

Improving the OSH Knowledge of Indonesian Forestry Workers by Using Safety Game Application: Tree Felling Supervisors and Operators

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Abstract

This research focused on the possibility to improve the possession of OSH knowledge of Indonesian forestry workers, especially of both supervisor and operators who carried heavy responsibilities as executors of any forestry program. To meet the demand of both respondent groups, a prototype of a board - education game developed in 2015 called "the Felling Safety Games: Supervisor" was up-graded and modified. Data derived from questionnaires, direct observation, in-depth interviews, and logical assumption, provided information on the recent perception of OSH knowledge, the success of the education game implementation, and factors that led to the success of the implementation. The fact that all respondents in this research were overrated their OSH knowledge reflected serious problems in the field of OSH in the forestry work in Indonesia. It was satisfying to know that the safety game showed a very optimistic result, as the OSH knowledge of the workers were significantly improved after only 2–6 game repetitions. Another factor that led to the success of the implementation of the game was the performance of OSH agent who played a role as facilitator during the game. However, a strong management commitment developed based on a local-based OSH management system, remained as an important requirement for the creation of a safe work behaviour change and healthy workplace.

Keywords: felling supervisor, chain saw operator, work accident, OSH knowledge, safety game

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Introduction

Forestry work, especially in logging operation, is well associated with high risk of accidents and occupational health disorders (OSHA 2000; Yoshimura & Acar 2004; Lindroos & Burstrom 2010; Oka *et al.* 2011). A high risk of the work resulted from the combination of characteristics of logging operation itself, adverse working conditions (Suchomel & Belanová 2009), and worker's safety behaviour (Yovi & Yamada 2015). Accident rate on forest industry in many countries has been reportedly significantly higher than other sectors, e.g. New Zealand (Bell 2002), Australia (Driscoll *et al.* 1995), and Spain 2007 (Cabeças 2007). In 2002, Indonesian Government released a data showed that logging accident rate in Indonesia had increased from 3,253 cases in 1995 to 4,534 cases in 1999 (resulted in 129 deaths, equalled to 9% of the total national fatal work accidents). It is possible that this number is only the tip of the iceberg, since there is a tendency of under reporting of work accidents with minor injuries (Thelin 2002) or even worse. In field of health disorder, the operation has been proven to impose workers with 49–79% of one's maximal physical work capacity

(during active working) (Yovi *et al.* 2005), in which possibly higher as in the same time workers also severe from heat stress and dehydration (Cullen & Nadel 1994; Bates *et al.* 2001).

Participatory approach that has been discussed and promoted globally has been considered as one of interesting strategy in improving and promoting safety and health at work (Kazutaka 2012). In this approach, appropriate knowledge (as well as sufficient power to improve process and outcome) is a prerequisite to the success of people's involvement in both planning and control of their own activities (Wilson 1991), as the knowledge will initiate active involvement leads to improve learning, changes in perception, and understanding of the work environment (Haims & Carayon 1998). The word of "people" cover the workers at all level, from operator to top manager level. Managers play important role in this approach, as they are key actors to promote participation. Unfortunately, in Indonesia, it is a fact that forest workers are dominated by workers possessing inadequate OSH knowledge (Yovi *et al.* 2012).

Yovi and Yamada (2015) propose a technique to increase OSH knowledge in logging operation through the application of a safety education tool, called "Felling Safety Game: Supervisor" which was constructed to meet the demand of field supervisor (middle-lower level management). The tool is designed as a board game to counter the lack of interest in being informed and studying among some workers (Thelin 2002). The prototype of the game was constructed based on findings from observation and in-depth interviews which extract the understanding of the perceptions of felling workers toward OSH. Yovi and Yamada (2015) note that the trial of the prototype has been able to increase OSH knowledge of the supervisors up to 24% ($\alpha = 95\%$) just after 1 game cycle (equal to 1.5 hours playing).

This research was aimed to offer a cost-effective strategy in improving the OSH knowledge in tree felling operation, not only for middle-lower management level (supervisor level), but also for the operator level (in this study represented by chainsaw operators) through implementation of the Felling Safety Game. Operators was targeted as they are actual executor for any sustainable forestry programs, in this case: safety felling operation.

