A Study on the Current Status and Improvement Plans for e-Learning Utilization Using the Delphi Technique: Focusing on Scuba Diving Education

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[Abstract]

This study aims to analyze both the current utilization of e-learning in the scuba diving education sector and the possible improvements by using Delphi analysis. The study administered three rounds of Delphi surveys with 25 specialists, including business executives and educational leaders from scuba diving centers and resorts affiliated with organizations that conduct scuba diving education through e-learning. The comparative analysis of the state of e-learning utilization and factors for improvement revealed significant insights. In terms of expected benefits, the analysis highlighted an increase in user convenience, temporal flexibility in learning activities, and easy access to products. However, it identified major issues such as the simplistic mandatory exams, inadequate professional depth in the feedback provided, and a lack of bidirectional communication between learners and instructors. Recommendations for improvements included enhancing communication through various online communities, conducting mandatory exams offline, and developing a variety of content. Conducting regular program quality evaluations, integrating with various diving communities, and assigning dedicated tutors were deemed crucial factors for future development.

▸Key words: e-Learning, Scuba Diving Education, Delphi Technique, Current Utilization, Improvement Plans

[요   약]

이 연구는 델파이 분석을 활용하여 스쿠버다이빙 교육현장의 이러닝 활용실태와 개선방안을 분석하는데 목적이 있다. 이러닝으로 스쿠버다이빙 교육활동을 진행하고 있는 스쿠버다이빙 교육단체 소속 스쿠버다이빙센터 및 리조트의 경영대표, 교육팀장 등 운영에 관련된 전문가 25명을 대상으로 3차례에 델파이 조사를 진행하였다. 이러닝 활용실태와 개선방안 요인을 비교 분석한 결과 활용 기대효과에서는 사용자의 편의성 증대, 학습활동의 시간적 유연성, 상품에 대한 접근성 용이가 중요 요인으로 나타났으며, 문제점에서는 단순한 필수시험 합격, 단순한 설명의 피드백으로 전문성 결여, 학습자와 교수자 간 양방향 커뮤니케이션 미비가 중요 요인으로 나타났다. 개선방안에서는 다양한 온라인 커뮤니티를 연계한 소통, 필수시험은 오프라인으로 실시, 다양한 콘텐츠 개발이 중요 요인으로 나타났으며, 발전방향에서는 주기적인 프로그램 품질평가 실시, 다양한 다이빙 커뮤니티로의 연계, 담당 튜터 배정이 중요 요인으로 나타났다.

▸주제어: 이러닝, 스쿠버다이빙교육, 델파이, 활용실태, 개선방안

I. Introduction

As the distribution and utilization of the internet increase and IT infrastructure expands, a growing global trend of educational activities and services that cross national boundaries is emerging. Additionally, fueled by the rapid growth of advanced information and communication technologies, e-learning is rapidly spreading, offering a new educational environment that leverages technology to enhance the equity and feasibility of education. This has led to the visibility of an e-learning-based learning environment accessible anytime and anywhere [1].

Currently, the demand for high-quality e-learning content appropriate for the new digital user environment goes beyond the simple and unilateral information delivery typical of current video or flash-based systems. It includes the use of CG, 3D imaging, augmented reality, virtual reality, and simulation technologies. Moreover, the emergence of the constructivist paradigm, which emphasizes personal experiential learning and the self-construction of knowledge, has increased the need for new learning methods and e-learning technologies [2].

This phenomenon is also bringing about changes in the sports industry. In advanced countries, sports industry policies are primarily focused on creating new value through the integration of IT with sports goods+services, facilities+services, and sports+health services, forming service strategies that involve both homogenous and heterogenous combinations. Furthermore, global corporations are shaping the market around platforms that integrate sports and IT, impacting the entire sports industry ecosystem [3].

In the marine sports education industry, e-learning programs have been implemented for over a decade. The Professional Association of Diving Instructors (PADI) was the first in the leisure sports industry to introduce e-learning technologies that allow learners to immerse themselves in a study environment, enhancing the realism and engagement and thus improving learning outcomes. This response to societal demands for next-generation learning content and systems provides a learner-centered educational environment that supports autonomous learning, enabling learners to engage in diverse educational experiences tailored to their individual needs. Additionally, by integrating learners' level and contextual information, it is possible to estimate the necessary learning conditions and content for each individual, ensuring the provision of optimal learning environments and content [4].

Currently, scuba diving education organizations are employing a variety of e-learning methodologies, but the majority of the learning sequence follows the pattern: e-learning → underwater training → certification acquisition → connection to the diving community. Even after e-learning, underwater training time is necessary for instructors to develop practical skills, and feedback-driven learning development occurs to address deficiencies in theoretical knowledge that e-learning alone may not fully cover.

According to PADI, the scuba diving e-learning program has been disseminated across approximately 130 countries, with 70% of the one million scuba diving trainees annually acquiring their certification through e-learning. In addition, about 100 scuba diving education facilities linked with PADI in the domestic market utilize e-learning programs. Each year, 60% of the 20,000 scuba diving trainees in these programs receive their education through e-learning [4].

