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A Study On The Optimal Allocation Of Occupational Safety And Health Education Courses: A Case Study Of Universities And Colleges In Southern Taiwan

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Abstract:
The functions of universities and colleges today are no longer limited to the acquisition of professional knowledge and training of skills, but have further become a crucial phase for students to learn occupational safety and health (OSH) education and develop personal safety protection awareness. After entering the workforce, OSH education also becomes essential knowledge for every employee. This study simulates the implementation of OSH training courses at universities and colleges in southern Taiwan under time constraints. In consideration of maximizing school participation, we use scheduling algorithms to achieve optimal allocation.

Key Word: *Occupational Safety and Health Training; Optimization; Scheduling Algorithm*

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I. Introduction

In recent years, due to the declining birth rate in Taiwan and the widespread accessibility of higher education, schools at all levels—including universities, high schools, junior high schools, and elementary schools—have been actively competing for student enrollment. Because student numbers are critical to the survival of schools, every institution has worked to increase enrollment willingness by enhancing teaching quality, faculty standards, and upgrading educational equipment. The competition for university enrollment is especially fierce. A significant drop in student intake may lead to school closure. Therefore, improving teaching quality to increase student enrollment has become a top priority for every university.

With societal evolution, universities and colleges now represent the final step before students enter the workforce. In the pursuit of improving education quality, one easily overlooked aspect is compliance with occupational safety and health regulations. Laboratories—whether for chemistry, biology, physics, or medicine—are areas where student accidents frequently occur. Preventing such accidents is crucial, and enhancing OSH training is necessary. Providing this education during school not only helps prevent accidents but also increases safety awareness, thereby improving students' crisis management abilities in the workplace.

This study simulates the scheduling of OSH training courses in universities and colleges in southern Taiwan under a limited timeframe. To maximize school participation, we apply scheduling algorithms for optimal allocation. Section 3 discusses how graph theory and scheduling algorithms are used to solve the participation optimization problem. This algorithm can also serve as a reference for scheduling across various industries.

II. Research Method

Number of Training Days

Student data was sourced from the Ministry of Education's University Information Disclosure Platform. Based on student population, training days are categorized as follows:

- Under 4,999 students: 1 day
- 5,000–9,999: 2 days
- 10,000–14,999: 3 days
- 15,000–19,999: 4 days
- Over 20,000: 5 days

The training program is scheduled for completion during the first half of 2025 for most universities in southern Taiwan.

Directed Graph

A directed graph consists of vertices and directed edges and can be used for path planning, task scheduling, and production processes.

Dynamic Programming

Dynamic programming is widely used in mathematics, management science, computer science, economics, and bioinformatics to solve optimization problems. For shortest path problems, dynamic programming or greedy algorithms are commonly used.

III. Simulation Process

Scheduling Algorithm

We utilize the following steps in a scheduling algorithm to achieve optimal results:

Step 1: Create a directed graph $D_0 = (V_0, E_0)$, where V_0 represents the set of universities and colleges in southern Taiwan. If University A's training ends before University B's training begins, and no other training can be inserted in between, then a directed edge is created from A to B in D_0.

Step 2: Calculate values (a,v,w) for each node in D_0. Here,w is the number of training days for the school,a is the maximum cumulative training days up to that school,v is the preceding school in the path that results in a total of a days.

Step 3: From Step 2, obtain the maximum sequence P_1 and total training days α in D_0.

Step 4: Remove the vertices of P_1 from D_0 to generate a new directed graph $D_1 = (V_1, E_1)$.

Step 5: Repeat Steps 2 and 3 on D_1 to obtain the second-largest sequence P_2 and total training days β.

Step 6: Remove P_2 from D_1 to form $D_2 = (V_2, E_2)$.

Step 7: Repeat Steps 2 and 3 again on D_2 to obtain the third-largest sequence P_3 and total training days γ.

By executing Steps 1 to 7, we obtain the largest sequence P_1(total training days α), the second-largest sequence P2 (total training days β), and the third-largest sequence P3(total training days γ).For optimization, if there is only one instructor, use sequence P_1; if two, use P_1 and P_2. For three instructors, the school training sequences are P_1, P_2, and P_3, and the total required training time is $\Delta = \alpha + \beta + \gamma$. This configuration allows training to be conducted for most universities in southern Taiwan while meeting time constraints.