Method

The study was conducted in 2013–2015. Respondents comprised of 51 tree fellers and 70 felling supervisors selected from 40 forest management units in Java Island of Indonesia, which were purposively chosen. All of the management units employed motor manual, short-wood logging system, in which chainsaw is used for felling, trimming, topping, and bucking. Selection criteria of the respondents were those (1) involved in felling activity and (2) agreed to spend time to actively participate in this research.

Based on respondent's characteristic, tree fellers were divided into 3 groups, while supervisors were divided into 2 groups (Table 1). Since the respondents in this study were active workers, there were limitations in setting the time between completions of their occupational task and participated in the research, which has resulted in the variations of the number of game repetitions.

The level of knowledge was measured through 2 types of questionnaires namely control-based assessment (CBA) and self-assessment (SA). The questionnaires comprised of 6 OSH main topics: basic knowledge, managerial knowledge, operatives, safety, felling, and maintenance which were divided into 24 OSH issues (Table 2) tailored to the local circumstances, which were distributed into 64 questions. Self-assessment questionnaire was given prior to safety game to determine the current perception of the respondents toward their OSH knowledge. To measure the changes in the level of OSH protection knowledge, CBA questionnaire was administered before (pre-test) and after (post-test) the game was played. This measurement was objective as the respondents' answers were scored based on the international and national OSH standards (Yovi & Yamada 2015).

In accordance with its designation, the topics on the CBA questionnaire was identical with those of the SA, but the question form was designed differently. For example, with regard to occupational disease, the question on the CBA questionnaire was be written as: "Explain what is meant by occupational diseases!", while the SA question was written as: "In your opinion, what is the value of the knowledge (0–10 scale) that you have over the issue of occupational diseases?" The answers to the CBA questionnaire then evaluated based on OSH guidelines for felling adopted from various research results, international guidelines, and

Table 1 Respondent groups and number of repetitions

Respondents	Number	Characteristics	Game repetition*	
			Post Test 1	Post Test 2
Chainsaw operator				
1. Opt 1	15	Outsourcing workers, all were elementary school graduates, much prefer to communicate in their local dialect, experienced only in large diameter tree, conducted logging using handsaw.	3	6
2. Opt 2	16	Outsourcing workers, 81% were elementary school graduates, much prefer to communicate in their local dialect, experienced only in small diameter tree, conducted logging using chainsaw.	3	5
3. Opt 3	20	Outsourcing workers, 70% were elementary school graduates, much prefer to communicate in their local dialect, carried out logging by using chainsaw.	2	4
Felling supervisor				
Junior supervisor (JS)	30	Permanent workers, all held diploma certificates, fluent in both local dialect and national language, inexperienced as felling supervisor.	2	
Senior supervisor (SS)	40	Permanent workers, 95% were senior high school graduates, fluent in both native and national language, well experienced as felling supervisor.	2	

* The number of replications varied due to time limitation to participate in this study.

Table 2 Main topics and issues described in the Felling Safety Game: Supervisor*

1. Basic knowledge	3. Operatives
Issues: Occupational accident	Issues: Operating chainsaw
Occupational disease	Aid-tool
Risk	4. Safety
Sources of hazard	Issues: Safety features on a chainsaw
Workplace	Parts of the body to be protected and personal protective equipment
Unsafe human acts	Escape route and emergency procedure
Unsafe working conditions	Work in uphill side
Kind of occupational diseases	5. Felling
Heat stroke	Issues: Felling preparation
2. Managerial knowledge	Felling technique
Issues: Risk management	Felling hung-up tree
Duty and responsibilities	6. Maintenance
The reasons why OSH protection is important	Issues: Chainsaw maintenance
The benefits of implementing OSH	
Others: nutrient, workload, communication	

*Adopted from Yovi and Yamada (2015)

national regulations (Yovi & Yamada 2015), in the end, the answers assessed on nominal scale (0–10). Following series of test validity and test-retest reliability for questionnaire SA, Wilcoxon signed-rank test ($\alpha=5\%$) was applied to test the significance knowledge improvement of both respondent groups. The critical factors that influenced the success of the tool were encapsulated through a reading of key respondent's perception taken from in-depth interviews and direct observations.

