N. M. Sang, N. V. Toan, T. V. Dien

CDIO approach in developing effective learning skills of engineering and technology-profile students

Introduction. The process of Vietnam’s ever-growing international integration into the modern global economy places increasingly high demands on educational institutions, especially in the digital age.

Having effective strategies for teaching engineering and technology-profile students according to the core principle of the innovative educational environment (known as CIOD: Conceive – Design – Implement – Operate) is extremely important and vital for the universities engaged in training a new generation of engineers, particularly, in the Mekong Delta in Vietnam, towards meeting the needs of the international labour market.

Materials and methods. The research involved the managers, teachers, academic advisors and students of Vinh Long University of Technology Education (Vietnam). The total number of respondents was 191, of them 45 managers, 56 teachers and academic advisors and 90 students.

The information collected at the University of Technology Education was split into 2 stages: stage 1 from 1 to 31 March 2022 and stage 2 from 1 to 31 March 2023.

Results. The students demonstrated much better skills in planning their learning activities at the 2nd stage of the survey (p < 0.05). The students developed good skills in setting objectives, content and methods of learning, as well as in self-examination and evaluation of success in the realisation of own study plans. Making study plans, organisation of their implementation, checking, evaluating, improving and correcting these plans are also important skills for students.

Positive results were also obtained for the use of other efficient strategies for study skills training by the engineering and technology-profile students: strategies for practising effective study skills (p < 0.05) and strategies for practising students’ soft skills (p < 0.05).

Conclusion. The acquisition of professional skills for engineering and technology-profile students of Vietnamese universities practicing CDIO is a key to their sustainable development and, in general, to high-quality education in Vietnam.

Keywords: CDIO approach, study skills, students, engineering and technological sciences, Mekong Delta, Vietnam

For Reference:
The CDIO Initiative in January 2011 adopted 12 standards for CDIO education programmes. These standards were developed to help educational programme managers, university graduates and social partners, with a view to guide them in respect of the principles according to which CDIO programmes and their graduates will be professionally recognised and evaluated.

The developed CDIO standards define the distinctive features of CDIO programmes and serve as a specific guide in implementing educational reforms and evaluating their efficiency. The proposed standards clearly show the goals and objectives a university should set for itself to achieve public and professional recognition worldwide.

The CDIO programme proceeds from the principle that creation and development of products and systems throughout their life cycle forms a necessary context for engineering education. The approach “Conceive – Design – Implement – Operate” represents a model of the entire product life cycle. At the “Conceive” stage, the buyer’s needs are identified; the technologies used at the enterprise, its development strategy and its charter are taken into account; conceptual, technical and business plans are drawn up. At the second stage “Design”, design plans, schemes and algorithms for the production of the item to be manufactured are developed. At the “Implement” stage, the product is manufactured, coded, tested and registered according to the developed plans and schemes. At the final stage “Operate”, the manufactured product is used for its intended purpose, with its technical maintenance; or the product is further utilised and/or recycled. CDIO creates a due engineering education environment where technical knowledge and practical skills are taught, learnt and applied in practice. This approach to education is adopted when the faculty unanimously decides to open new CDIO programmes or switch the existing programmes to CDIO, and when the officials responsible for the realisation of the educational programmes fully agree with this principle and are willing to develop it [1].

In the process of Viet Nam's increasingly deep international integration into the current global economy, greater demands have been placed on higher education institutions, especially in the digital age, which is having a huge impact on Viet Nam.

The Mekong Delta has 17 universities [2] (6 private universities) with a team of lecturers and scientists who basically meet the training needs of the schools. Unlike high school, the university environment is a major turning point in life to help students practice, cultivate knowledge, and have effective learning skills, meeting the learning outcomes to approach CDIO (Conceive – Design – Implement – Operate). To form those skills, students in the engineering and technology major make learning plans, organize learning activities according to plans, test and evaluate learning results, build a standard learning routine for themselves, proficient in determining goal-setting skills, determining content, choosing effective learning methods, forms, and means (including studying in class and self-studying at home), form self-study and lifelong learning skills, and ensure professional practice capacity after graduation according to employer requirements.

The research "Curriculum Reform: Cooperative Learning: The Hong Kong Institute of Education", authored by Linn & Songer (1988), pointed out that it requires an understanding of what needs to be learned and the types of experiences in the activity to well design learning activities, which will lead to effective learning [3].
According to Vu Xuan Hung [4], lecturers not only need to have a deep understanding of theoretical knowledge but also have practical capacity to foster teaching capacity for pedagogical university students in pedagogical practice according to experimental capacity. In addition, the author also proposes some measures to foster the ability to teach practical skills for university students, contributing to improving quality. Tran Dinh Hoe [5] believes that Vietnam’s national qualifications framework for higher education is the minimum standards, a set of criteria with asymptotic volume, output standards, knowledge requirements, skills, attitudes, etc. according to standards of countries in the region and the world; appropriate to the requirements of each industry sector, in order to manage the quality of human resources. Nguyen Thuy Van [6] has pointed out solutions: raise awareness about building learning outcomes for training programs at universities. In the process of building output standards and developing training programs, the educational philosophy of fundamental and comprehensive innovation in education and training must be demonstrated and associated with the implementation of the motto “the quality of the school’s training”. The field is the unit’s combat readiness. Educational philosophy must first be thoroughly grasped in the process of building learning standards, thereby penetrating deeply into the process of developing training programs. Building output standards of training programs must start from labor market research. On the basis of analyzing the needs of society (students, schools, units), based on the school’s mission, vision, and core values to build output standards and develop training programs. Nguyen Duc Giang [7]; Ngo Van Khanh et al. [8; 9] believes that: students’ learning activities are self-conscious, active, proactive, self-organizing, and self-controlling their cognitive and learning activities to acquire, process them, and transform information into their own knowledge, in which learners express themselves and enrich their own values.