Case Study: Universities and Colleges in Southern Taiwan

Simulating OSH training courses for universities in southern Taiwan in 2025, training days for each school are assigned based on student enrollment data from the Ministry of Education's disclosure platform. Training days are based on weekdays only, excluding public holidays and weekends.

Table 1. The training days

Number	School Name	School Name Abbreviation	Student Enrollment	Training Start Time	Training End Time	Training Duration
1	National Cheng Kung University	NCKU	23,082	9/24	9/30	5
2	National Kaohsiung Normal University	NKNU	7,396	10/2	10/3	2
3	Cheng Shiu University	CSU	15,487	9/4	9/9	4
4	Chia Nan University of Pharmacy and Science	CNU	9,396	9/18	9/19	2
5	Meiho University	MU	4,886	9/16	9/16	1
6	National Sun Yat-sen University	NSYSU	10,346	9/18	9/22	3
7	CTBC University of Technology	CTBC	2,131	10/22	10/22	1
8	National Chung Cheng University	CCU	11,540	10/23	10/27	3
9	National Tainan Junior College of Nursing	NTIN	1,983	11/3	11/3	1
10	Southern Taiwan University of Science and Technology	STUST	14,917	9/24	9/26	3
11	Tainan Theological College	TTCS	59	9/11	9/11	1
12	Min-Hwei Junior College of Health Care Management	MHCHCM	3,573	10/21	10/21	1
13	National University of Tainan	NUTN	5,961	11/7	11/10	2
14	Shu-Te University	STU	8,453	11/20	11/21	2
15	Kun Shan University	KSU	8,413	10/16	10/17	2
16	Shu-Zen Junior College of Medicine and Management	SZMC	7,241	9/12	9/15	2
17	Tzu Hui Institute of Technology	TZUHUI	2,155	9/24	9/24	1
18	Chang Jung Christian University	CJCU	5,654	11/13	11/14	2
19	I-SHOU University	ISU	11,721	11/13	11/17	3
20	National Kaohsiung University of Hospitality and Tourism	NKUHT	4,303	11/27	11/27	1
21	Chung-Jen Junior College of Nursing, Health Sciences and Management	CJC	3,017	11/11	11/11	1
22	Wenzao Ursuline University of Languages	WZU	7,262	9/4	9/5	2

Number	School Name	School Name Abbreviation	Student Enrollment	Training Start Time	Training End Time	Training Duration
23	Nanhua University	NHU	4,894	10/9	10/9	1
24	National Pingtung University of Science and Technology	NPUST	10,394	10/2	10/7	3
25	National Kaohsiung University of Science and Technology	NKUST	28,069	11/20	11/26	5
26	Taiwan Steel University of Science and Technology	TSUST	1,235	10/28	10/28	1
27	National University of Kaohsiung	NUK	6,145	11/11	11/12	2
28	National Pingtung University	NPTU	8,859	11/18	11/19	2
29	National Chiayi University	NCYU	11,582	10/16	10/20	3
30	Tajen University	TJU	3,863	11/11	11/11	1
31	Chung Hwa University of Medical Technology	HWAI	7,346	10/28	10/29	2
32	Kaohsiung Medical University	KMU	6,621	10/23	10/24	2
33	Fooyin University	FYU	8,462	11/3	11/4	2
34	Tainan National University of the Arts	TNNUA	1,638	10/2	10/2	1
35	I-Kuan Tao College	IKTC	77	11/28	11/28	1
36	Tainan University of Technology	TUT	9,660	11/20	11/21	2
37	CTBC Business School	CTBC	957	11/18	11/18	1
38	Open University of Kaohsiung	OUK	4,067	9/11	9/11	1
39	Yuh-Ing Junior College of Health Care and Management	YUHING	1,833	10/28	10/28	1
40	Wufeng University	WFU	3,782	9/23	9/23	1

We perform the following steps to determine the sequences P_1, P_2, and P_3(training days α, β, and γ).

Step 1: Create directed graph $D_0 = (V_0, E_0)$.