Prior to the study, some modifications were made to the safety game that has been prepared by Yovi and Yamada (2015) to allow the game to be played by operator groups with weaker cognitive abilities than the supervisor groups. The modifications included shorter and easier to understand phrases, addition of more practical information and illustrations to improve OSH Guideline, and changing in the rule of the game, so that players were no longer oriented toward the goal of "collecting as many coins as possible", but changed to "collecting as many gold trophies as possible". This way, respondents did not only pursue "financial gains" (represented by the coins), but also grew "willingness to participate" (gold trophies represented good OSH conducts). We believed that this modification would lead to the willingness of the respondents to conduct proper action in the implementation stage. And in the end, a significant increase in the OSH knowledge played an indicator that the modified safety game can be used as a safety educational tool for both the middle-lower level management and operational levels in tree felling activities.

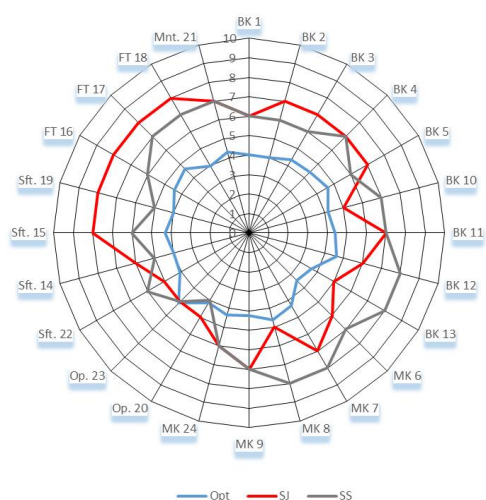
Results and Discussion

Recent perception toward appropriate OSH knowledge

Test validity showed that 62 out of 64 questions of SA had significant value over 0.05. Overall, analysis of the subjective perception (SA) of OSH knowledge of respondents resulted in a higher score (ranged 4–8 with an average of 6), compared to the score of the objective assessment (CBA pre-test) (ranged 1–3 with an average of 2). The difference in the scores (ranged 3–5) was relatively high

considering the 0–10 scale in the scoring. Among the respondent groups, operators affirmed that they possessed very poor OSH knowledge in all topics (Figure 1). However, supervisor groups claimed that they have better knowledge, especially in managerial knowledge (for senior supervisors, SS) and felling technique (for junior supervisors, JS). A scale of 7 and 6 were chosen by JS and SS, respectively, to present their subjective perception toward their OSH knowledge level. These were indicated an overestimate perception, as the CBA of the 3 groups were classified as 1, 3, and 2 for operators, JS, and SS, respectively, which was categorized as very poor knowledge level. In view of the fact that the answers to CBA questionnaire were objective, this difference indicated that the entire groups of respondents had false impressions toward their actual knowledge. In the other words, it meant that all respondent groups have inadequate OSH knowledge. This finding is in line with Yovi *et al.* (2012) that underline significant gap in OSH knowledge, skill, and attitude of Indonesian field supervisor and forest work operators.

Results of direct observation showed that the condition of the chainsaw they used obviously indicated respondent's lack of competences. Chainsaw is a very common working tool in felling activity, yet chainsaw is responsible for most fatalities in forest-work accidents (Thelin 2002). Some unsafe chainsaw operations found in the field were operating chainsaw that were (1) not equipped with safety devices and (2) had no good and regular maintenance. Chainsaw safety features such as chain brake, muffler and spark arrestor, anti-vibration system, front hand guard, throttle trigger lockout (interlock), and the blade cover (guide bar cover) were not well attached on the chainsaw used (Figure 2). This became very risky considering the devices were designed to improve operator's safety. Chain brake protected operator's left hand from possibility of injury due to slipped or when a kickback occurs. Muffler and spark arrestor served as noise barriers and protection against chainsaw gas emissions. Front hand guard protected operator's left hand as well as an important tool part of the chain brake system, and throttle trigger lockout avoids unintentional trigger pulling. The blade cover



Opt: operator; JS: junior supervisor; SS: senior supervisor; BK: basic knowledge; MK: managerial knowledge; Op.: operatives; Sft: safety; FT: felling technique; Mtn.: maintenance; 1: occupational accident; 2: occupational diseases; 3: risk; 4: source of hazard; 5: workplace; 6: risk management; 7: duty and responsibilities; 8: the importance of OSH; 9: benefits of OSH implementation; 10: unsafe human acts; 11: unsafe working condition; 12: kind of occupational diseases; 13: heat stroke; 14: parts of the body to be protected and personal protective equipment; 15: escape route and emergency procedure; 16: felling preparation; 17: felling technique; 18: hung-up tree felling; 19: working uphill; 20: operating the chainsaw; 21: chainsaw maintenance; 22: chainsaw's safety features; 23: aid-tool; 24: others.