Dang Thanh Hung assumed that in principle, Vietnamese educational activities are explained and specified from the approach based on new aspects of modern teaching [10]. The study “Self-study – A Basic Learning Method for Students” by Pham Viet Ha affirmed that self-study and self-training were extremely important, and it was necessary to aim for self-study and lifelong learning [12].

Pham Thi Thanh Hai in the article "Managing Student Learning Activities According to the Credit System at Vietnamese Universities" determined the content of managing student learning activities in the credit system includes planning and guiding students to make study plans, organizing the management system for student learning activities, guiding and directing students' learning activities, testing and evaluating students' learning activities [13].

Nguyen Thanh Son in the article "Managing Student Learning Activities at Southern Private Universities", determined the content of managing students' learning activities at public universities including decentralization of subjects within the university regarding managing academic activities, managing learning activities according to management functions (planning, organizing, directing, and examining) [14]. Thieu Van Nam with Managing learning activities according to Competency-Based Approach for ethnic minority students at boarding high schools in the Southwest Region" [15], Sam Thi Le Thanh with basic theoretical issues on managing learning activities of ethnic minority students at boarding high schools [16]. Nguyen Van Dinh with the thesis "Managing Students' Learning Activities in high schools in the Mekong Delta", proposed that managing students' learning activities in high school education is about implementing decentralization authority in management among subjects, from principals to professional team leaders and teachers, management content...
including managing learning habits, manage elements (objectives, content, methods, forms, testing, and evaluating learning results), and managing learning conditions (facilities, equipment, environment) [18].

There is still a gap in training high-quality human resources in the Mekong Delta region. To meet the needs of learners, society, and domestic and foreign labor markets, higher education institutions improve training quality, ensure the development of qualities and self-study capacity, and help students learn to enrich knowledge, creativity, professional ethics, scientific research capacity, practical capacity, professional skills, working behavior, labor discipline with life skills, working skills, foreign languages, information technology, digital technology, creative thinking, and international integration, global citizenship [19]. This is the top standard to evaluate the brand, reputation, and quality of educational institutions and universities. Having effective strategies to train learning skills for technology engineering students approaching CDIO in the Mekong Delta, Viet Nam to meet the needs of the international labor market is extremely important and vital to the universities.

RESEARCH METHODOLOGY

The article uses methods of collecting documents, analyzing, synthesizing, and comparing theoretical documents, documents, guidelines, and policies of the Communist Party of Viet Nam and the State of Viet Nam, internal and foreign research projects with content related to effective learning skills training for engineering and technology students approaching CDIO in the Mekong Delta, Viet Nam.

Method of document collection: These data are secondary data used in research including books, newspapers, and journals related to the article. These data are collected by reading and citing (citing references).

SWOT analysis: SWOT (Strengths, Weaknesses, Opportunities, and Threats) is the method used to analyze the advantages, limitations, and causes of problems, and propose effective measures to train learning skills for engineering and technology students approaching CDIO in the Mekong Delta, Viet Nam today.

Scale: To evaluate the level of perception, the article used a 5-level Likert scale in the questionnaires. It is a commonly used scale in quantitative research, developed and introduced by Rennis Likert in 1932. The average value (Mean) is used to evaluate for each factor as follows:

<table>
<thead>
<tr>
<th>Level</th>
<th>Point Range</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4.2 - 5.00</td>
<td>Very good</td>
</tr>
<tr>
<td>4</td>
<td>3.40 - 4.19</td>
<td>Good</td>
</tr>
<tr>
<td>3</td>
<td>2.60 - 3.39</td>
<td>Fair</td>
</tr>
<tr>
<td>2</td>
<td>1.80 - 2.59</td>
<td>Poor</td>
</tr>
<tr>
<td>1</td>
<td>1.00 - 1.79</td>
<td>Bad</td>
</tr>
</tbody>
</table>

In addition, the article also uses methods including the investigation method, interview method, observation method, practical summary method, experimental method, product research method, and expert method. In particular, statistical methods are used to process investigation results. Stata, SPSS 25, MS Excel software, and One-way ANOVA are implemented to analyze research results and evaluate the reliability of survey data.
To improve knowledge of effective learning skills for engineering and technology students to meet CDIO standards, we want to survey the current situation and conduct experiments to propose strategies aiming at training learning skills for engineering and technology students to meet the CDIO standards of universities in the Mekong Delta and help students improve their learning skills.

*The author conducted a survey and pedagogical experiment in universities to outline the experimental pedagogy and the feasibility of effective learning skills training strategies for engineering and technology students approaching CDIO.

The goal of the method is to collect investigative information about what needs to be studied. The survey method is divided into 2 phases: phase 1 (from March 1 to March 31, 2022) and phase 2 (from March 1 to March 31, 2023) at Vinh University of Technical Education Long.

The participants were 03 groups of managers, lecturers, academic advisors, and students of Vinh Long University of Technical Education. The number of people surveyed was 191 people, of which 45 were managers; 56 were lecturers and academic advisors, and 90 were students.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Vinh Long University of Technical Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managers</td>
<td>45</td>
</tr>
<tr>
<td>Lecturers, Academic Advisors</td>
<td>56</td>
</tr>
<tr>
<td>Students</td>
<td>90</td>
</tr>
</tbody>
</table>

The research objectives and pedagogical experiment focus on the main contents: the importance and feasibility of strategies to practice learning planning skills, use effective study skills, develop soft skills for students, and build learning space approaching CDIO which is suitable for engineering and technology students.

