The Safety and Behavior of the Machinery Practical Training Factories in Campus

Lee Win Chin*[1], Huang Cheng Hung*[1], Chih Fu Wu*[1], Yi Jung Lee*[2]

*[1]Tatung University, Taiwan, *[2]National Chiao Tung University, Taiwan

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Abstract

This study is about a survey on the safety and behavior of the practical training factories in colleges, and the study object is a practical training factory in a technical college in Taiwan, separately based on the college department like mechanical engineering, automatic engineering and industrial management. We used statistics analysis software SPSS to sampling analysis, and the general safety investigation is including students' study attitude, teachers' teaching behavior, the degree of safety aware of teachers and the safety of environment facilities, and which is to provide the ways to improve the safety management of practical training factories in technical colleges.

1.Preface

1.1 Background and motivation of the study

Training factories are the indispensably occasion in colleges or universities, particular in the departments of mechanical engineering, industrial of management, automation engineering and industrial design etc. The course, factory training, is one of the most important subject. We can develop new device or equipment through operating machines and keeping practicing. However, most of machines in factories are dangerous such as lathes, milling machines, drilling machines and electric welding

machines etc. For students and teachers, the most important is that "How to operating machines safely during learning?" Everyone should achieve safe operation, professional ethics and eco-friendly reguest.

1.2 Research motivation

The priority of the safety in training factories is to manage related machinery, equipments, environment and operating system which are dependent on education. Under great teachers and much resource, college is just a good occasion to instill occupational safety into students. Looking forward to create the safer learning environment in cooperation with government's policy is my main motivation.

2. Related work

Recently, many contingencies occurred in schools. It seems that there must be something need to improve and modify for safety and health in schools. On 13th May, 2013, it happened an industrial accident in the department of chemistry in National Chung Hsing University. While two students were doing the experiment "recrystallization". The cylinder exploding was caused by adding too much reactant. The slice of glass even hurt the eye of one students which he would almost lose his sight.

The first step for great technical personnel is to work and do research safely. Once you lose your life, you lose any possibilities. According to the estimation of enterprises, accidents distribute like 2% for natural disasters and 98 % for artificial reasons. Furthermore, 88% can separated for two parts, 88% caused by unsafe behavior and 10% caused by under the unsafe condition(Wang Xian Zhang, 1997). Once people are absent-minded, accidents happen. Therefore, we definitely can't ignore the management of safety in training factories.

3. Method

3.1 Questionnaire survey

1. Collect related data

(1) Collect data related to safety management of training factories

(2) Take one university of technology for example. Do a questionnaire to students using training factories.

2. This study takes "Safety of training factories and behavior questionnaire survey" as research tool. The detail is as following:

(1) Personal information:

This part includes sex, department (day school or night school), number of classes of students.

(2) Current condition of safety management of training factories:

A. How's the study attitude of students?
B. How's the teaching behavior of teachers?
C. How's the cognition and behavior of safety?
D. What's the degree of safety aware of teachers?

3. This study concerned the answer ability of students.
This research adopted "Likert scale". The format of typical five-level Likert item, for example, could be:1 always, 2 usually, 3 sometimes, 4 seldom 5 never.
4. Pretest sample number
The subject of pretest and formal test were same that they were all college students.

3.2 Process of questionnaire survey

The survey adopted the method by going to the class directly to do the questionnaire survey, and then collected to do statistics analysis.
1. Differentiate personal information by department, sex, day/night school.
2. Select the 20 classes which are representative and using training factories to do questionnaire survey.
3. Collect questionnaires.