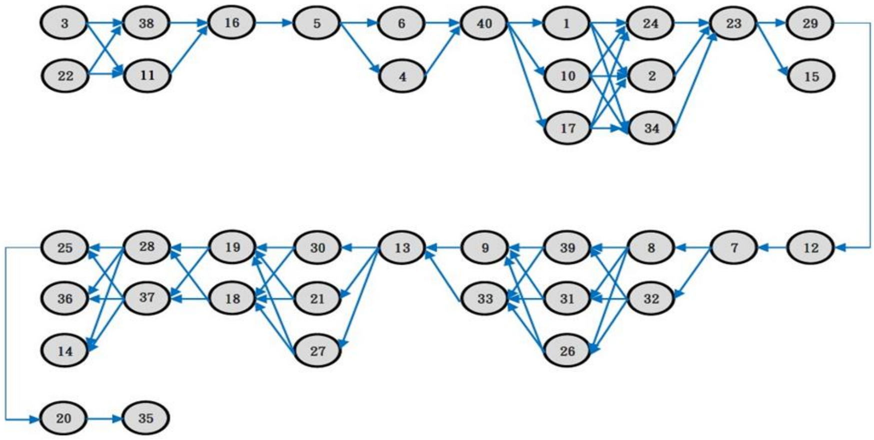

Figure 1. The directed graph D_0

Step 2: Compute the (a,v,w) values for each vertex in D_0.

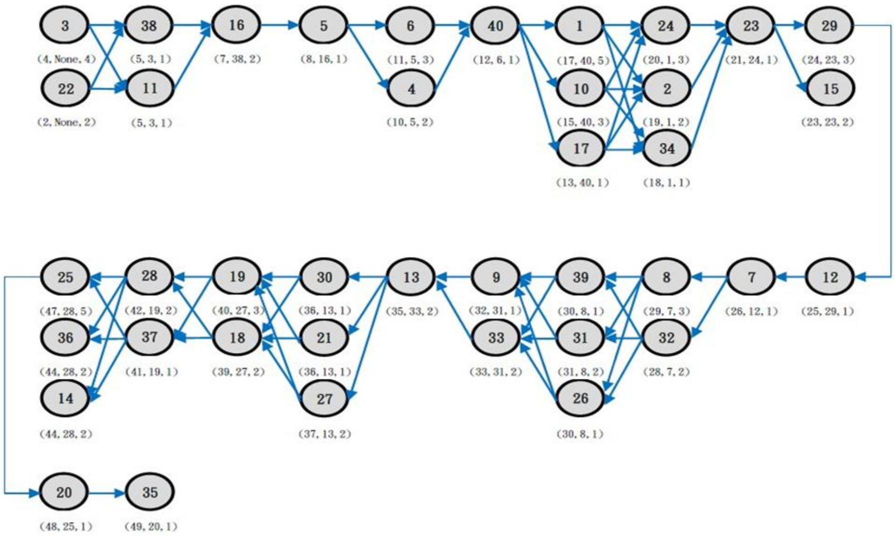

Figure 2. Calculate (a,v,w)

Step 3: From D_0, obtain the maximum sequence P_1 and α = 49.

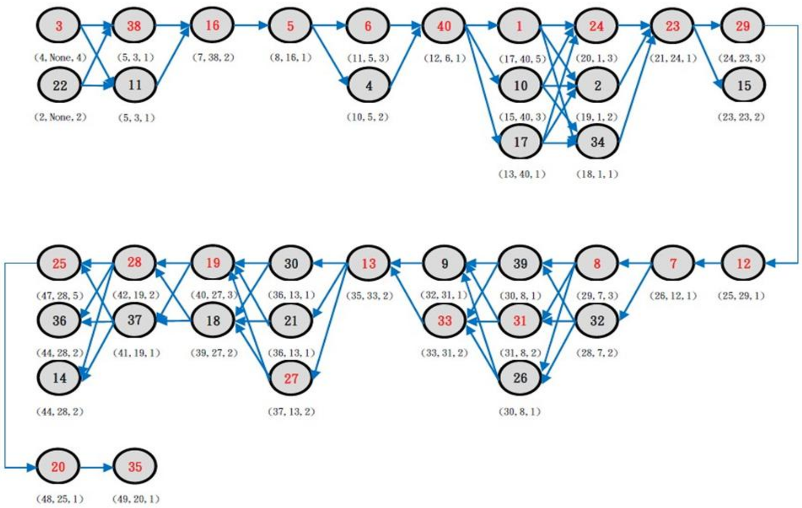

Figure 3. The maximum sequence P_1

Step 4: Remove P_1 to generate $D_1 = (V_1, E_1)$.
Step 5: From D_1, obtain the second-largest sequence P_2 and β = 22.