*Experimental scale*: Assess the level of opinion polling (5 levels): Very Good, Good, Average, Poor, Bad. Compare the results Pretest and Posttest of the experimental method.

Processing questionnaire data through mean scores (5 levels). Mean score = (n1 $\times$ score 1 + n2 $\times$ 2 +...)$/N$

$n$ = the number of valid observations for the variable 1 (or 2; 3; 4; 5) ; $N$ = The total number of observations.

Mean (Gía trị khoảng cách) = $(\text{Maximum} – \text{Minimum})/n = (5 – 1)/5 = 0,8.$

Preparing for the experiment: Control method: The control is carried out by taking surveys of managers, lecturers, and students pretest (from March 1 to 31, 2022) and posttest (March 1 to 31, 2023). Prepare experimental conditions: Ask the school leadership for permission to organize meetings with managers, lecturers of 02 professional faculties, and the teaching aid department participating in the experiment to deploy the content, process, and report experimental results on schedule.
The Likert Scale

<table>
<thead>
<tr>
<th>Meaning</th>
<th>Level</th>
<th>Point Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bad</td>
<td>1</td>
<td>1.00 - 1.79</td>
</tr>
<tr>
<td>Poor</td>
<td>2</td>
<td>1.80 - 2.59</td>
</tr>
<tr>
<td>Fair</td>
<td>3</td>
<td>2.60 - 3.39</td>
</tr>
<tr>
<td>Good</td>
<td>4</td>
<td>3.40 - 4.19</td>
</tr>
<tr>
<td>Very Good</td>
<td>5</td>
<td>4.2 - 5.00</td>
</tr>
</tbody>
</table>

Experimental activities: Organize meetings for managers and lecturers to implement the experimental plan, disseminate and clarify the contents and its steps, send documents and instructions for implementing activities according to the process to departments and participants, organize surveys, measurements, and evaluation in pretest, closely monitor the experimental process so that implementers do not miss the content and steps of the experimental process. After finishing the experimental activities, the implementing departments report the results of carrying out the activities according to the procedure and the experimental requirements.

Measuring experimental results is conducted through questionnaires to survey the opinions of managers, lecturers, and students. The standard deviation is determined to measure the dispersion of the answer point compared to the mean score. If the standard deviation is smaller, the dispersion is closer to the mean score, proving that the result is of high value. Otherwise, the deviation score is larger showing that the answer score is far from the mean score, and related factors need to be reviewed.

Firstly, the experimental results for training learning skills according to plans. In pretest, the difficulties students often encountered were regarding learning planning skills, students did not clearly understand planning methods (not identifying their strengths, weaknesses, opportunities, and challenges before planning); and did not clearly understand the content structure and how to present the plan according to the necessary headings (plan format). Difficulties in implementing the content according to the given formal structure such as determining the goals to be achieved according to the learning period (measurable, achievable, realistic, and time-bound), determining the learning content that must closely follow the set goals (classroom learning content and self-study content), identifying appropriate resources, tools, and means of self-study, and completing the plan according to the time schedule for effective implementation is very difficult for students.

Making a study plan is difficult for students, so implementing the compiled study plan is even more difficult. In reality, learning activities encounter many external circumstances, and environmental impacts which hinder the progress, method, and time compared to the original plan, forcing students to take many measures. Improving, adjusting, and overcoming so that the learning plan can be carried out satisfactorily as planned is very difficult for students.

Besides, the skill of testing and evaluating the learning results according to the plan is quite new to students. Students only know how to study according to the instructions of the lecturer and the checks and reminders from the lecturer. They have not proactively checked and evaluated their own learning activities because they do not have the skills to do this from their own learning practice.
In posttest, the results were as follows: To ensure statistical reliability, the researcher investigated the correlation coefficients between variables in the model, and the results of the skill variables had quite good correlation coefficients with each other. good (>0.98). At the same time, the p-value coefficient < 5% for all variables shows a statistically significant correlation between selected variables (table 3).

Experimental results from Table 3 showed that training planned learning skills for students in engineering and technology students, the results in the posttest were evaluated as the fair level (3.49 /5 points), while in the pretest, the rating was "average" (2.12/5 points).

It can be clearly seen that the improvement in study planning skills of these students in the posttest was clearly compared to the ones in the pretest. To confirm the value of the mean score compared in the Pretest and Posttest. The researcher continued to perform a t-test to evaluate the difference in average scores between the two surveys (before and after) and the results of the Pr value (|T| > |t|) = 0.00 (p-value < 5%) showed that there is a and statistically significant difference between the mean value of the planned study skills training score between the first observation and second one. It can be concluded that the score in the posttest is higher than the first one which is statistically significant in the experiment.

