A Learning Model for Cultivating Self-Awareness on Human Decision-Making in an Emergency Situation

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Abstract

People may have knowledge to handle a certain situation; however, often they might not be able to perform their behaviour well when encountering the actual situation. There are knowledge-to-action gaps that make ones do not aware the existing knowledge and act improperly. This research aims to motivate learner to become aware of their thought by proposing 1) a learning model using "surprise" as a trigger for motivating learner to realize their thinking process; and 2) a Relax-Half-Baked Microworld and its decision-making model which are used as a simulated environment. Learners could modify parameters, anticipate expected outcomes and compare observed simulated outcomes with their expected ones. Learners would feel surprise from unexpected results in the comparison, and used it to reflect their thought and to be aware of how did they make decision.

Keywords*: self-awareness,decision making, microworld, rational, emotional*

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Introduction

Self-awareness is an important skill that an individual need it in daily. It is even more important in a critical situation (Enders, 2001). However, it is difficult for ones to realize their own thinking process by themselves. For example, there was belief that people may have knowledge useful for a certain situation; however, they failed to apply it to solve the problem they encountered (Tanaka, 2015). In emergency case, as an instance, people may know what proper behaviours are for dealing with an emergency, but many of them may still behave improperly and emotionally when they confront the actual situation. In cognitive science, there is a term as knowledge-to-action gap describing these phenomena. It is important for people to be aware and be able to apply the right knowledge to the situation. However, self-awareness is very difficult to be cultivated because mental process is implicit and vague.

From the learning aspect, authors believe that surprise caused by self-awareness could be a good activator for learning. People are not aware of how do they think/believe to cope with a situation and they often believe that they can think appropriately without evidence. If they could observe their thinking process and realize that the result of their thinking is not reasonable, they would "surprise" that they are not good at thinking and will be motivated to cultivate the self-awareness on thinking process. The role of surprise is a trigger that makes learners have deeper realization on their own thinking. This paper has two objectives: 1) to propose a learning model using surprise as a trigger for realization on self-awareness; and 2) to propose a Relax-Half-Baked Microworld used as simulated environment for learning.

The proposed learning model aims to use surprise to motivate realization on self-awareness of the learner. In this research, the model is demonstrated through a simulated emergency of building fire. All simulated agents in the building need to escape the building immediately. The agents are a combination of physical type: regular and handicapped; and mental type: rational and emotional. The handicapped agents always require supports from regular ones. For the learning activities, learners are expected to explicitly describe their prediction of what would happen to those agents, run the simulation, observe simulated outcomes, then make a comparison between their expected and observed outcomes. Surprise would happen when the comparison shows unexpected differences since it implies that thinking process of the learner and decision-making model are different. Then the learners start to monitor their own thought. They can modify model's parameters to test their hypothesis. The awareness of their thought has begun. The hypothesis of this research is that surprise would be a good learning trigger for the learners to deepen the self-awareness on their own thinking process and would reflect on their own behaviours if they are in an actual emergency.

The proposed Relax-Half-Baked Microworld is a type of Microworld which will be described with more detail in the later section. Microworld, in general aspect, could be considered as a simulated environment designed for a learning purpose, especially in Physics and business domains. It could be classified as 1) traditional Microworld and 2) Half-Baked Microworld. Microworld requires a model, which is well-design defined by equations and/or rules, to explain the learning phenomena. Learners understand the learning subject by observing relationship between model modification and phenomena changes, then understand how the model's mechanism works. However, traditional- and Half-Baked Microworld are confined to the learning subject that its model strongly relies on equations and/or rules to describe a certain phenomenon. Learning subject that cannot be defined by equations or rules is not acceptable since the model's mechanism cannot be defined. The proposed Relax-Half-Baked Microworld can handle this limitation since the goal is not to exactly understand the model's mechanism, but to let the phenomena happen. The phenomenon in this case is to let the learners feel surprised.

Relation of Surprise, Learning and Self-Awareness

There are different meanings to describe surprise, for example, mismatch-based surprise and astonishment surprise (Lorini, 2007). Each meaning could be used in different research domains. For the domain of learning, surprise could play as an important role to let learners understand the learning subject. A research showed that a false visualization caused learners felt surprised and promoted their awareness on the learning subject more effective than a regular class (Horiguchi, 2014). In cognitive science domain, realizing of knowledge-to-action gaps also aims to become aware of how we think or behave, and try to lessen mistake caused by these gaps.