4. Results

4.1 Collect data and do analysis

This study adopted the method of going to the related classes to do questionnaire survey and collected after completing the survey. Choose representative classes of department of mechanical engineering, automotive engineering and industrial engineering and management as subject. All these students were using training factories. Pretest questionnaire amounted to 170 from 10th September, 2011 to 24th September, 2011. Delete improper 10 questionnaires, so here we got 160 proper questionnaires which confidence interval is approximately 95 %.We used statistics analysis software SPSS to sampling analysis. Get the critical ratio (CR value) for each item. Then we defined subject who get the CR value between 25% to 33% as "high score group", 67%-75% as "low score group". Then we did the significance test. If the CR value get to the large significance whichα is smaller than 0.05 or$\alpha$is smaller than 0.01, it indicates that this item(question) can differentiate the reaction degree of different students. Therefore, we regarded significance as the standard of whether deleting questions or not.

4.2 Investigation of current distribution

The investigation was passed through reliability test that deleting questions from 40 items to 26 items. We used statistics analysis software SPSS to sampling analysis. The number of formal questionnaires was amounted to 750 from 1st October, 2011 to 30th November, 2011. Cancelling 35 improper questionnaires, there was still 715 questionnaires which the confidence interval is approximately 95 %.

4.3 Factor analysis of management of training factories

The questions remained 26 items after the reliability test. We used KMO (Kaiser-Meyer-Olkin) and Barlett's to check if these 26 items are suitable for doing factor analysis. When KMO value of the item is lower than 0.5, the item is not appropriate for factor analysis. We got 0.704 for KMO value which indicates is suitable for doing factor analysis. Furthermore, the x^2 value of Bartlett's test of

sphericity is 3112.912 (degree of freedom is 325) with great significance which means it's suitable to do factor analysis and there exists co-factors between related matrix of items.

Table 1 Table of KMO and Bartlett's test (

Kaiser-Meyer-Olkin measure of sampling adequacy	0.704
x^2 value of Bartlett's test of sphericity	3112.912
Degree of freedom	325
Significance	0.000***

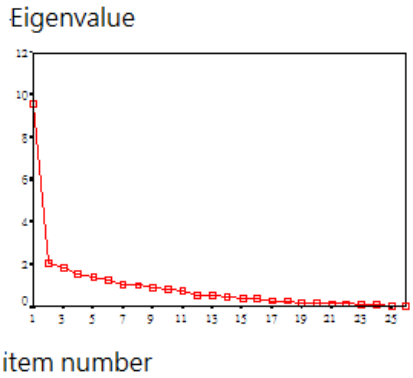

Figure 1 Factor Scree Plot (the first factor analysis)

We used principal component analysis to do factor analysis extraction. To make the difference of factor loading of co-factors to be in the largest range, we adopted "varimax" to turn the axis to simplify the factor structure. Process analysis is as followings:

This research decided the number of remaining factors by scree test. We can know the number of factor we can extract by Scree plot (figure1). The curve decreased dramatically after number8, and turned smooth gradually. Therefore, we kept 8 factors.

At the first factor analysis, there were eight factors which eigenvalue are larger than 1. However, the fifth factors were only A22 and A18, the sixth factor was only A27, the seventh factor was only A1 and the eighth was only A6. Therefore, it was more appropriate to delete from the fifth factor to the eighth factor. It was a exploring factor analysis, so deleting would change the factor structure at the same time. We needed to do factor analysis again to prove the construct validity of the scale. After sifting the data out, there were 21 items (excluding A22.A18.A27.A1.A6) for the second factor analysis.

The process of the first factor analysis and the second factor analysis were the same. The only difference was that we only choose 21 items for the second factor analysis (excluding A22. A18. A27. A1. A6). After we ensured 21 items, we used KMO and Bartlett's to check whether these 21 variables were suitable for doing factor analysis. We got KMO value for 0.750, which means suitable for factor analysis. Moreover, x^2 value of Bartlett's test of sphericity is 2365.106 (degree of freedom is 210) with great significance, which means it's suitable to do factor analysis and there exists co-factors between related matrix of items.