Figure 1 Scores of OSH knowledge of the SA before the safety game intervention.

avoids worker from injury due to exposure while carrying the chainsaw. Anti-vibration system would protect the operator from various health disorders, as vibration might exacerbate hearing loss caused by noise generated by chainsaw (Miyakita *et al.* 1987).

In the term of felling supervisor, field observation confirmed the supervisor's weaknesses in supervising logging activities. They allowed other parties beside the loggers and field supervisors to stand very close (radius 2–3 m) from trees felled during the logging process. They also allowed unprotected operators (no adequate personal protective equipment or PPE attached) to fell the trees. For some extend, however, reason behind the negligence in wearing protective clothing for chainsaw operators is "understandable" since the clothing causes discomfort to the operators as it imposes them with a significant thermal insulation. This low possession of the OSH knowledge will be a barrier to achieve the expected behavioural capacity to take appropriate actions. And this will be resulted in the under performance of the level of competence required to perform the task well (Wilson 1991).

Changes in OSH protection knowledge level The CBA scores of JS and SS groups before the OSH knowledge intervention, were 0–5 and 0–6, with average scores of 2 and 3, respectively (Figure 3). Compared to the operator groups, JS and SS groups showed better possessions of OSH knowledge, although still far to meet the standard OSH knowledge, as they failed in 4 out of the 6 topics provided, e.g.: basic knowledge (occupational accident, the source of



Figure 2 A common practice in tree felling operation: less safety devices equipped chainsaw and chainsaw operator.

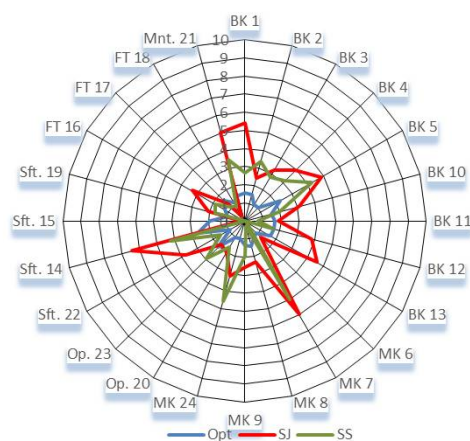
the hazard, work place, kind of occupational diseases, and heat stroke), managerial knowledge (duty and responsibilities), safety (parts of the body to be protected and personal protective equipment, chainsaw's safety features, escape routes, emergency procedures, and working up the hill), and chainsaw maintenance. These showed that JS and SS groups had weaknesses on practical work-related topics (topics related to felling and chainsaw operations). The scores also indicated that the OSH knowledge of the operator group on all of the 24 issues, were unsatisfactory with scores ranged between 1–3 and an average score of 1. In general, analysis of the answers to the CBA pre-test, showed that all respondent groups had weak knowledges in all OSH issues.

Significant difference in OSH knowledge was found in the CBA post-test. The results strongly indicated significant improvement in OSH knowledge of all respondent groups (Table 3). In addition, there was a positive relationship in all respondent groups between the improvement and the number of game repetitions (Figure 4). These findings are in line with many learning-repetition scientists who have concluded that repetition does facilitate memory, therefore, it gradually enhances the process of learning (Hintzman 1976; Nelson 1977). Repetition is an important key in the success of the game to improve the OSH knowledge, as mere repetition would mean more information that could be absorbed by the respondents.

In the in-depth interview sessions, the 3 groups of respondents expressed their willingness to repeat the game (score 8 out of 10) because the game was thought to allow them to enhance their OSH knowledge. This result was supported by previous studies, which found that the learning process by using a game, might increase the respondents' interests to learn (Tüzün *et al.* 2009). The repetition of the safety game has been very plausible, since the device is portable, can be played anywhere and able to provide the correct OSH knowledge without the presence of OSH experts. This suggested that improved understandings of

Table 3 The result of Wilcoxon Signed Ranks Test on Control-based Assessment ($\alpha = 5\%$)