The surprise in this research is defined as surprise caused by self-awareness. The surprise here is a realization that our thinking method is not well enough as expected. The surprise plays as a trigger to motivate learners to start reflecting their own thinking process, find mistake or missing jigsaws and be aware of what is good or bad for them by themselves.

In the experimentation, learners can modify parameter setting such as total number of agent in the scenario, proportion among regular and handicapped agents, proportion among rational and emotional agents. Based on this parameter setting, learners explicitly describe their expected outcomes of the phenomena, run the simulation and observe the outcomes. Figure 1 showed a case of a scenario which has 25 regular-emotional agents; and 5 handicapped, the learner expected most agents, 24 agents would surviv: 20 regular and 4 handicapped. The learner might have an image in mind that emotional agents would be ones who tend to help others in high possibility. The more number of brave agents, the more number of survivals, this learner might believe. However, the observed outcomes after running the simulation showed that only a half of prediction agents survived. This unexpected difference would cause the learner to feel "surprised". The learner starts to monitor his/her thought what was the missing or overlooking information when the learner made a prediction. The learner might find no mistake, but when the learner was tracing information in detail the learner found out that his/her thought started to differ from simulated outcomes at state 3: accessible to handicapped. The learner expected most regular-emotional agents were able to reach the handicapped, but the simulation showed the difference. Moreover, in stage 4: the successful help showed that even there were 14 times that the agents successfully access to the handicapped, but only 10 survived, while the learner thought most agents, 19 agents showed in stage 4, who were successfully access to the handicapped, 22 agents in stage 3, could survive. After the learner made a comparison, he/she would be aware that he/she did not realize about the difficulty of accessibility to handicapped in emergency. Then the learner realizes that carelessly travelling in the emergency environment is more dangerous than expected previously. This realization would be applied not only on selecting paths to help others, but also on selecting paths to exit the building as well.
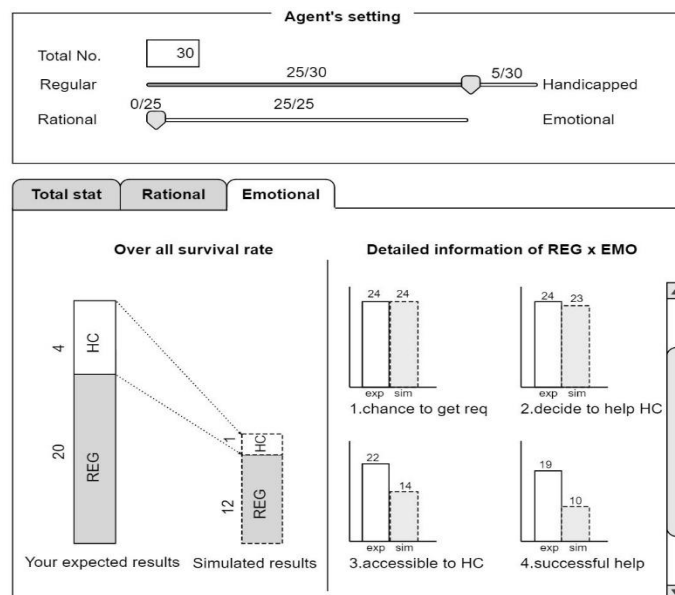

Figure 1. Comparison result between expected- and observed outcomes

Role of Microworld in the Learning Aspect

Before discussion on the proposed Relax-Half-Baked Microworld in more detail, the concept of Microworld should be introduced first. Microworld was firstly introduced in 1980s (Papert, 1980) for simulating a programming environment for children. The term became well accepted and was used in various learning domains, especially learning Physics and business. Microworld is a small, controlled space for specific learning subject. It requires a well-design learning-subject model to guide learners to explore alternatives, test hypothesis and discover learning content by themselves (Rieber, 1996, DiSessa, 2001). The learning-subject model in Microworld is a component that makes Microworld different from game. A model-based inquiry learning is simulations that allow learners to develop knowledge about a specific domain by using specific tools and methods, while games seem to bring forwards intuitive knowledge since the learning goals usually do not include systematically exploring and defining the underlying scientific model. Finally, learner tends to lose their learning goals to game goals while playing game (de Jong, 2008).

