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ถึง สถานศึกษาสังกัดสถาบันการอาชีวศึกษาเกษตรภาคใต้

พร้อมหนังสือนี้ สถาบันการอาชีวศึกษาเกษตรภาคใต้ ขอส่งสำเนาหนังสือมหาวิทยาลัยเทคโนโลยีราชมงมลล้านนา ตาก ที่ อว ๐๖๕๔.๐๒(๐๒)/ว๗๓ ลงวันที่ ๒๒ กันยายน ๒๕๖๕ เรื่อง ขอส่งบทความวิจัยนำไปใช้ประโยชน์สำหรับบูรณาการจัดการเรียนการสอน มาเพื่อเผยแพร่ให้สถานศึกษาในสังกัดนำไปใช้ประโยชน์ รายละเอียดตามเอกสารดังแนบ

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มหาวิทยาลัยเทคโนโลยีราชมงคลล้านนา ตาก
อำเภอเมืองตาก จังหวัดตาก ๖๓๐๐๐

๒๒ กันยายน ๒๕๖๕

เรื่อง ขอส่งบทความวิจัยนำไปใช้ประโยชน์สำหรับบูรณาการจัดการเรียนการสอน

เรียน ผู้อำนวยการสถาบันการอาชีวศึกษาเกษตรภาคใต้

ด้วย รองศาสตราจารย์ ดร.กัญฐณา ดิษฐ์แก้ว สังกัดสาขาการบัญชี คณะบริหารธุรกิจและศิลปศาสตร์ มหาวิทยาลัยเทคโนโลยีราชมงคลล้านนา ตาก ได้ดำเนินงานวิจัยเรื่อง "MASK MANUFACTURING APPROACH USING CASE-BASED LEARNING WITH AN ACTIVITY-BASED COSTING METHOD" ซึ่งงานวิจัยดังกล่าวได้สร้างองค์ความรู้ใหม่ และต่อยอดองค์ความรู้เดิมในบริบทของประเทศไทย ตลอดจนสร้างความเข้าใจเกี่ยวกับแนวปฏิบัติเกี่ยวกับการจัดการเรียนการสอนในรายวิชาการบัญชีบริหารนำไปสู่การใช้ประโยชน์จริงกับนักศึกษาอย่างเป็นรูปธรรมเพื่อการขับเคลื่อนตามพันธกิจของมหาวิทยาลัยในการผลิตผลงานวิจัยที่เป็นการสร้าง และประยุกต์ใช้องค์ความรู้ สร้างสรรค์นวัตกรรม หรือทรัพย์สินทางปัญญาที่ตอบสนองยุทธศาสตร์ชาติ ความต้องการของสังคม ชุมชน ภาครัฐ ภาคเอกชน และประเทศชาติ นั้น

ในการนี้คณะบริหารธุรกิจและศิลปศาสตร์ มหาวิทยาลัยเทคโนโลยีราชมงคลล้านนา ตาก ขอส่งบทความวิจัยเรื่อง "MASK MANUFACTURING APPROACH USING CASE-BASED LEARNING WITH AN ACTIVITY-BASED COSTING METHOD" มายังหน่วยงานของท่านเพื่อนำไปใช้ประโยชน์ในการเป็นต้นแบบสำหรับการจัดการเรียนการสอนที่ดีของสถาบันการอาชีวศึกษาต่อไป

จึงเรียนมาเพื่อโปรดพิจารณา และขอขอบพระคุณเป็นอย่างสูงมา ณ โอกาสนี้

ขอแสดงความนับถือ

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รองคณบดีคณะบริหารธุรกิจและศิลปศาสตร์ ตาก

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MASK MANUFACTURING APPROACH USING CASE-BASED LEARNING WITH AN ACTIVITY-BASED COSTING METHOD

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Abstract

This research was conducted to investigate the activities and cost drivers in the mask manufacturing process and investigate the effectiveness of activity-based costing lessons. Moreover, to investigate perform a comparison of learning achievements attained through the case-based learning of mask production using the activity-based cost method. A total of 104 accounting students enrolled in Management Accounting course as the study sample, as these students are considered good research ambassadors. The study results were reported as means, standard deviations, and dependent samples (t-test) results. The analyses revealed that five activity centers are involved in the production of valveless surgical masks and costs were determined by both volume and duration, whereby the Process Efficiency/Product Efficiency (E1/E2) ratio of 82.25/81.55 met the predetermined standards. Moreover, students' academic achievement after completing the case-based learning activity increased at a significance level of .01. Thus, these research findings can be of value for teachers aiming to develop lessons for students in accordance with the 21st century teaching and learning strategies.