	Pre-Post1	Pre-Post2	Post1-Post2
Operator 1			
z	-3.493 ^a	-3.446 ^a	-2.165 ^a
Asymp. Sig. (2-tailed)	0.000	0.001	0.03
Operator 2			
z	-3.519 ^a	-3.521 ^a	-2.955 ^a
Asymp. Sig. (2-tailed)	0.000	0.000	0.003
Operator 3			
z	-3.867 ^a	-3.922 ^a	-3.851 ^a
Asymp. Sig. (2-tailed)	0.000	0.000	0.000
Junior supervisor			
z	-5.780 ^a		
Asymp. Sig. (2-tailed)	0.000		
Senior supervisor			
z	4.459 ^a		
Asymp. Sig. (2-tailed)	0.000		



Opt: Operator; JS: junior supervisor; SS: senior supervisor; BK: basic knowledge; MK: managerial knowledge; Op.: operatives; Sft: safety; FT: felling technique; Mtn.: maintenance; 1: occupational accident; 2: occupational diseases; 3: risk; 4: source of hazard; 5: workplace; 6: risk management; 7: duty and responsibilities; 8: the importance of OSH; 9: benefits of OSH implementation; 10: unsafe human acts; 11: unsafe working condition; 12: kind of occupational diseases; 13: heat stroke; 14: parts of the body to be protected and personal protective equipment; 15: escape route and emergency procedure; 16: felling preparation; 17: felling technique; 18: hung-up tree felling; 19: working uphill; 20: operating the chainsaw; 21: chainsaw maintenance; 22: chainsaw's safety features; 23: aid-tool; 24: others.

Figure 3 Scores of OSH knowledge of the CBA before the safety game intervention.

OSH protection for all respondent groups, were very likely to be achieved in enormous scale and at very affordable cost.

On the whole, different groups showed different responses in the increased of OSH knowledge (Figure 5). The scores for the operator groups' knowledge remained in the ranged from 2–6 (3 on average) within 0–10 scale even after 4–6 times of game repetition. At the end of the study, only 1 of the 24 issues was successfully mastered by the operator groups (score of 6 on post-test, and 1 on pre-test). As for JS

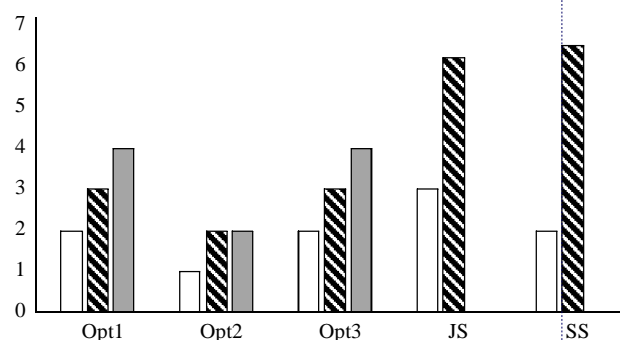


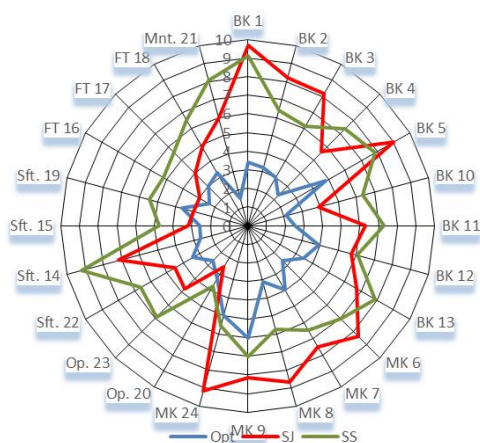
Figure 4 Relationship between OSH knowledge improvement and safety game playing repetition. Pre-test (□), post-test 1 (▨), post-test 2 (■).

and SS groups, the scores ranged between 3–10 (6 on average) and 4–9 (7 on average), respectively. In JS group, 7 issues received good scores, while in SS group, 11 issues had satisfactory scores among the 24 issues. Although the scores for more practical works were found to be unsatisfactory, however, they showed better values than the pre-test knowledge level. In addition, considering that JS and SS groups only played the safety game twice, these results indicated promising achievements. Regardless of the varied responses among the groups, to the question "Had the game significantly enhanced the OSH knowledge of its players?" it can be strongly argued that playing the safety game had significantly increased the OSH knowledge of the players.

