank is applied as the priority consideration step that must be done in the phases. The rank is based on the value of the Defuzzification Process (DV), by using equation 2.

$$d = \sqrt{\frac{1}{3}[(M_1 - m_1)^2 + (M_2 - m_2)^2 + (M_3 - m_3)^2} \quad (1)$$

$$DV = \frac{1}{3} * (m_1 + m_2 + m_3) \quad (2)$$

Table 2. Linguistic Scale.

5 Point Linguistic Scales	Fuzzy Number		
	m_1	m_2	m_3
Strongly agree	0,6	0,8	1
Agree	0,4	0,6	0,8
Moderately agree	0,2	0,4	0,6
Not agree	0	0,2	0,4
Strongly not agree	0	0	0,2

3 Results and Discussion

The result of data analysis by considering the expert consensus for each sub-phase can be seen in Table 3, Table 4, and Table 5. Based on the tables, each sub-phase in the instructional of model phase can be agreed by experts and those are appropriate to be applied to facilitate HOTs and 21st moral values. All sub phases have acceptability percentage of more than 95% and the values is $d \leq 0{,}2$. It means that all sub phases must be carried out and they can facilitate HOTs and 21st moral values but they must consider different the priority order. The higher the sub phase rank, the more priority the sub-phases to be conducted.

In *Engage* phase, the priority order is sub-phase number 2 as the first priority, sub-phase number 1 and 5 as the second priority, sub-phase number 3 gets the third priority, and sub-phase number 4 is in the fourth priority. In the *Research* phase, sub-phases number 2, 3, 5 obtain the first priority; while sub phases number 1 and 4 get the second priority. In present phase, sub phase number 2 is in the first priority and sub phase number 1 is in the second priority.

Instead of analyzing FDM data in sub-phases, FDM data analysis is also implemented in all phases (see Table 6). The analysis in all phases is used fuzzy number analysis in average, defuzzification process (DV) value, and phases rank. Based on the data analysis, research and presents phases are in the first rank, while the engage phase is in the second rank. It means that the phases of *Research* and *Present* are the priority phases to be implemented first before the *Engage* phase.

Table 3. Data analysis of experts responds in *engage* phase.

SP	FN	Expert (FN)										$\overline{FN}$	d/%	S	DV	R
		1	2	3	4	5	6	7	8	9	10					
1	m_1	0,6	0,6	0,6	0,6	0,4	0,4	0,4	0,6	0,6	0,6	0,54	0,06/ 94	A	0,74	2
	m_2	0,8	0,8	0,8	0,8	0,6	0,6	0,6	0,8	0,8	0,8	0,74				
	m_3	1	1	1	1	0,8	0,8	0,8	1	1	1	0,94				
2	m_1	0,6	0,6	0,6	0,6	0,4	0,6	0,6	0,6	0,6	0,4	0,56	0,04/ 96	A	0,76	1
	m_2	0,8	0,8	0,8	0,8	0,6	0,8	0,8	0,8	0,8	0,6	0,76				
	m_3	1	1	1	1	0,8	1	1	1	1	0,8	0,96				
3	m_1	0,6	0,6	0,4	0,4	0,4	0,6	0,4	0,6	0,6	0,6	0,52	0,08/ 92	A	0,72	3
	m_2	0,8	0,8	0,6	0,6	0,6	0,8	0,6	0,8	0,8	0,8	0,72				
	m_3	1	1	0,8	0,8	0,8	1	0,8	1	1	1	0,92				
4	m_1	0,6	0,6	0,4	0,6	0,2	0,6	0,4	0,6	0,6	0,4	0,50	0,10/ 90	A	0,70	4
	m_2	0,8	0,8	0,6	0,8	0,4	0,8	0,6	0,8	0,8	0,6	0,70				
	m_3	1	1	0,8	1	0,6	1	0,8	1	1	0,8	0,90				
5	m_1	0,6	0,6	0,6	0,6	0,4	0,6	0,4	0,6	0,6	0,4	0,54	0,06/ 96	A	0,74	2
	m_2	0,8	0,8	0,8	0,8	0,6	0,8	0,6	0,8	0,8	0,6	0,74				
	m_3	1	1	1	1	0,8	1	0,8	1	1	0,8	0,94				

Table 4. Data analysis of experts responds in *research* phase.