The role of Microworld here is to provide a conceptual simulation representing a situation of emergency as a learning playground to learners (Clements, 1988). The emergency demonstrated in this research was a situation of building fire. All agents in the building tried to escape the building safely. Agents were a combination of different physical types (regular and handicapped) and mental types (rational and emotional). Handicapped agents needed supports from regular agents for escaping. Rational and emotional agents had different decision-making method to handle with the situation they were in, then they tended to behave differently depended on information the agent had at that time. A rational-emotional-decision-making model, RED model, was introduced in this paper, in later section. RED model represents the simplified version of rational and emotional decision-making process for each agent in the simulated environment. Learners were allowed to modify parameters, predict what would happen with those rational and emotional agents based on their initial belief and describe them explicitly, run the simulation, observe simulated outcomes, compare their expected outcomes with observed outcomes and reflect themselves. The differences in comparison would bring "surprise" to learners, and they use it as a trigger to reflect their thinking process. Finally, after realization of their thinking process, their belief might be changed.

Relax-Half-Baked Microworld

Microworld could be considered as traditional Microworld and Half-Baked Microworld. For traditional Microworld, the learning-subject model is designed by specific equations or rules to achieve the designed learning goals. Learners learn by modify model's parameters and observe the phenomena which is the result of the well-designed learning-subject model. The learning goal is to understand how the model works (Papert, 1980, Miller, 1999). In this case, the learners act as an observer to observe relation of parameters and phenomena. For Half-Baked Microworld, there is a slightly difference from traditional one. The learning-subject model of Half-Baked Microworld is intentionally designed to be incorrect or incomplete. The incorrect model makes learners think deeper by trying to correct the model to present correct phenomena (Kynigos, 2007). Furthermore, a learner is able to design his/her own incorrect model and ask other learners to correct it. By changing role of the learner from observer to modeller, it would make the learning even more effective (Kynigos C. a., 2010). However, the traditional Microworld and Half-Baked Microworld rely on certain equations and rules to describe a specific phenomenon (Smyrnaiou, 2012). Thus, the concept that cannot be defined by equations or rules cannot be modelled.

Table 1. Summary concepts of Microworlds

	Traditional Microworld	Half-Baked Microworld	Relax-Half-Baked Microworld
Goal	To understand how the model work	To understand the learning subject by an incorrect model	To motivate self-awareness by surprise without concern the correctness of the model
Keys of the learning process	a. Correct model b. Observe relation between parameter modification and phenomena c. Guess how the model work	a. Intentionally incorrect model b. Deepen learner's thought by correcting the model to present correct phenomena	a. Vague model b. Explicitly show learner's thought c. Create surprise by comparing learner's thought and simulation results d. Use surprise to motivate self-awareness
Role of the learner	Observer – to observe relation of parameters and phenomenon	Modeler – to figure out how to correct the model	Reflector – to observe their own thought and to design their own new thinking

In this research, one of the learning tasks was to observe behaviours of rational and emotional agents. Then the decision-making model was required to represent how rational and emotional agents would behave. However, human decision-making is complex and has no agreement to define it yet. The Rational-Emotional-Decision-Making model (RED model) was proposed. However, the goal of this model is to make learners feel "surprise" and use it as a trigger to be aware of their thought, not to make them understand the RED model's mechanism. Learners were not required to know how the model work. Moreover, the model's mechanism was hidden to learners. Surprise is expected to be occurred when learners found out the unexpected difference while comparison between their expected simulated outcomes and observed simulated outcomes, which will be discussed more in Learning Model section. According to this concept, authors named it as Relax-Half-Baked Microworld since the model can be incomplete, similar to Half-Baked Microworld, and more relax on no-requirement of correct equations

or rules. The goal of Relax-Half-Baked Microworld is to feel something and use it to reflect themselves. In this case, the goal of Relax-Half-Baked Microworld is to make learners feel "surprise" and use it to motivate learners to be aware of their self-awareness without concerning the correctness of the model. The learner's role would be a reflector who observes their own thought and to design their own new thinking. The summary of traditional, Half-Baked and Relax-Half-Baked Microworlds are shown in Table 1.

Designing of Rational-Emotional-Decision-Making Model (RED Model)

Behaviour could be considered as an action resulted after an individual made a decision. This section discusses how the decision-making process is conducted. Decision-making is considered as a cognitive process (Crozier, 1997). It plays an important role in the selection of belief, based on values and preferences of the decision-maker, to take action among several alternative possibilities. Decision-making is regarded from different perspectives; psychological aspect focuses on examining each individual's decision-making in the context of relation among set of needs, preferences and values the individual has or looking for; cognitive aspect considers decision-making process as a continuous process which is integrated in the interaction with environment (Crozier, 1997); normative aspect interests on logic of the decision-making process; neurological aspect studies functions in the brain while an individual makes a decision (Walton, 2004). These studies are based on what perspectives they have toward decision-making process.