Factors affecting the knowledge improvement

1 Formal education background

As much as 13% of JS and SS respondents hold a bachelor's degree, and the rest were high school



Opt: operator; JS: junior supervisor; SS: senior supervisor; BK: basic knowledge; MK: managerial knowledge; Op.: operatives; Sft: safety; FT: felling technique; Mnt.: maintenance; 1: occupational accident; 2: occupational diseases; 3: risk; 4: source of hazard; 5: workplace; 6: risk management; 7: duty and responsibilities; 8: the importance of OSH; 9: benefits of OSH implementation; 10: unsafe human acts; 11: unsafe working condition; 12: kind of occupational diseases; 13: heat stroke; 14: parts of the body to be protected and personal protective equipment; 15: escape route and emergency procedure; 16: felling preparation; 17: felling technique; 18: hung-up tree felling; 19: working uphill; 20: operating the chainsaw; 21: chainsaw maintenance; 22: chainsaw's safety features; 23: aid-tool; 24: others.

Figure 5 Scores of OSH knowledge of the CBA after the safety game intervention.

graduates. On the contrary, most of the operator group (80%) were elementary school graduates. According to the knowledge gap hypothesis, higher education level would enable the acquiring of information at a faster rate than those with lower levels of education, as education improves communication skills (Tichenor *et al.* 1970).

In this study, the learning behaviour of the respondents was closely in line with the hypothesis. Both, the JS and SS groups gave a score of 9 (on a scale of 1–10) with regard to the ease in understanding the concept of OSH protection through playing the safety game. The supervisor groups showed better performance of learning dynamics within the 1.5 hours (average) of discussion per game cycle, than the operator group. JS and SS groups have the tendency to pursue into deeper discussions when they were faced with topics that they were not too familiar with. The situation was quite the opposite for the operator group, as there were hardly any dynamics active discussions found. The average time for the operator group to finish one cycle was less than 1 hour. Interview with the respondents showed that 81% of the operators had a lack of understanding the objective of the game in enhancing OSH information. As a result, winning was their main goal, meant reaching the finish line first, instead of trying to obtain the OSH information as much as possible.

2 Performance of OSH agents

OSH agents who played the roles as leader in the discussion, were vital to the success of the safety game. Goldhaber and Walch (2014) note that a strong

knowledge of content is one of the attributes that leads to the success of the learning process. Therefore, agents are required to have strong OSH protection knowledge so that he/she could facilitate the discussion properly and at the same time, avoid providing too much information. In the end, the game would run effectively and the players would receive complete knowledge. In this study, OSH agents for JS and SS groups were comprised of experienced OSH protection experts (PhD degree holders) while OSH agents for the operator group were undergraduate students.

OSH agents were also demanded to be able to understand the local culture, especially the local dialect, as language barriers potentially lead to retarded or distorted messages. In their study on the impact of language on knowledge-gap, Dalisay and Liu (2015) state that language is one of the keys to the success of an exchange of information. In this study, OSH agents on JS and SS groups were able to communicate in the local dialect and thus understood the local terms, whereas the OSH agents for the operator group failed to perform effective communication as they lack local dialect, as the operator group were dominated by people who communicate better in their local dialect.

3 Motivation

Many studies noted that motivation would unquestionably affect the learning process. Maehr and Meyer (1997) claim that motivation affects the making of choices since it would determine the specific goals of the learner. Pugh and Bergin (2006) show that motivation affects cognitive process related to the transfer, so the learning process will run effectively. In this study, it was clear that the supervisor groups had stronger motivations than the operators. The supervisor groups showed dynamic discussions and persistence, which were indicators of motivation (Maehr & Meyer 1997). The supervisor groups figured scored 9 (out of a scale of 0–10) to illustrate their enthusiasm to improve their OSH knowledge. Achievement of career advancement was the underlying purpose of their persistence. On the other hand, among the operators, the reason to improve their OSH protection knowledge through safety game was simply to obey orders from their superiors.

Underlining the OSH knowledge improvement strategy: safety game for felling

OSH disorders not only bring multiple consequences at social aspect, but also at economical aspects (Lefort *et al.* 2003). This indicates serious prevention OSH protection acts which requires proper OSH knowledge of forestry workers at all levels. This paper discussed an attempt in challenging the poor OSH knowledge of forestry workers by providing wider access to OSH information (Schulte 2002) through safety game as an information medium. This game provided wide flexibility to meet the needs of the workers. Through this medium, forestry workers could increase their OSH protection knowledge with enthusiasm and joy; learning could even be done during a break time at the felling site (Figure 6).