Keywords: Activity Based Costing, Case-Based Learning, Surgical Mask

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Introduction

Coronavirus disease 2019 (COVID-19) is an infectious illness brought on by the recently identified coronavirus, and it first emerged in Wuhan, China, in December 2019. Then, Mask production has increased dramatically since the COVID-19 outbreak, forcing the manufacturing industry to adapt to these exceptional circumstances. As thus far more than 1 million people have died as a result of the virus, which has spread to 187 countries across the globe (Manochanphen, 2021), the demand for masks is now five times greater than it was prior to the pandemic, estimated at around 200 million pieces every month. The epidemic of the COVID-19 is so severe and rapid that many countries take measures to control and declare a state of emergency, affecting the economy and competitive advantage. Initially, surgical masks were difficult to obtain (Government Pharmaceutical Organization, 2020), motivating many companies in Thailand to start manufacturing high-quality single-use masks. As according to Thai Industrial Standards (TIS), the production capacity needs to be increased, efficiency enhancement as well as cost control is needed. Moreover, as the world moves into the age of technology and the age of environmental change, science is rapidly advancing in every discipline. Consequently, education is critical for each country's population to grow and develop in order to become skilled and qualified, as well as able to contribute to the country's development. This requires sound educational leadership as well as investment into curriculum design to ensure that students are imparted with the skills needed in the 21st century workplace. The importance of student participation, as well as the utilization of case studies as a tool for learning management, should thus be emphasized. Learning techniques for the 21st century learning skills are defined as the processes that leads to changes as a result of experience, which leads to improved performance and greater ability to learn in the future. Organisation for Economic Co-operation and Development (2012) and Great Schools Partnership (2016), focus should be given to 3Rs (reading, writing, and arithmetic) and 4Cs (critical thinking, communication, collaboration, and creativity). As a part of the present study, an activity-based costing course was taught using a case study of a company's mask production to teach students about the actual production process and the way in which cost allocation is performed. Although this project was motivated by the COVID-19 pandemic, the findings yielded can be used as a roadmap for entrepreneurs that want to start making similar products. Cost control in manufacturing processes ensures a company's global competitiveness, and often requires utilizing the activity-based costing system concept, which can also be applied to investigate the production costs of mask makers. This exercise allows the management to learn about the company's operating expenses, how the manufacturing process works, and what operating costs in the key activities need to be considered. Likewise, cost management entails adjusting and lowering expenses in a variety of operational tasks, as well as making recommendations for improving the overall system efficiency, as this will have an impact on the mask manufacturing industry's future sustainability. However, as research on case-based learning is limited, the aim of the present study is (1) to investigate the activities and cost drivers in the mask manufacturing process, (2) investigate the effectiveness of activity-based costing lessons, and (3) perform a comparison of learning achievements attained through the case-based learning of mask production using the activity-based cost method. Then, these issues are examined through an investigation of three research questions:

1) How does the activities and cost drivers in the mask manufacturing process?
2) How does effectiveness of activity-based costing lessons?
3) How does perform a comparison of learning achievements attained through the case-based learning of mask production using the activity-based cost method?

The remainder of this research paper is structured as follows: a review of the literature is presented in the next section; the following section is describing the methodology of this

research. Next, the results are presented, followed by a discussion, and the last section is presenting the limitations, implications, and opportunities for future study.

Literature Review

Traditional Allocation Costing

As cost information is very important for planning, performing and controlling production, managers should focus on managing costs properly and accurately to create competitive advantage for their firms. As production costs are considered an indirect cost, they must be allocated. The traditional allocation system "assigns manufacturing overhead based on a single cost driver, such as direct labor hours, direct labor dollars, or machine hours, and is optimal when there is a relationship between the activity base and overhead" (Ditkaew & Pitchayatheeranart, 2019). This approach is, however, only appropriate if direct labor is a large part of the product cost. The idea behind the single cost driver is that this particular cost driver increases as overhead increases, and further analysis is more costly than it is valuable. However, if the business has a complex manufacturing process or manufactures disparate products, such method is inaccurate and should be replaced by the activity-based costing (ABC).