### Table 3

<table>
<thead>
<tr>
<th>No</th>
<th>Contents</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Managers</td>
<td>Lecturers</td>
</tr>
<tr>
<td>1</td>
<td>Study-planning skills</td>
<td>2.26</td>
<td>2.12</td>
</tr>
<tr>
<td>1.1</td>
<td>Goals, roadmap planning skills</td>
<td>2.22</td>
<td>2.07</td>
</tr>
<tr>
<td>1.2</td>
<td>Skills in determining work content and how to implement the plan.</td>
<td>2.38</td>
<td>2.05</td>
</tr>
<tr>
<td>1.3</td>
<td>Skills in implementing study plans.</td>
<td>2.18</td>
<td>2.23</td>
</tr>
<tr>
<td>2</td>
<td>Skills in implementing study plans over time</td>
<td>2.29</td>
<td>2.21</td>
</tr>
<tr>
<td>2.1</td>
<td>Learning in classes</td>
<td>2.44</td>
<td>2.42</td>
</tr>
<tr>
<td>2.2</td>
<td>Self-study at home</td>
<td>2.13</td>
<td>2.00</td>
</tr>
<tr>
<td>3</td>
<td>Skills to self-check the results of implementing study plans</td>
<td>1.82</td>
<td>1.97</td>
</tr>
<tr>
<td>3.1</td>
<td>Quality of types of study plans</td>
<td>2.00</td>
<td>1.82</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>2.16</td>
<td>2.07</td>
</tr>
<tr>
<td></td>
<td>p-value</td>
<td>p-value &gt;5%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pearson correlation coefficient</td>
<td>r&lt;0.6</td>
<td></td>
</tr>
</tbody>
</table>

Students are trained and guided specifically and methodically by instructors on the steps to learn, practice, and form skills in planning, organizing, and implementing plans, checking, and evaluating the plans, and their performance in learning activities. On this basis, students have basically grasped the process and how to carry out learning tasks according to the plan.
From making a study plan, then organizing the implementation of the learning plan and testing, evaluating, improving, and adjusting work throughout the learning process is the most basic. The skills of learning about one’s own strengths, weaknesses, opportunities, and challenges before planning are thoroughly and accurately understood by students. Students carry out planning according to types of plans that meet real-life learning needs.

Students achieve the requirements of skills in determining goals, content, and methods of implementation over time and skills in self-examination and evaluation of the contents of implementing their own learning plans that gradually form, and enter into a stable routine quite thoughtfully and effectively, as announced by the post-experimental evaluation results. Overcome most of the limitations in skills that were raised before the experiment. The quality of all types of plans has been improved, meeting students’ learning needs, and promoting one’s positivity, initiative, and creativity in studying according to plans with remarkable initial results.

Second, the experimental results for using effective learning skills.

In pretest, using these learning skills had the following limitations which was students did not have a clear and specific understanding of the goals, connotations, usage, and advantages of each learning technique. This particular effect is that students have not been introduced, trained, or guided to learn in-depth about theory and practice the content and methods of effective learning techniques mentioned above. Students have not experienced using these techniques in regular practice, so students do not have the skills to choose and use them effectively as expected learning requirements.

The results showed that students’ skills in using effective learning techniques through the assessment survey are at an average level (scores are quite low at this level). Specifically, students have difficulty choosing and using learning methods, skills in implementing technical design projects - approaching CDIO, skills in giving positive feedback in learning, and especially skills in writing internship reports and graduation theses with the lowest average score. These are the difficulties students encounter when pre-experimenting with this content.

In posttest, regarding using learning skills, there are comments as follows. The correlation coefficient between variables in the model has quite good correlation coefficients with each other (>0.8). In addition, the p-value coefficient < 5% for all variables shows a statistically significant correlation between selected variables (table 4).

The experimental results for using effective learning skills in learning were assessed by the survey that there is a significant improvement compared to pretest with the mean score in the posttest of 3.44/5 (good level) and the mean score in the pretest was 2.25/5 points (the fair level). However, this is only the mean score compared pretest and posttest. The researcher continues to perform a t-test to evaluate the difference in average scores between the two surveys (before and after) and the results of the Pr value (|T| > |t|) = 0.00 (p-value < 5%) show and confirm that there is a statistically significant difference between the mean score for training effective learning skills between the pretest and posttest.

Students basically clearly understand the connotation, meaning, and implementation of learning techniques, functions, and tasks in corresponding to the learning content. Students are trained, guided, and provided with knowledge, and experiential skills to implement these learning skills in practice by the lecturer. On this basis, it helps students deeply understand and apply these familiar learning skills in practice, bringing interest in learning and learning results according to the subject requirements.
Table 4
Practicing effective learning skills

<table>
<thead>
<tr>
<th>No</th>
<th>Contents</th>
<th>Pretest</th>
<th>Posttest</th>
<th>Rank- ing</th>
<th>Rank- ing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Managers</td>
<td>Lectu- rers</td>
<td>Students</td>
<td>The average score</td>
</tr>
<tr>
<td>1</td>
<td>Active listening skills (listening with notes)</td>
<td>2.26</td>
<td>2.12</td>
<td>2.23</td>
<td>2.20</td>
</tr>
<tr>
<td>2</td>
<td>Active reading skills</td>
<td>2.22</td>
<td>2.07</td>
<td>2.19</td>
<td>2.16</td>
</tr>
<tr>
<td>3</td>
<td>Giving and Responding Positive feedback skills</td>
<td>2.38</td>
<td>2.05</td>
<td>2.28</td>
<td>2.23</td>
</tr>
<tr>
<td>4</td>
<td>Effective note-taking skills</td>
<td>2.18</td>
<td>2.23</td>
<td>2.22</td>
<td>2.22</td>
</tr>
<tr>
<td>5</td>
<td>Skills in choosing learning methods</td>
<td>2.29</td>
<td>2.21</td>
<td>2.27</td>
<td>2.25</td>
</tr>
<tr>
<td>6</td>
<td>Skills to collect and use learning materials</td>
<td>2.44</td>
<td>2.42</td>
<td>2.34</td>
<td>2.39</td>
</tr>
<tr>
<td>7</td>
<td>Practical - production skills</td>
<td>2.13</td>
<td>2.00</td>
<td>2.19</td>
<td>2.12</td>
</tr>
<tr>
<td>8</td>
<td>Skills in implementing technical design projects - CDIO approach</td>
<td>1.82</td>
<td>1.97</td>
<td>2.11</td>
<td>2.00</td>
</tr>
<tr>
<td>9</td>
<td>Skills for writing internship reports and graduation theses;</td>
<td>2.00</td>
<td>1.82</td>
<td>2.19</td>
<td>2.03</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>2.16</td>
<td>2.17</td>
<td>2.35</td>
<td>2.25</td>
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<td></td>
<td>p-value</td>
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<td>p-value &gt;5%</td>
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<tr>
<td></td>
<td>Pearson correlation coefficient</td>
<td></td>
<td></td>
<td></td>
<td>r&lt;0.6</td>
</tr>
</tbody>
</table>