Table 2 Table of KMO and Bartlett's test

Kaiser-Meyer-Olkin measure of sampling adequacy	0.750
x^2 value of Bartlett's test of sphericity	2365.106
Degree of freedom	210
Significance	0.000***

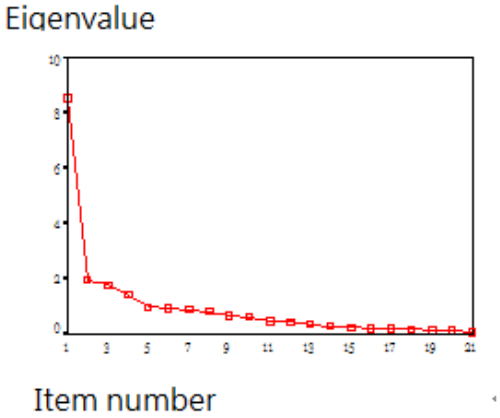

Figure 2 Factor Scree Plot (the second factor analysis)
We could see that the slope gets smaller after the fourth factor. Thus, it was more suitable to choose for 3 to 4 factors.

Table 3 The factor analysis of safety management of training factories (excerpt 1)

Item	Contents	Explained variation	Cumulative variation	Factors of components				
				Factor 1	Factor 2	Factor 3	Factor 4	Intercommunity
12	Without approval of teachers, I don't use dangerous mechanics.	20.003 %	20.003 %	0.8493	0.1845	0.1139	0.1449	0.7893
36	The training factories make regulations by the safety law of the government.			0.7225	0.3089			0.6245
8	When finding any wrong with equipments, I will ask for help immediately.			0.7161		0.1034	0.3614	0.6615
35	The electronic devices in training factories have ground connection.			0.6835	0.4798			0.7074
33	There are emergency lights in training factories.			0.6128	0.3566	0.2507	0.2273	0.6174
3	When using dangerous equipment, I follow by what teachers taught.			0.5987	-0.2115	0.2398	0.1601	0.4864
34	There are enough and proper protective equipment.			0.5514	0.2950	0.5503		0.7009
14	Teachers will request students that students need approval before using dangerous machines.			0.4828	0.4713	0.2199	0.2652	0.5741

There are 7 items which factor loading are above 0.5. This means this section puts much emphasis on teaching behavior and regulation of labor safety which we named "Teaching behavior".

Table 4 The factor analysis of safety management of training factories (excerpt 2)

Item	content	Explained variation	Cumulative variation	Factors of components				
				Factor 1	Factor 2	Factor 3	Factor 4	Intercommunity
28	Before class starting, I understand positions of main power switches.	19.263%	39.266%		0.7764	0.1736		0.6430
39	The disaster of recovery plan and the route chart are all setting up for the training factories.			0.2413	0.7478		0.3693	0.7588
31	It is adequately ventilated in the training factories.			0.3314	0.6728	0.1275	0.3396	0.6942
11	I will notice the position of emergency entrance.			0.3965	0.6571	0.2453	0.1072	0.6608
29	I will notice the position of the first-aid box.			0.2920	0.6540	0.3272	0.1839	0.6540
13	Before class, teachers organize students into groups and do the assignment.			0.2482	0.5097		0.3603	0.4539

There are 6 items which factor loading are larger than 0.5. This means that the section focuses on learning attitude and self-request which we called "the learning attitude and behavior".

Table 5 The factor analysis of safety management of training factories (excerpt 3)

Item	Components	Explained variation	Cumulative variation	Factors of components				
				Factor 1	Factor 2	Factor 3	Factor 4	Intercommunity
23	Even though after class, I keep working for my project until finishing.	13.762 %	53.028 %	0.1027	-0.1359	0.8337	0.1675	0.7522
15	I clearly understand the position and using method of the protective equipment such as fire extinguishers.			0.2145	0.1932	0.6919	0.2898	0.6462
4	When using dangerous machines, I use protective equipment to keep away from danger.				0.2399	0.6814		0.5293
37	The staff in the factories is familiar with using fire extinguishers.				0.4430	0.6227		0.5905