SP	FN	Expert (FN)										$\overline{FN}$	d/%	A	DV	R
		1	2	3	4	5	6	7	8	9	10					
1	m_1	0,6	0,6	0,4	0,6	0,4	0,6	0,6	0,6	0,6	0,6	0,56	0,04/96	A	0,76	2
	m_2	0,8	0,8	0,6	0,8	0,6	0,8	0,8	0,8	0,8	0,8	0,76				
	m_3	1	1	0,8	1	0,8	1	1	1	1	1	0,96				
2	m_1	0,6	0,6	0,6	0,6	0,4	0,6	0,6	0,6	0,6	0,6	0,58	0,02/98	A	0,78	1
	m_2	0,8	0,8	0,8	0,8	0,6	0,8	0,8	0,8	0,8	0,8	0,78				
	m_3	1	1	1	1	0,8	1	1	1	1	1	0,98				
3	m_1	0,6	0,6	0,6	0,6	0,4	0,6	0,6	0,6	0,6	0,6	0,58	0,02/98	A	0,78	1
	m_2	0,8	0,8	0,8	0,8	0,6	0,8	0,8	0,8	0,8	0,8	0,78				
	m_3	1	1	1	1	0,8	1	1	1	1	1	0,98				
4	m_1	0,6	0,6	0,6	0,6	0,2	0,6	0,6	0,6	0,6	0,6	0,56	0,04/96	A	0,76	2
	m_2	0,8	0,8	0,8	0,8	0,4	0,8	0,8	0,8	0,8	0,8	0,76				
	m_3	1	1	1	1	0,6	1	1	1	1	1	0,96				
5	m_1	0,6	0,6	0,6	0,6	0,4	0,6	0,6	0,6	0,6	0,6	0,58	0,02/98	A	0,78	1
	m_2	0,8	0,8	0,8	0,8	0,6	0,8	0,8	0,8	0,8	0,8	0,78				
	m_3	1	1	1	1	0,8	1	1	1	1	1	0,98				

Table 5. Data analysis of experts responds in *present* phase.

SP	FN	Expert (FN)										$\overline{FN}$	d/%	A	DV	R
		1	2	3	4	5	6	7	8	9	10					
1	m_1	0,6	0,6	0,6	0,6	0,2	0,6	0,6	0,6	0,6	0,6	0,56	0,04/96	A	0,76	2
	m_2	0,8	0,8	0,8	0,8	0,4	0,8	0,8	0,8	0,8	0,8	0,76				
	m_3	1	1	1	1	0,6	1	1	1	1	1	0,96				
2	m_1	0,6	0,6	0,6	0,6	0,4	0,6	0,6	0,6	0,6	0,6	0,58	0,02/98	A	0,78	1
	m_2	0,8	0,8	0,8	0,8	0,6	0,8	0,8	0,8	0,8	0,8	0,78				
	m_3	1	1	1	1	0,8	1	1	1	1	1	0,98				

Table 6. Data of FDM for all phases.

Phase	Fuzzy Number (FN)			DV	Rank
	m_1	m_2	m_3		
Engage	0,53	0,73	0,93	0,73	2
Research	0,57	0,77	0,97	0,77	1
Present	0,57	0,77	0,97	0,77	1

ERP instructional model is developed by using a learning concept based research. Several reasons are used as the basic rationale in using learning-based research: (1) Research becomes one of important aspects in higher education [17] and the learning trend currently [18]; (2) It integrated learning-based research activities that can improve students' learning outcomes [19] and learning based contextual problems [20],[21] because it facilitates students to construct the knowledge independently so as students understand and evaluate the concepts that have been learned [17],[22]; (3) Learning outcomes that encompasses cognitive, affective, and psychomotor can be achieved by students by applying research activities integrated in teaching and learning process [23]. It is therefore hoped that by using ERP instructional model that comprises research activities provides the students to acquire HOTs in science and social science learning.

In the Engage phase, there are activities to understand the local wisdom values so ERP model developed can be integrated with local wisdom. The idea of integrating Local Wisdom is seen by the advantages of local wisdom. First, local wisdom is very important to be integrated into the learning process [24]. Second, it is needed to introduce local wisdom to college students [25] so its values can be grasped by the students. Third, positive values of local wisdom can be interpreted by students [25],[26] to avoid the negative effect of the globalization era. Moreover, local wisdom relates to familiar event or phenomenon or object in each region and nation, particularly they are related to local culture [27]. Therefore, the combination of research activities and local wisdom values in science and social science learning can facilitate the college students to have 21st century moral values.

According to benefits provided ERP instructional model, this provides two implications to science and social learning science in the classroom—as an alternative of the instructional model in strengthening research skills emphasizing collaborative learning strategy and new perspective in developing instructional model. First, in the context of goal of the learning process, ERP aims to strengthen the research capability of college students because it comprises several sub-phases accentuating research skill. When sub-phases of this model underpin some skills in research, the college students are engaged in all activities that lead

how to conduct research scientifically. Second, this type of instructional model refers to a collaborative learning strategy in the classroom. This is a very pivotal aspect in supporting 21st century skills needed by students. As we know, in the context of 21st century learning, all students have to have collaborative skill. The skill of doing collaborative learning can widen other skills, for example, reasoning and argumentation skill. In addition, methodically, the use of FDM as a research method in developing the instructional model is relatively new in Indonesian educational research. Many Indonesian researchers focused on taking Research and Development method with taking a little expert to judge the framework of instructional model developed. In this method, at least ten experts value and provide feedback for an instructional model constructed so that this situation strengthens ERP model developed.

4 Conclusions

Based on the finding, it can be concluded that *Engage, Research, and Present* (ERP) instructional model facilitates Higher Order Thinking Skill (HOTs) and 21st century moral values, both in science and social science learning. Each step in ERP model has sub-phase that has to be conducted. *Engage* phase has several staged: reading local wisdom based phenomena, identifying the phenomena, writing the research question, reviewing of related literature, and creating an identification map. The *Research* phase covers formulating hypothesis, doing investigation, analyzing data and doing discussion, concluding the research, and writing the report. *Present* phase reveals making mind mapping of research and presenting the research results by using mind mapping providing an opportunity to develop communication skill with others.

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