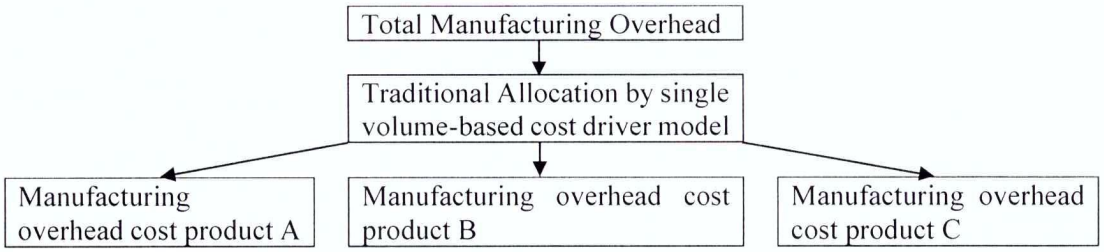

Figure 1 Traditional Cost Allocation Using the Single Volume-Based Cost Driver Model.

In the first step of the traditional method shown in Figure 1, manufacturing costs are allocated to production centers, whereby all overhead cost is combined to compute an overhead burden rate based on some input activity, as indicated by the following equation:

$$\text{Single cost driver} = \frac{\text{manufacturing overheard of all products}}{\text{single volume-based}}$$

Activity-based Costing (ABC)

The activity-based costing (ABC) method was developed in the United States during 1980s. It was extended and developed by Cooper & Kaplan (1988) based on the assumption that indirect cost would have an increasing share in the product cost. ABC can be effectively applied in both job order cost and process cost systems, as it considers the rate of activity in the manufacturing process and allocates the production cost as required. To adopt this method, the firms must know all the input variables needed to estimate the indirect cost of production. This method could help in strategizing, long-term planning, and creating production cost advantages, as it determines indirect cost based on objective activities, such as events or tasks and the associated characteristics, timing, and output (Ditkaew & Pitchayatheeranart, 2019). As shown in Table 1, this approach allocates production expenses to each item or product type, using the cost driver of the activity as a criterion for allocation. To identify the cost driver, the amount of work and effort related to that activity will be considered (Almeida & Cunha, 2017; Ditkaew & Pitchayatheeranart, 2019; Lu et al., 2017).

Table 1 Cooper's hierarchical model of activities

Activity Level	Definition of Activity	Examples of Activities
Unit-level activities	Increase in the inputs for every unit that is being produced	Installing parts, painting final products, servicing individual customers
Batch-level activities	Variation in the inputs for every batch that is being produced	Setting up machines, ordering rolls of steel
Product-sustaining activities	Necessity of the inputs to support the production of each type of product	Research and development, product testing
Facility-support activities	The drivers which are related to the facility's manufacturing process	Company-wide advertising, plant supervision, human resources

In the mask production process, the ABC method was implemented in four steps, as described below.

Step 1: The activity centers of mask production were identified, as they impose direct costs on the activity centers and attract indirect costs from other activity centers. According to the ABC theory, product costs are the result of a hierarchy of activities, denoted as unit-level activities, batch-level activities, product sustaining-level activities, and facility-level activities, as described in the Cooper's hierarchical model of activities shown in Table 1.

Step 2: When identifying the cost driver, the factors that contribute to the production cost must be analyzed to determine the base cost of activities. According to the ABC theory, cost drivers could be classified into volume driver and duration driver categories.

Step 3: Calculating the base cost of activity rate to be used in allocating the production cost to products, as it depends on the number of involved activities.

Step 4: In the final step, indirect production costs are assigned and allocated to products according to the number of activities required for obtaining each product and calculating the base production cost of each product which could reflect the true cost.

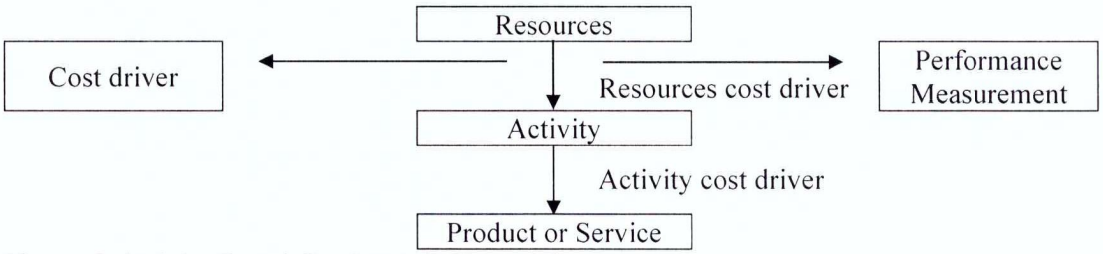

Figure 2 Activity Based Costing (ABC) Model.