To explain decision-making mechanism, there are many research studies investigating it and trying to understand how it works. For example, in 1980s, GOFER model was introduced. It classified decision-making process into five steps: goals, options, facts, effects and reviews (Janis, 1977); in 2008 a DICIDE model, alternatively, classified the process into six steps which slightly different components to GOFER model (Guo, 2008). JS Lerner also describe how emotion involved decision-making process (Lerner, 2015). Even though these models have different designs, they have shared commonness. For example, making alternatives and selecting the best alternative to take an action. Researcher could model a decision-making process differently depending on their perspectives and goals. For this paper, the proposed decision-making model was designed from the learning oriented perspective. The design aims to introduce a learning scenario to motivate learners to be able to balance their rational and emotional decision-making in an emergency situation. It is considered as motivating learners to be aware of their thinking process.

This research considers on two types of decision-making process: rational and emotional decision-making. Figure 2 presents a decision-making model for both rational and emotional decision-making process. Both of these processes share almost common modules. Only Emotion, represented as a big black circle in the figure, is the difference among them. Emotion could be able to involve other modules and influent the results to become emotional behaviour.
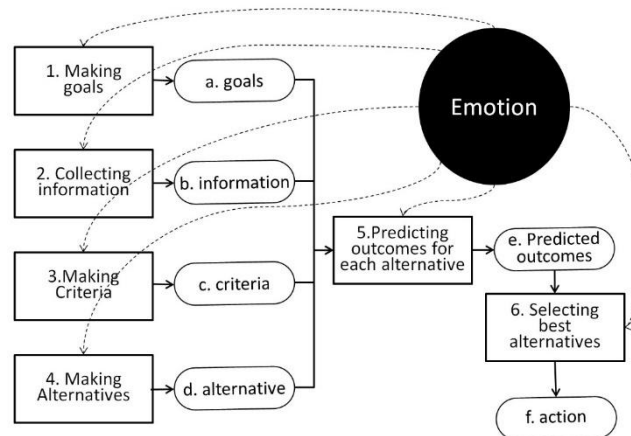

Figure 2. Decision Making model representing procedures of rational and emotional decision-making process

Definition of Rational Decision-Making

In this research, the definition of rational person is one who processes its thought logically and prioritize the most on its safeness. Even though there is an assumption that everyone is kind and has

intention to support others if possible. Prioritizing on its safeness does not mean people will ignore to help others. Rational persons, in this research, are able to help others to evacuate the emergency situation and still keep themselves safe. The rational decision-making model is described as following the steps depicted in Figure.2. (1) Making Goal: an individual would set their goals before making any a decision. Goal can be a main goal, i.e., escape to the outside of the building safely, or sub-goals, i.e., support other persons to evacuate to the outside of the building safely and prioritize to help handicapped persons. The output from this module, making goals, are goals. Multiple goals are acceptable. (2) Collecting Information: an individual collects perceived information surrounding him/her. The perceived information is not necessary to be facts. It could be missing information, outdated information, incorrect information or the mixture of them. This information is including the individual's own information, for example, whether he/she is a handicapped person or not. (3) Making Criteria: criteria could be conditions or preferences of an individual for making a decision. For example, ones may prefer to select a shortest route to escape. (4) Making Alternatives: to achieve their goals, there may be many alternatives. For example, an individual has to think about going to North or South. (5) Predicting Outcomes for each Alternatives: this procedure uses the results from (1)-(4) as its input. The individual has to process and assess those goals, information, criteria for each alternative to predict possible result of it. (6) Selecting Best Alternative: the predicted result for each alternative will be evaluated its values in the individual's mind. The individual will select the most valuable option and take action according to the selected alternative.