Equipping students with effective learning skills and showing them how to use these learning skills are very meaningful things to help students proactively and actively study, bring a passion for learning, and highly effective learning, promote study habits, and form lifelong learning habits for students. They are factors for sustainable learning in the future, especially the skill of giving positive feedback in learning. In the pretest, it ranked seventh before the experiment but ranked first in the post-test. This is a very necessary skill to improve learning efficiency, because only with feedback can there be adjustments and improvements from the subjects.

The results showed that students have acquired an increased capacity to use learning skills in practice. This means that the experimental research has scientific significance, the experimental method is practical, and the results achieved meet the objectives of the experimental task set out for this content.

Thirdly, the experimental results for developing soft skills for students.

In pretest, soft skills still had many limitations. Students in the engineering and technology major were very hesitant to communicate with people in real learning and living. The ability to speak in front of a crowd, speak in the classroom, in group activities, and talk with lecturers, and friends in events, and seminars always face many difficulties, such as reluctance to speak, being afraid to speak, not being proactive in speaking. When speaking, the content is not expressed logically so that the listener can fully understand the issue that needs to be presented. In written communication, students do not know how to present coherently and concisely according to a necessary coherent structure to express what needs to be presented. Besides, writing is not good enough for everyone to read easily due to the computerization of written documents.
Students' soft skills of thinking, reasoning, creativity, problem identification, problem criticism, and problem-solving still reveal many limitations. The use of language, symbols, and information transmission has not been appropriately focused on practice when presenting certain issues in learning and living. Vocabulary and sentence structure are not yet coherent and logical to express scientific issues.

Self-management skills have the lowest ranking among the skills. Students mainly follow the learning requirements from the lecturer, and their friends and have not yet built an action plan for learning and manage themselves to shape their future.

The skills to implement the process of Conceive – Design – Implement – Operate (CDIO approach) of engineering-technology students do not meet the needs of initiative, raising their own ideas, and technical design according to their thinking, manufacture according to the design, and organize the manufacturing technical operations according to the learning contents' requirements in a clear and effective way.

Regarding foreign language and information technology skills of engineering and technology students, they are ranked higher than other skills but it has a bad score. It can be said that it faces many difficulties, it really does not meet the needs of the digital age which requires searching for learning materials in cyberspace, in diverse forms and learning methods, especially listening, speaking, and reading foreign languages.

In posttest, soft skills have improved: The correlation coefficient between variables in the model has quite good correlation coefficients with each other (>0.9). In addition, the p-value coefficient < 5% for all variables shows that there is a statistically significant correlation between the selected variables. DTUONG is the only variable with low correlation coefficient (<0.1) and p-value coefficient >5% with all variables, proving that in this test there is no difference between research participants (managers, lecturers, and students) on developing soft skills for students (table 5).

Experimental results in Table 5 showed that in terms of "developing soft skills for students in engineering and technology students, the level of success is considered quite good (in the posttest, it scored 3.42/5 while in the pretest, it scored 2.44/5). The value of mean was compared in the pretest and posttest. The researcher continued to perform a t-test to evaluate the different values between the two surveys (before and after), and the result was $Pr \, \text{value} \,(|T| > |t|) = 0.00 \,(p\text{-value} < 5\%)$ is proven, confirming that there is a statistically significant difference between the mean score of "soft skills training for students" between the pretest and posttest.

<table>
<thead>
<tr>
<th>No</th>
<th>Contents</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Managers</td>
<td>Lecturers</td>
</tr>
<tr>
<td>1</td>
<td>Direct communication skills (speaking, presentation, vv)</td>
<td>2.44</td>
<td>2.60</td>
</tr>
<tr>
<td>2</td>
<td>In direct communication skills (written communication)</td>
<td>2.38</td>
<td>2.67</td>
</tr>
<tr>
<td>3</td>
<td>Thinking, evaluation, and critical thinking skills</td>
<td>2.62</td>
<td>2.78</td>
</tr>
<tr>
<td>4</td>
<td>Problem-solving skills</td>
<td>2.38</td>
<td>2.63</td>
</tr>
</tbody>
</table>
Skills for working in a technical environment

<table>
<thead>
<tr>
<th>Skills</th>
<th>Mean</th>
<th>p-value &gt;5%</th>
<th>p-value &lt; 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5</td>
<td>2.53</td>
<td>2.95</td>
<td>2.68</td>
</tr>
<tr>
<td>Management and personal development skills</td>
<td>2.27</td>
<td>2.30</td>
<td>2.33</td>
</tr>
<tr>
<td>7.5</td>
<td>2.31</td>
<td>2.65</td>
<td>2.49</td>
</tr>
<tr>
<td>Skills in implementing the CDIO approach</td>
<td>2.49</td>
<td>3.12</td>
<td>2.66</td>
</tr>
<tr>
<td>Foreign language skills</td>
<td>2.73</td>
<td>3.12</td>
<td>2.70</td>
</tr>
<tr>
<td>Applying information technology skills</td>
<td>2.46</td>
<td>2.55</td>
<td>2.59</td>
</tr>
</tbody>
</table>

Overcome some outstanding limitations of soft skills mentioned in the pretest basically and effectively.