Previous research confirms and state that ABC is claimed as one of the most important management accounting innovations of the twentieth century (Kitsantas et al., 2022). As a result, the ABC system has been widely utilized in nations including Canada, (Quinn et al., 2017). However, because developing economies like Malaysia (Ahmad et al., 2017), Taiwan (Lou et al., 2017), Sri Lankan (Wijerathne & Gooneratne, 2019), and Turkey (Özcan, 2020) benefit from competitive advantages in the goal of globalizing their economies, ABC has also acquired attention internationally. Thus, implement ABC as a method of measuring accurate cost information for product costing (Al-Dhubaibi, 2021). Therefore, reasons that justify the ABC method are to improve cost control, cost reduction, cost information for product costing, more accurate allocation of indirect costs, identification of activity costs, improvement of operational efficiency, and thus, it provides managers with data for planning, decision-making, and organizational performance.

Case-based Learning

The main goal of accounting education is to impart knowledge to pupils. Most students participate in lectures passively, acting as observers or listeners. However, for student-centered learning to be effective, students must be engaged actively and positively. Case-based learning (CBL) is a teaching style that focuses on allowing students to apply what they have learned in the classroom to real-life scenarios in order to develop higher-order thinking skills and prepare them for real-world situations. Therefore, it is a method of teaching that combines theory and practice (McLean, 2016). Nonetheless, case-based learning is frequently studied in conjunction with or compared to problem-based learning. According to the most often used definitions, semantic problem-based learning can be applied to a variety of situations, whereas case-study learning focuses on searching for both information and relevant content in conceptual settings, whereby concepts to be mastered are matched to the learners' interests and requirements. This requires a considerable preparation and focus on the part of the instructor. In response to the Accounting Education Change Commission (1990) call for more innovative teaching of accounting to develop desired employment skills, such as communication skills, interpersonal skills, and intellectual skills, such as the capacity to exercise judgment, locate and organize relevant information, and find and solve unstructured problems, case studies are increasingly being used in accounting education. Yadav et al. (2007) found that utilization of the case study method exposes students to realistic situations and assists them in developing self-management, interpersonal and problem-solving skills through the integration of theory and its practical application and peer interactions. Similarly, Jeong & Kwon (2012) investigated and compared students' experiences of case-based e-learning and traditional tutoring in higher education. These authors observed that students exposed to case-centered learning significantly increased their domain knowledge and perceived case-based e-learning positively in terms of user satisfaction, ease of use, and usefulness, which increases their learning motivation. More recently, Grassberger & Wilder (2015) found that adopting the case study technique to teach graduate students results in increased student connection and engagement with course content, as well as considerable learning incentives. Guided by these positive findings, a case-based approach was adopted for this study as a part of which students were required to interview the operators in order to learn about the face mask manufacturing process, identify and assess the activity group, and compute the activity base from the real production process.

Methodology

Population and Sample

The population of interest for this research comprised of students attending the Rajamangala University of Technology Lanna Tak (RMUTL Tak), Faculty of Business Administration and Liberal Arts, Accounting Department. Thus, during the first semester of 2021, 362 students were eligible for participation (Rajamangala University of Technology Lanna, 2021). Purposive random sampling was utilized to choose 104 accounting students enrolled in Management Accounting course as the study sample, as these students are considered good research ambassadors. The Human Research Ethics Committee at Rajamangala University of Technology Lanna (RMUTL- IRB 016/2021) approved the data collection for this study based on the criteria of the Declaration of Helsinki and The Declaration of Helsinki and International Conference on Harmonization in Good Clinical Practice (ICH-GCP).

Research Instrument

Achievement Test: According to Bloom (1956), there are six levels of learning, namely objectives and conceptualization, encompassing knowledge, comprehension, application, analysis, synthesis, and evaluation to produce an achievement test. To determine the Index of Congruency (IOC), the prepared achievement test was given to professionals who have the expertise needed to verify the accuracy, clarity of language, topic coverage, and consistency

between the questions and the learning objectives. The three experts' evaluation results ranged from 0.67 to 1.00, which is within the acceptable threshold. Then, the difficulty (p) and discriminating power (d) were assessed on a set of 30 non-sample students (r). The difficulty value (p) was determined to range from 0.38 to 0.89, the power of discrimination (r) was determined to range from 0.32 to 0.75, and the test confidence was determined, leading to the belief value with an alpha coefficient of 0.91. The redesigned exam was then given to the student sample to collect the data used in analyses.