Definition of Emotional Decision-Making

In this research, the definition of an emotional person is ones who tend to use their emotion rather than rationale in a decision-making process. Anyone could be an emotional person since all of us have emotions: worried, fear, hopeful, etc. Ones when they are thinking too optimistic, they would believe that they can do anything successfully. At this state of the emotion, typically, they would not carefully analyse information they have to evaluate the situation in their thinking process. For example, someone, who is emotionally kind, would recklessly go to help a handicapped person on a 3F of a fired building without knowing the location of that person. On the other hand, ones when they are thinking too pessimistic, they would ignore any information, but focus only the goal they already have in mind. They may easily miss chances to analyse information they have carefully in order to adapt themselves to a better situation. For example, when a fire alarm begins ringing in a resident building, people start to evacuate to the outside of the building. The fire is igniting at 4F. A person in 3F also wants to evacuate as fast as possible even though there is no sign of fire in this floor. This person is too worried about the situation and does not respond to a request for helping from a handicapped next door. Finally, he heads to the main entrance of the building for evacuation by himself. However, if this person thinks carefully and rationally, he will notice that the situation is not too bad yet. It is possible to help that handicapped person next door. Moreover, he would notice that the emergency exit is closer to his room than the main entrance. Even though it cannot be justified, in this example, that which behaviours are right or wrong, the most people would agree on the later behaviour is more appropriate.

The most processes of emotional decision-making are the same as rational decision-making process, except Emotion could have effects to other modules (1)-(6). For example, emotion could change the criteria as the family members have to be safe or emotion could impact on how an individual process information. Ones may receive a piece of information, but interpret it mistakenly because of the current emotion. Someone might call it 'panic.'

Learning Model for Cultivating Self-Awareness using Surprise

The proposed learning model provides a framework that uses surprise as a trigger for motivating learner to realize their self-awareness. The content in this research is about to realizing and balancing of rational and emotional decision making process in an emergency situation in learner's mind. The learning model is divided into 3 phases: 1) pre-learning which aims to introduce the objective of the learning, to provide surrounding content to enhance the quality of learning (Miller, 1999), and seeding curiosity on self-awareness to learner; 2) main-learning which aims to let learners explicitly describe what they thought, they will show expected outcomes based on their understanding of the phenomena, surprise is expected to happen in this phase and trigger them to monitor and reflect their thinking process; 3) post-learning which aims to evaluate the results of learning by questionnaires. Table 2 represents a big picture of goals and learning activities of each phase.

Table 2. Overall processes of the learning model. There are 3 phases: Pre-, Main- and Post-learning

Phases	Order	Goal	Learning content	Learning activity
Pre-learning	1	a. Introduce objective of the learning b. Introduce concept of rational and emotional decision making c. Seed curiosity on self-awareness	Video and text of emergency scenarios	Motivate learner to realize loss in emergency
Main-learning	2	Explicitly describe learner's prediction	Explanation of Microworld with example	Understand how to interact with Microworld
	3	Let surprise happens to trigger learners to be aware of their thought	Half-Banked Microworld with RED-Model	Set parameters and express the expected results
	4			Run the simulation (Microworld)
	5			Compare expected results and actual results
	6	Reflect learners thinking process		Aware difference and similarity and expected surprise happened
Post-learning	7	Evaluate results of learning	Questionnaires	Reflect on self-awareness

In this paper, the main-learning phase will be focused since it is a key process that surprise would trigger learners to realize their self-awareness. The framework of main-phase is presented in Figure.3. The rectangles represent learning activities module. Ovals are an input/output for activities modules. The black oval represents a mental status, in this case is surprise. The flow is represented by three types of arrows. A solid arrow represents activity sequence. This arrow informs what the next activity is. Small-dash arrow represents input/output from learner. For example, (e) surprise is a mental status of a learner. It occurs when the learner compare their (b) expected outcomes with (d) observed outcomes. The long-dash arrow represents a Microworld's input/output. For example, (a) parameters could be an output created by learner from module (2), but it is an input used for system in module (3) predicting outcomes.