Students implemented their soft skills in their learning and living practices naturally, gently, and effectively.

Students feel confident, proactive, positive, and creative in choosing and applying soft skills in studying, communicating with people, solving problems in learning, and doing scientific research effectively.

Compared to the pretest, effective learning ability is improved through training and developing soft skills in studying and living in the posttest.

**Fourthly**, the general assessment of the experimental results of the project "Strategies to train effective learning skills for engineering and technology students approaching CDIO in the Mekong Delta, Viet Nam".

Regarding training learning skills according to plans, there are successful results at the highest level. Practicing study-planning skills means forming and training scientific and methodical working skills according to a plan from the planning stage, organizing the implementation of the plan, and evaluating the level of implementation of the plan to adjust and improve the plan and bring about the highest learning results.

Regarding using effective study skills and soft skills, there are very necessary and important skills that must be equipped for students to organize learning in class and self-study at home according to their goals.

The above experimental results show the necessity, suitability, feasibility, scientificity, and practicality of the experimental content to ensure and improve learning capacity for learners through fostering effective learning skills for engineering and technology students in the Mekong Delta, which is feasible and highly effective.

**DISCUSSION OF RESULTS**

**Firstly, practice the study-planning skills**

One of the important contents of learning activities is to practice planning skills for students, including personal learning planning skills, skills for implementing learning plans, and self-checking or self-evaluating skills for the results of implementing learning plans.

**Procedure: Step 1**, professional faculties assign lecturers to perform training tasks and guide students to make personal study plans including the following tasks: First, students clearly understand the training program and learning outcomes about knowledge, skills, and attitudes when completing the course. Second, instruct analyzing personal capacity,
behavior, habits, time and learning conditions. Third, determine each individual’s specific learning goals right from admission. Build short-term goals to remind and motivate you to achieve long-term goals. Fourth, make a study plan for each individual (first year, second year, third year, fourth year and each specific subject/module; daily, weekly, monthly, semester schedule, etc.). Fifth, monitor and edit the plan regularly. **Step 2**, lecturers prepare training materials and tools, including theoretical guidance documents associated with practicing study-planning skills, develop tools and forms with clear structures including sections and subsections; implement method is planning for each topic in the plan structure and and determine criteria for evaluating finished products (completed plan). Step 3, lecturers provide forms and documents to guide "study planning" for students and carry out training tasks, instructing students to practice making a study plan according to the prepared form and tool; integrated practice in theory, mainly practice making plans; set aside time for students to complete each part of the product's content; make sure to complete each item in the plan before moving on to the next step; ask students to present, criticize, evaluate, and supplement, edit each part before moving on to another task

**In terms of products:** Planning products include the entire course study plan, showing the content of tasks of each semester in the course; study plan for each semester, showing expected course registration (course name, number of credits, etc. for each semester); subject study plan (each subject registered for each semester), showing learning goal, content, etc. according to the official timetable the Faculty has arranged; determine the content of self-study time for studying at home (self-study); plan for grade skipping and re-study (if any), along with the training program for each semester; the additional study plan for the second degree (if any).

**Products on organizing:** the implementation of learning skills according to plans include tables to monitor learning progress according to each type of plan mentioned above; mainly monitoring the progress of implementing each subject's learning plan (goals, content, time).

**Products for self-checking the implementation of learning skills according to the plan,** including a diary to self-assess the level of completion of the implementation of the learning plan for each subject by semester (goals, content, time). In particular, it is necessary to clearly show a diary assessing progress in achieving goals during the learning process and at the end of the subject; devising plans to overcome and improve to exceed their current leve.

**In terms of assessment criteria:** Assess skills of planning, implementing plans, and checking the implementation of your own plans; evaluate the quality achieved according to the criteria required by each type of product-specific learning plan. Conducting assessments mainly assessed by students themselves and lecturers (in consultation with the assessment of department-level management). Evaluation through objective survey, using a scale of 5 levels (Vere good, good, fair, bad, poor).

**Secondly, use effective learning skills**

**Procedure:** **Step 1**, the professional faculties assign lecturers to compile and provide students with a set of handbooks for practicing effective learning skills including active listening skills (listening with notes); active reading skills; skills to respond positively to information in learning; effective note-taking skills (when listening to lectures and reading documents independently); skills in choosing learning methods; skills to collect and use learning materials; practical – production skills; skills in implementing technical design projects - CDIO approach; skills for writing internship reports and graduation theses; briefly write how to practice each skill, how to choose skills appropriate to the specific learning content. **Step 2**, the professional faculties assign and monitor lecturers to implement, train,
and guide students to practice effective learning skills according to the issued theoretical handbook. **Step 3**, the lecturer carries out the task of guiding students to practice "effective learning skills" and monitors students practicing during class time and the time for self-study at home. Lecturers organize teaching by guiding students to apply effective learning skills consistent with the theoretical, practical, and integrated content of each subject. **Step 4**, lecturers create conditions for students to demonstrate their ability to use effective learning skills through practical learning activities in class and assigned learning products. Classroom learning and self-study tasks at home, scientific research tasks, and in-depth learning activities that apply effective learning skills in practice.