Case Study from Interviews with Mask Manufacturers: By employing interviews as a data collection instrument, the researcher was able to conduct both quantitative and qualitative research, as well as comply with the COVID-19 guidelines. The researcher used Google Meet to conduct an online interview using a research tool informed by a review of relevant literature sources. The interview questions were provided to experts to verify the content's veracity, and mask producers who were not among the informants chosen for the actual study were interviewed to test and refine the questions to be used when interviewing mask manufacturers. The developed interview form comprised of three parts:

Part 1: The operator's essential information, comprising of the length of the operation, the amount of space available, the total number of employees, and the average daily production volume.

Part 2: Costs for each activity were provided, including direct raw material characteristics and costs, direct labor expenses, and mask manufacturing overheard for each model to determine each activity's resource consumption.

Part 3: Activities (types of work) used in the manufacture of masks with and without valves were specified.

Verification of data was performed by conducting both data and investigator triangulation. Data triangulation ensures that the information gathered at several points in time is consistent, whereas investigator triangulation ensures that the same findings are obtained when using different investigators. This approach demonstrates the reliability of the research instruments, the consistency of data yielded by repeated investigations, and the validity of the research tools.

Data Analysis

To evaluate the efficiency of the activity-based lesson, the 80/80 (E1/E2) standard was adopted. Using t-test dependent samples statistics, the data were analysed to compare the mean learning achievement scores obtained before and after learning. The level of significance was set at 0.01.

Results and Discussion

Figure 3 depicts the information obtained about the key production activities, thus identifying the causes and the expenses associated with the manufacturing of surgical masks.

Mask manufacturing process is illustrated in Figure 3 which input raw materials for manufacturing. Additionally, paper pulp is needed for cardboard in packaging. Metal is only needed for the nose strips, and a variety of metals can be used. Overall process illustrate that face masks provide good protection against airborne particles and aerosols, which highlights the need for research and development in face mask processing and quality control. As a result, from mask manufacturing process can be separate issues for activities pool and cost drivers of the valveless mask.

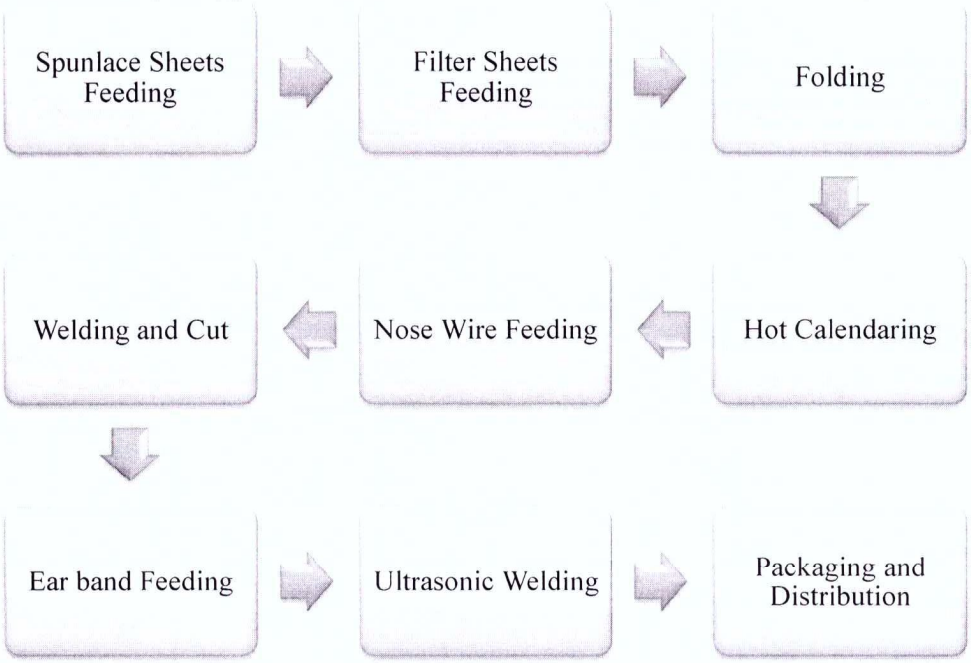

Figure 3 Mask Manufacturing Process

Table 2 Activities pool and cost drivers of the valveless mask

Activities Pool	Cost Driver	Activity Frequency
Acquisition of raw materials	Number of times to supply	Four times per year
Production preparation	Number of times to prepare	Once per day
Machine use	Machine working hours	24 hours per day
Mask-making	Number of hours of direct labor	24 hours per day
Quality inspection	Number of times to check quality	Once per hour

As can be seen from Table 2, five activity centers are involved in the production of valveless surgical masks and their cost is driven by both volume and duration.