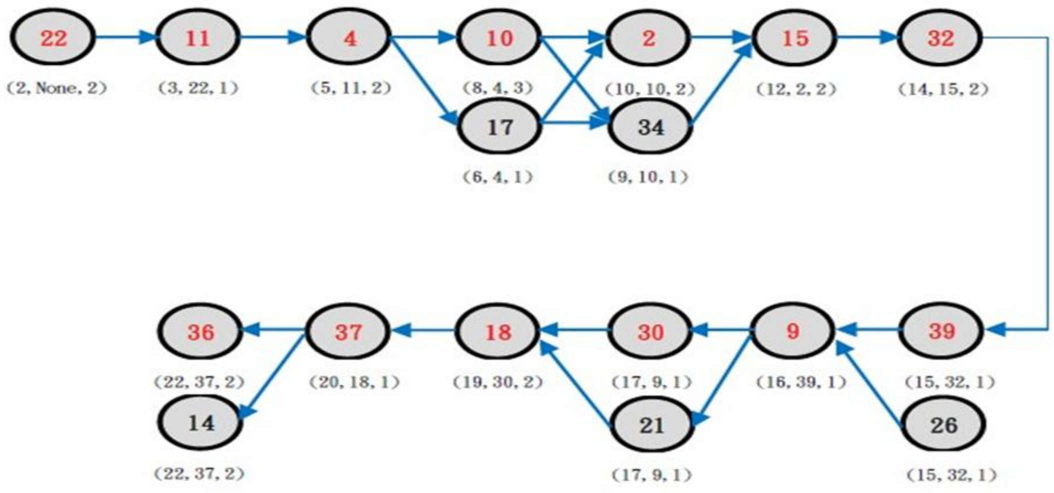

Figure 4. The second-largest P_2

Step 6: Remove P_2 to generate $D_2 = (V_2, E_2)$.
Step 7: From D_2, obtain the third-largest sequence P_3 and γ = 6.

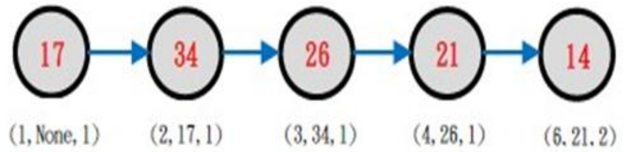

Figure 5. The third-largest sequence P_3

Optimization Results
Maximum sequence P_1 and training days α = 49.

P_1 includes 22 universities such as Cheng Shiu University, Open University of Kaohsiung, Shu-Zen Junior College of Medicine and Management, Meiho University, Meiho University, National Sun Yat-sen University, Wufeng University, National Cheng Kung University, National Pingtung University of Science and Technology, Nanhua University, National Chiayi University, Min-Hwei Junior College of Health Care Management, CTBC University of Technology, National Chung Cheng University, Chung Hwa University of Medical Technology , Fooyin University, National University of Tainan, National University of Kaohsiung, I-SHOU University, National Pingtung University, National Kaohsiung University of Science and Technology, National Kaohsiung University of Hospitality and Tourism,and I-Kuan Tao College.

Second-largest sequence P_2 and training days β = 22.

P_2 includes 13 universities such as Wenzao Ursuline University of Languages, Tainan Theological College, Chia Nan University of Pharmacy and Science, Southern Taiwan University of Science and Technology, National Kaohsiung Normal University, Kun Shan University, Kaohsiung Medical University, Yuh-Ing Junior College of Health Care and Management, National Tainan Junior College of Nursing, Tajen University, Chang Jung Christian University, CTBC Business School,and Tainan University of Technology.

Third-largest sequence P_3 and training days γ = 6.

P_3 includes 5 universities such as Tzu Hui Institute of Technology, Tainan National University of the Arts, Taiwan Steel University of Science and Technology, Chung-Jen Junior College of Nursing,Health Sciences and Management,and Shu-Te University.

With three instructors, OSH training can be completed for most institutions in southern Taiwan within $\Delta = \alpha + \beta + \gamma = 77$ days.

IV. Conclusion

This study simulates the implementation of the maximum number of OSH training courses for universities in southern Taiwan under time constraints. Given the large number of institutions, holding all training sessions without an optimized plan would be impractical and result in wasted time, space, and manpower. Therefore, high-efficiency optimization is essential to confirm priorities and improve scheduling. Strategic allocation of resources and task coordination can maximize participation. As more schools require OSH training, calculating maximum participation becomes increasingly complex. Nevertheless, with optimal resource allocation, even complex and diverse information can be effectively managed through increased participation. This study also provides valuable scheduling references for various industries.

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