**In terms of products:** Demonstrating the use of effective learning skills in students' diaries. The product of using effective learning skills is students' learning results, assessed through the learning process in class and self-study at home (lecturers' regular assessment, peer assessment, and self-assessment); and course learning outcome.

**In terms of assessment criteria:** Assess effective learning skills through the levels of proficiency and effectiveness in using these skills in practical learning (knowing, understanding, applying, creating). Conducting assessments mainly assessed by students themselves and lecturers (in consultation with the assessment of department-level management). Evaluation through objective survey, using a scale of 5 levels (very good, good, fair, bad, poor).

**Thirdly, develop soft skills for students**

**Procedure:** **Step 1**, Establish the content of a theoretical model of practical soft skills that need to be formed for students during the learning process (editing, evaluating, publishing). The editorial board includes many scientists, managers in the fields of culture, society, and humanities, lecturers, union officials, and student representatives. **Step 2**, organize the implementation for students to learn and apply the issued theories. Lecturers mainly organize for students to practice soft skills during class time and regular classroom activities (learning theory, practice, and integration); and create opportunities for students to practice their English skills and information technology application capabilities through subjects, learning activities, and exams. Students participate in club activities to improve foreign language skills, international conferences, and participate in scientific research effectively. **Step 3**, coordinate between professional faculties and organizations inside and outside the school to create opportunities for students to practice soft skills effectively in lively training environments associated with learning activities, school activities, and the daily life of students. Expand training in activities of organizations, clubs, student groups.

**In terms of products:** Students' soft skills are expressed through their behavior, attitudes, level of confidence, and proficiency in studying, researching, and living inside and outside of school. It is also expressed through students' learning capacity and behavior; between students and lecturers and administrators; between students and off-campus customers; and between students and internship companies. Specifically, it is the students' ability of students to behave and communicate directly; abilities to present and debate in front of a crowd; scientific critical capacity by topic.

**In terms of assessment criteria:** Assess soft skills through levels of communication behavior in learning and research in school and society. The ability to complete the requirements in performing learning tasks is demonstrated through the level of thinking, analysis, evaluation, criticism, and giving opinions on certain issues. Conducting assessments through channels is mainly self-assessment by students, and mainly assessments by
lecturers and administrators at the department and school level. Evaluation through objective survey, using a scale of 5 levels (Good, good, average, weak, poor).

Based on SWOT analysis, identify strengths, weaknesses, opportunities, and challenges, to propose some effective strategies to train learning skills for engineering and technology students approaching CDIO in the Mekong Delta, Viet Nam today.

**Firstly, practice study planning skills.**

Experimental results show that managers, lecturers, and students are especially interested in and evaluate the importance and feasibility of the measures: practicing study planning skills (planning skills, skills for implementing study plans, skills for self-checking the results of implementing study plans). Quality of different types of study plans for students of engineering and technology majors approaching CDIO in the Mekong Delta, educational managers, lecturers, and students have an average score of 3.49 points. Personal study plans are considered the product of planning activities done by oneself. Personal study planning is the process of determining goals, mobilizing and arranging resources, and choosing methods and measures to achieve the goals in the plan. Study planning skills includes:

Skills in determining goals, determining roadmaps, and learning progress through SWOT analysis (strengths, weaknesses, opportunities, challenges). Goals need to be specific, measurable, achievable, realistic, and time-bound.

Skills in determining work content and how to implement the plan. Skills in completing detailed study plan for each module (making diagrams and work progress). Set up paper and electronic boards to remind you of due work.

Skills in implementing study plans. Skills to self-check the results of implementing personal study plans.

**Secondly, practice effective learning skills**

In general, administrators, lecturers, and students highly evaluate the importance and feasibility of the measures group: active listening skills (listening with notes), active reading skills; skills to respond positively to information in the classroom; effective note-taking skills; skills in choosing learning methods; skills in collecting and using learning materials; practical skills; skills in implementing technical design projects – CDIO approach; skills in writing internship reports and graduation theses (educational managers, lecturers and students have an average score of 3.44 points) are proved in the results. Experimental results have proven that.

**Practice active listening skills (listening with notes).** Listen to lectures on theoretical, practical, or integrated learning content. Step 1, prepare to listen to the lecture: students must mobilize knowledge from previous lessons, read the textbook themselves, and determine the content they need to listen to in class (write it down, and mark it before studying); Step 2, during the process of listening to lectures, determine what knowledge is specifically contained in the textbook; Step 3, take notes while listening to the lecture, practice taking notes appropriately and effectively while listening to lectures (shorthand of the entire lecture, summarizing main ideas, writing briefly in your own way, diagrams, drawings, symbols); Step 4, review after listening to the lecture, review what you have written to update more thoughtfully [20].

**Practice active reading skills.** Practice reading while studying in class and reading outside of class (library, at home, etc.). Read textbooks, lectures, and relevant references. Practice reading forms: thoughtful reading, systematic reading, selective reading, lip reading, silent reading (with eyes), word-by-word reading, eye level reading (wide/narrow), using a pen guide when reading, finding main ideas and highlighting while reading, combining listening
to music while reading, reading summaries of each article's content, changing reading techniques to increase reading speed, combining reading with writing (marking), scanning, skimming, focused reading, unfocused reading, passive reading, active reading, deep reading, reading with purposes.