The learning model starts with anticipating phase. This phase consists of three steps; framing situation, modifying parameter, and predicting outcome as shown in Figure.3. The objective of this phase is to let learners use their current thinking process and present it as a prediction of the simulation results. For step (1) Framing situation: this step allows the learners to observe the situation for collecting important information. The information could be environmental information such as location of exits, layout of the building; and simulated agents' information such as whether they are handicapped person, rational or emotional person. (2) Modifying parameters: this step allows learners to be able to modify parameters to test their hypothesis. For example, modifying rational/emotional parameters of the model will cause the selected agents behave more rational/emotional, respectively. (3) Predicting outcome: based on the information learners collected or a set of inputs (a) parameters, learners have to analyse and process these information and predict how the situation goes i.e., simulated agents' behaviours. The output from this step is (b) expected outcome which is an output created by learner.
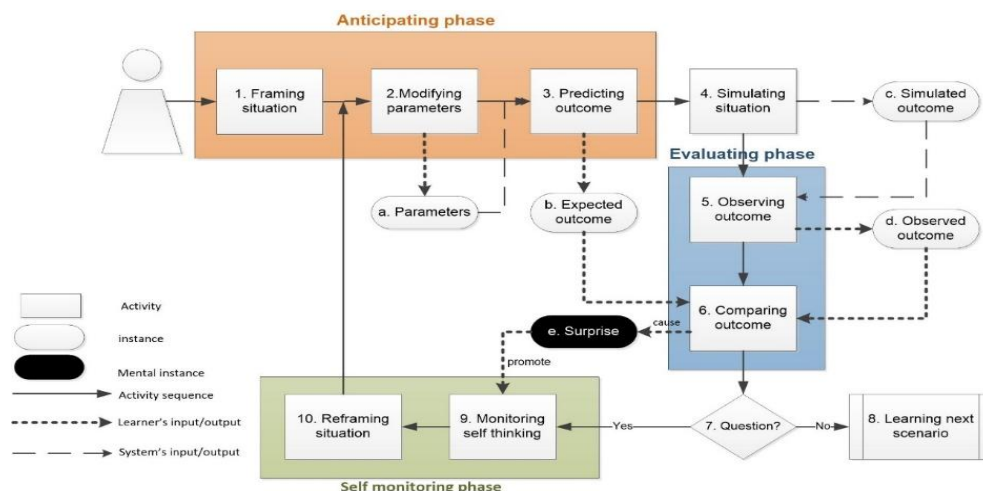

Figure 3. Key learning model in a main-phase

The model uses surprise as a trigger for learners to motivate their thinking process. There are three phases: Anticipating, Evaluating and Self-Monitoring phases. Each phase has it own learning objectives.

Then the learners run the simulation in step (4) and get (c) simulated outcome which is an output from system. The simulation could present its output as both report and traceable information. The report could be used as overview information. For example, "20% (4 from 20) of emotional agents selected path Y for evacuation are successfully escaping the fire building". On the other hand, traceable information is a set of information that learners can view its whole history. Traceable information is possible to be presented because the simulation applies a designed model representing decision-making process. All simulated agents behave according to the designed model and its parameter setting. For example, "an agent X, who tends to do emotional decision-making in emergency situation, selected path Y for escape, because it is the shortest path in its knowledge at that time".

Next phase is evaluating phase. The objective of this phase is to let learners to evaluate whether their expectation (b) are similar or different from the simulation output. For step (5) observing outcome: learners observe the (c) output from simulation which is reports and traceable information generated from step (4). Learners observe this information and interpret them into (d) observed information based on learners' understanding. Then learners compare their predicted outcomes (b) and observed outcomes (d) together. They would check similarities and differences among them.

If the comparison results are similar, and there is no (7) question left, the learner may finish this learning scenario and go to next scenario (8). On the contrary, if the comparison results are different, the learners would have question in mind and the surprise could happen (e). This learning framework would use this surprise to motivate learners to find out what cause these differences. At this moment, learners are in the self-monitoring phase. The objective of this phase is to let learner monitor their thinking process, find out what make their expected outcomes and observed outcomes different. For step (9) monitoring self-thinking: the learners are surprised and aware that probably there are something missing or some mistakes in their thinking process. The evidence is that their expected outcomes and observed outcomes are different. (10) reframing situation: learners are able to re-think about their thinking process again: what important information is missing, or what is the mistake they commit by comparing with traceable information (c). They are also able to test their hypothesis by modifying parameters and simulate it again until they reach their satisfaction.

In this paper, the learning content is about balancing rational and emotional thinking in an emergency situation. Learners are expected to realize that people can make improper and emotional decision making while they might think they are rational person.

Conclusion

The objective of this paper is to motivate learners cultivating self-awareness of their thinking process in a learning content of balancing rational/emotional thinking process in an emergency situation. To achieve the objective, this research proposes: 1) a learning model using "surprise" as trigger for motivating learners to be aware of their thinking process; 2) a Relax-Half-Baked Microworld and its Rational-Emoitonal-Decsion-Making model (RED model) which are used as a simulated environment. The purpose of the learning model is to make learner feel "surprised" and deepen their thinking process. The learner is not required to guess or correct the model from observing the simulated phenomena, but expected to feel surprised and reflect their thinking process by themselves.

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