In addition to the number of players that could be adjusted with the number of available workers, the game could also be played independently without the presence of OSH experts or

logging experts considering the availability of discussion guide book that could be used as references by whoever is playing the role of facilitator during the discussion (Yovi & Yamada 2015). However, in order to avoid possibility of experiencing overloaded information especially at operator level, it is highly recommended to put the repetition as critical point instead of the depth of the discussion during playing.

In this context, the modified "Safety Game: Tree Felling" proved to be an OSH education tool which was effective instrument for forestry workers at all levels to reach acceptable standards of OSH knowledge. Further, sufficient knowledge will generate a closer involvement in OSH protection by safety issues sharing and contributed to the design of effective solutions to the safety problems (Dedobbeleer & Beland 1991), which in turn would encourage changes in attitude, and eventually would positively influenced the safety behaviour of the workers (Channing 2003).

Nevertheless, it should be noted that this instrument is intended only to improve the level of knowledge, and enhanced knowledge does not directly guarantee decreasing injury rates (Daltroy *et al.* 1997). In addition, behavioural changes of the forestry workers were not something that could be acquired immediately, thus a comprehensive strategy would be required to ensure simultaneous and continuous behavioural change. Therefore, to create competent human resources, practical trainings are required immediately once their knowledge has reached the expected standard. Practical training is expected to promote a change from unhealthy work practices to healthy work practices (Väyrynen & Könönen 1991).

However, sufficient knowledge and skills have not ensured the achievement of acceptable OSH standards. At the next level, inspection and control with prioritizing corrective

actions by a strong management commitment, rather than penalties (Schulte *et al.* 2005; Bell & Grushecky 2006; Hsu & Lee 2012), which developed based on a local-based OSH management system, remained an important requirement for the creation of a safe work behaviour change and healthy workplace.

Conclusion

In the scheme of massively increased OSH protection, a learning instrument called Safety Game: Tree Felling was proven to be able to increase the possession of OSH knowledge significantly for both supervisor and operator levels. The game that is repeatable, cost effective, and reckoned as a workable alternative strategy is easy to play at any time and for anyone. To reach OSH standard comprehension, the application of the game should be supported by the opportunity to improve various aspects of skills training, as well as supervision and guidance on the management with strong commitments.

Recommendation

As mentioned previously, maintaining wellness-knowledge workers at all levels is vital to reach acceptable OSH standards. This implies that management commitment is vital, as O'Toole (2001) mentions that the upper management's approach on safety leadership and commitment to safety are very important in improving occupational safety and health of the workers; where the management take an action in commitment to safety, employees' perceptions of the safety management process have been positively influenced.

On the other hand, the superior-subordinate hierarchy is highly viscous culture of the workers in the study area. Among the Sundanese living in West Java Province, there is a local philosophy "cai di hilir mah kumaha cai ti girangna", meaning that a subordinate acts by mimicking the leader. Similarly, among the Javanese, there is a philosophy of "ingarso sing tulodo" meaning that a leader is obliged to provide good examples to his/her subordinates. In both cultures, it implied that many workers were dependent and tend to make their superior as a role model. Since the supervisor has "power/authority" and he or she was often used as a role model, supervisors were expected to pass information to workers (in this case the chain saw operator and assistant operator). Hsu and Lee (2012) show that the relation-oriented cultural role in influencing the OSH protection of cultural change in the workplace is a good basis for this recommendation. This information was expected to not only affect the knowledge level of the workers, but could also transform the attitude domain of the workers, which would be a necessary condition for the occurrence of a behaviour change (Channing 2003). Therefore, in order for OSH protection practices be well performed in Java Island, Indonesia (as the study area), then the safety game should be applied firstly at the management level (in this study represented by supervisors).

Until now the "Safety Game: Tree Felling" instrument has been used widely in seven forest management units in Java Island and the state-owned forestry educational institutions. Considering that the concept of OSH protection



Figure 6 A joyfull OSH learning process during a breaktime in the felling site.

in logging is a widely applied concept, the safety game that has been developed could be adopted directly by other developing countries with similar OSH issues in felling activities as Indonesia.

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