**Practice giving positive feedback skills in learning.** Implement the skills of analyzing, criticizing, and presenting the content in learning. Give feedback through writing, drawing, and presenting (speaking effectively means speaking so that others understand what is being presented). Give feedback by asking questions, raising problems, expanding on problems, and giving similar problems about learning content.

**Effective note-taking skills** (when listening to lectures and reading documents). Note-taking skills while listening to lectures and self-note-taking skills while perceiving learning materials, studying theory, learning practice, and learning to integrate theoretical and practical content. There are many effective note-taking styles such as note-taking main ideas (a few words, sentences), writing briefly, making an outline, box style, table style; shorthand (with drawings, images, characters, symbols), herringbone style, column division style, mind map style; note-taking information in the form "question, answer, evidence" or your own understanding.

**Practice skills in choosing learning methods.** Raise awareness for students about the need to use active learning methods (due to rapid socio-economic development, science and technology, educational integration trends in the region and the world, and innovating training methods according to the credit system). Establish a positive learning style for students: imagine, reflect, analyze, think, decide, act, balance, create, create, experience. Students can choose active learning methods suitable for the engineering and technology field, mainly learning through experience, problem-based learning, learning through situations, learning through inquiry; community service learning, project-based learning, and collaborative learning.

**Practice skills in collecting and using learning materials.** Develop students' skills in searching and looking up information on the internet from published books, specialized scientific journals, specialized scientific documents, seminar documents, course-appropriate learning materials, school library, digital library, and lecturer’s documents. Equip skills to set up a personal learning material repository.

**Practice practical and production skills.** Phase 1: Get familiar with tools, and production equipment (practice movements, know how to use tools, material selection, know how to open and close machines, etc.); Phase 2: Students practice simple movements and operations of each task in a certain stage; Phase 3: perform general tasks, practice combining many practical skills (practice positions, production line layout, simple calculations, checking and evaluating the quality of work and products process).

**Practice skills in implementing technical design projects – CDIO approach.** This skill follows the CDIO process, as follows: (i) Raise ideas: step 1, identify and model the problem, give ideas, evaluate, and state the design problem; Step 2, determine technical parameters; (ii) Design: step 1, make an implementation plan; Step 2, select the principle diagram and dynamic diagram; Step 3: calculate design; Step 4: sketch the structure of the entire system; step 5: set up drawing and model; (iii) Manufacturing and assembly; (iv) operation: Step 1: operate the product (test, calibrate, etc.); Step 2: prepare design documents (explanations, drawings, summary, etc.)

**Practice writing skills for internship reports and graduation thesis.** Ask students to present their opinions and thoughts about the engineering profession they are studying,
the reason for choosing this career, desires after completing the graduation theses, students will be more understanding of the engineering field they are studying, find it interesting, and determine their dream goals for their future career development.

Presentation skills in the correct format, structure, and style, according to the contents of the project or graduation thesis as prescribed by the school. The structure of the thesis includes two main parts: literature review and experimental basis. Make sure to research on schedule and complete your thesis. Report progress periodically to instructors. Follow the procedures after completing the project and submit it to the professional faculty. Prepare a report to present to the dissertation committee.

**Thirdly, practice soft skills for students.**

Highlights of training soft skills for students: Get very high agreement from administrators, lecturers, and students who are interested in and evaluate the importance and feasibility of the solution to train students' soft skills for students. The mean score of teachers and students is 3.42. Communication skills are expressed through (direct, indirect) verbal, physical, written, and non-verbal communication, debates, interviews, negotiation, presentation, critical thinking, evaluation (give your own arguments, evaluate and consider problems scientifically), problem-solving and planning skills (identifying and raising problems), skills for working in sequence and technical demonstration (ability to calculate, use working equipment), management and personal development skills (cooperating with people, working independently), design, manufacturing and implementation skills (imagine the problem that needs to be done, visualize the problem, design models and processes, produce the designed product), practice skills in using foreign languages and applying information technology in learning.

**Fourthly, build a learning space approaching CDIO suitable for engineering and technology students.** The learning space helps form ideas and helps students imagine new products and systems that suit real-life product needs. Spaces to practice individual and group skills. Modern equipment and technology, are suitable for learning, communication, and exchange needs (books, paper documents, digital documents, audio and visual devices connected to the internet, tools for drawing, note-taking, and presenting).

The learning space helps design product models and helps students form designs on appropriate tools, such as powerful computers with advanced technical design software (CAD, CAE, CAM, etc.) and an internet connection. Learning service tools "designed" ensure enough for group learning practice and individual learning practice.

The learning space helps manufacturing details, equipment, systems from small to large, from simple to complex, etc. (mechanical, electrical, control, software). Tools for manufacturing include metal processing machines, hand tools, technical measuring equipment, and technical programming computers to ensure high safety in practice.

Learning space helps operate students' learning and research products. The environment ensures students practice and experience operating research products, and manufacturing according to the learning technical equipment system process.

**CONCLUSION**

In the process of industrialization, modernization, and international integration in the digital age, revitalizing the country's education system is facing an urgent task, which is the need to train quality human resources with high quality, the capability to adapt
and meet the requirements of the labor market and society. Therefore, training effective learning skills for engineering and technology students approaching CDIO with life skills, work skills, foreign languages, information technology, digital technology, and creative thinking to integrate internationally, become global citizens, meet the needs of society and the international labor market is the key for Vietnamese universities to go beyond and develop sustainably in the digital age – the Fourth Industrial Revolution, international integration, knowledge economy.

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