There are 4 items which factor loading are above 0.5. It indicates that this section focus on the safety of students and the protective equipment using which we called "the cognitive behavior of students"

Table 6 The factor analysis of safety management of training factories (excerpt 4)

Item	Components	Explained variation	Cumulative variation	Factor of components				
				Factor 1	Factor 2	Factor 3	Factor 4	Intercommunity
10	Teachers teach and remind students of noticing safety during training class.	12.000 %	65.028 %	0.2345	0.1706		0.8212	0.7614
7	Teachers check the machines before operating.				0.3466	0.3201	0.7117	0.7292
9	Teachers request students that they should not bring anything unrelated.			0.3188		0.1791	0.6946	0.6199

There are 3 items which factor loading are larger than 0.5. This section focuses on teachers' reminding of safety and behavior of request. Thus, we named as "behavior of safety reminding of teachers".

Next, do validity analysis to get further information such as reliability and validity. After the factor analysis, we got four sections. Then, we did the reliability test for four sections and reliability analysis for total scale.

Table 7 The scale of validity analysis

Scale	Cronbach's Alpha value	The number of items
the learning attitude and behavior	0.8898	8
teaching behavior	0.8590	6
the cognitive behavior of students	0.7619	4
behavior of safety reminding of teachers	0.7525	3
total scale	0.9201	21

The scale of validity analysis shows that the Alpha value are 0.8898、0.8590、0.7619、0.7525 respectively that 4 values are larger than 0.70. The alpha value of total scale is 0.9201 which means the validity is good.

5. Conclusion and suggestion

5.1 The investigation of safety management in training factories

In 20th December 1993, the council of labor affairs legislated for the law of Labor Safety and Health Act Article 4, paragraph 15 and the second paragraph applies to laboratory, and training factories in schools. The main goal is to keep away from unsafe factors.

5.2 Conclusion for factor analysis

1. After first factor analysis, we got 4 sections. There are 8 factors which eigenvalue are larger than 1. However, the fifth factors were only A22 and A18, the sixth factor was only A27, the seventh factor was only A1 and the eighth was only A6. Therefore, it was more appropriate to delete from the fifth factor to the eighth factor. It was a exploring factor analysis, so deleting would change the factor structure at the same time. We needed to do factor analysis again to prove the construct validity of the scale. After sifting the data out, there were 21 items (excluding A22.A18.A27.A1.A6) for the second factor analysis.

The scale of validity analysis shows that the Alpha value are 0.8898、0.8590、0.7619、0.7525 respectively that 4 values are larger than 0.70. The alpha value of total scale is 0.9201 which means the validity is good.

5.3 Cognition of safety and suggestion

1. School takes attach importance to safety and health (It shows at table 8).

Table 8 The degree of focusing on safety and health

degree	percentage(%)
very much	85
ordinary	12
little	3

2. The participating condition of subjects shows at table 9.

Table 9 The participating condition of subjects

degree	percentage(%)
enthusiastic	70
Ordinary	27
non-enthusiastic	3

3. As for the cognitive behavior of students, students in the department of industrial of management realize and put in practice much better than students in the departments of mechanical engineering and automation engineering do. Particularly, female students in department of industrial of management pay more attention on teachers' awareness than male students. The reason is that most of female students have mechanical background for their families. Thus, they care more about the safety of using machines. I suggest that teachers in the departments of mechanical engineering and automation engineering should improve and attach more important on their safety of management.

4. As for the teaching behavior and learning attitude and behavior, the students in the department of mechanical engineering have better performance than the students in the departments of automation engineering and industrial of management do. Thus, I suggest that these two departments need to put more emphasis on teaching how to safely use machines.

5. The propaganda of safety in schools needs to be improved a lot.

6. Teachers are not familiar with the backgrounds and abilities of labor of health and safety managers (HSE managers). I suggestion that there should be more connection between teachers and HSE managers.

7. As for safe equipment in training factories, there is still large space to improve. It should improve and increase the safe equipment in factories.

6. Reference

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