Table 3 Efficacy analysis of activity-based costing lessons

The effectiveness of the lesson	Score	Mean	Percentage	Criteria
Test scores during class (E_1)	50	40.42	82.25 (E_1)	80
Test scores after class (E_2)	40	36.46	81.55 (E_2)	80

From Table 3, it is evident that the process efficiency (E1) and the resultant efficiency (E2) of the activity-based lesson development were 82.25 and 81.55, respectively, which is in accordance with the required 80/80 benchmark.

Table 4 Comparison of pre-study and post-study scores obtained in the integrated case study

Score	n	$\bar{x}$	S.D.	t-value
Pre-study	104	15.48	3.01	41.25**
Post-study	104	35.04	3.25	

(**$p < .01$, $t_{(\alpha.01,\ df\ 48)} = 2.4141$)

Table 4 shows that students benefitted from taking part in the case study and the improvement in their academic achievement was statistically significant at the .01 level. These findings suggest that employing case studies in teaching and learning motivates students to conduct research, think critically, and make decisions by focusing on self-discovery and collaborative learning with the help of teachers. These observations are consistent with the situated learning theory (Korthagen, 2010) that focuses on improving the ability to practice in real-world circumstances, with the emphasis on learner reactions and learning from the environment in order to enhance comprehension and cognitive skills. Active learning is the product of real-life events and is enhanced by the application of principles, and learning to examine facts, study, research, discuss, and exchange viewpoints. Our results are also consistent with the findings reported by Raza et al. (2020), who found that case study-based learning enhances student engagement and demonstrated presence of a significant and positive relationship between case-based learning and all four aspects of engagement, i.e., behavioral, emotional, cognitive and agentic engagement. According to the findings reported here, case-based learning leads toward greater understanding of concepts learned in class and the development of relevant skills, thus enhancing learning motivation. Moreover, Case-based learning promotes critical discourse, elicits pertinent experiences from students, incites doubt about conventional wisdom, and fosters communication between theory and practice (Ahmad et al., 2021). Additionally, this finding describes the results of an exploratory study into students' perceptions of the benefits of a case-based learning, discussion forum of mask manufacturing in managerial accounting. With the limited resources at their disposal, accounting educators struggle to find effective strategies to integrate discipline and employability skills into the curriculum to prepare students for the workforce. By describing context-specific ideas of learning connected to case assignments and examining connections between those conceptions of learning, student characteristics, and performance, the current study adds to the body of knowledge on accounting education (Moilanen, 2017). Thus, this study the effectiveness of case-based learning based on mask manufacturing. Specifically, it shows that the more students actively participate in the activities, the more effective their learning in introductory accounting.

Conclusion

In various respects, this work adds to the body of literature. In terms of its theoretical contribution, this study advanced knowledge of how specific unforeseen circumstances might successfully alter Thailand's adoption of ABC for the manufacturing of masks. It covered a wide range of literary genres, primarily literature on management accounting with an emphasis on ABC, business strategy and organizational performance literature. As a result, it filled a gap in the literature and eliminated uncertainty regarding the state of ABC adoption and implementation in enterprises throughout the country's key economic with education sectors. It also identifies the impact of various behavioral elements on ABC adopters and emphasizes the significance of assessing the success of ABC and integrating new information into the body of literature.

This study focused on a case study involving activity-based costing to teach accounting students how to improve their skills in the actual learning process by choosing to make masks because they can see the actual manufacturing process and as a guideline for other entrepreneurs interested in making masks. Moreover, case-based learning allowed the participating students to express and discuss their perspectives, as well as improve critical thinking, problem-solving, and decision-making abilities. Learners were also able to build self-confidence while considering other people's perspectives. Moreover, this study able be state that in as the nature of accounting work continues to change, it is more crucial than ever for students to be prepared for the workforce. Universities must be sensitive in order to align education with the reality of current and developing work, including the impact of COVID-19

pushing into case-based learning. In future research, collaborative teaching and learning management methods should be examined, and comparisons of learning outcomes with those obtained via traditional methods should be performed. Additionally, this result refers to the theory of set learning (Korthagen, 2010), which focuses on improving the ability to practice in real situations. Future research would it be better to use this method and results from this research to support future skills by 2030 skill set.

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