The significant uptake of e-learning within ten years among trainees suggests that it is especially favored by the younger generations learning scuba diving.

Scuba diving education can reach higher quality levels when theoretical and practical learning are harmoniously integrated and developed. Theoretical scuba diving education can effectively precede through e-learning, and when this foundational

learning is followed by underwater training, the educational impact is significantly enhanced. Indeed, one can fully expect the benefits of blended learning to manifest in this field.

Currently, scuba diving education is leading the way in developing and actively distributing e-learning programs among sports disciplines. It is clear that in line with contemporary trends, e-learning programs will continue to be developed and disseminated not only in marine sports but across all sports sectors.

However, there has been a lack of prior research related to e-learning in sports, with most studies focusing on practical training analysis in sports [5], case studies of physical learning through e-learning [6], examples of online university physical education classes [7], outcomes of e-learning with smart devices in digital environments [8], and the use of Padlet in blended e-learning [9]. Most existing research involves case analyses using e-learning in practical training and digital devices, but there is a notable absence of realistic, approach-oriented studies that simultaneously reflect the opinions of experts in the sports field.

Additionally, detailed analyses of factors contributing to the enhancement of sports through the introduction of e-learning are insufficient. Therefore, this study aims to compare and analyze the factors related to the current use and improvement of e-learning in the scuba diving education field, providing foundational data that will assist in the advancement of both the scuba diving education industry and the broader sports industry.

To achieve this purpose, the following specific research objectives have been established:

First, to analyze the expected benefits of e-learning utilization in the scuba diving education field.

Second, to identify the problems associated with e-learning utilization in the scuba diving education field.

Third, to analyze the improvement measures for e-learning utilization in the scuba diving education field.

Fourth, to investigate the future development directions for e-learning utilization in the scuba diving education field.

II. Method

1. Research Subject

For the empirical approach of this study, the panel selection comprised professional groups operating scuba diving education centers and resorts both domestically and internationally. Initially, 20 scuba diving centers and resorts affiliated with organizations conducting scuba diving educational activities via e-learning were selected from both domestic and international locations, as exemplified in (Fig 1). Ultimately, a Delphi analysis was conducted with 25 experts, including business executives and education team leaders involved in the management of these scuba diving centers and resorts. The participants of this study are listed in (Table 1).

Fig. 1. Example of e-learning program usage

Table 1. Characteristics of research participants

Devision Characteristic		N	%
Gender	male	16	64
	female	9	36
Age	20~29	6	24
	30~39	8	32
	40~49	7	28
	50 years and over	4	16
Position	CEO	6	24
	General manager	8	32
	Dive trainer	11	44
Total		25	100

2. Research Method

To analyze the current state of e-learning utilization and improvement measures in scuba diving education, the Delphi Method was employed as a tool to gather and consolidate expert opinions.

Initially, a literature review and expert meetings were conducted to identify the key domains for analyzing the use and enhancement of e-learning in the scuba diving education industry.

The first survey divided the investigation into four main areas related to e-learning in scuba diving education: expected benefits, challenges, improvement strategies, and future directions. It employed four open-ended questions covering these distinct categories.

The second survey was developed by consolidating, integrating, adjusting, and deleting responses gathered from the initial open-ended questionnaire. This refined survey structured the responses into a more organized format, with each question divided into ten items. These items were categorized on a 5-point Likert scale ranging from 'strongly agree' (5 points), 'agree' (4 points), 'neutral' (3 points), 'disagree' (2 points), to 'strongly disagree' (1 point), based on their relative importance.

The third survey built upon the results of the second survey. It extracted items that achieved an average consensus level of 3.5 or above and categorized their importance on a structured 4-point Likert scale as 'very important' (4 points), 'moderately important' (3 points), 'not important' (2 points), and 'not necessary' (1 point). The survey

was designed to present the mean and standard deviation for each sector, allowing for the identification of agreement or disagreement between individual participants and the collective opinions of all respondents.

Cronbach's Alpha was used to assess the reliability of each type of item in the questionnaire used in this study. The results showed reliability coefficients ranging from .784 to .868 for expected benefits, .772 to .881 for problems, .774 to .859 for improvement measures, and .782 to .885 for future directions, indicating that all values were within acceptable limits.

Regarding the data collection methods, the initial survey (July 12 to August 15, 2023) involved explaining the purpose of the research to each participant via telephone, followed by conducting the survey through online questionnaires and email. The second survey (August 20 to September 14, 2023) and the third survey (September 21 to October 10, 2023) were also administered and collected using online questionnaires and email.

IBM SPSS (ver. 22.0) and Microsoft Office Excel 2017 were used to run statistical data analyses (e.g., computing means and standard deviations).

III. Results and discussion

1. Analysis of Expected Benefits of e-Learning Utilization in Scuba Diving Education

(Table 2) presents the results of a survey conducted to analyze the expected benefits of e-learning in the scuba diving education field, divided into primary sub-factors, secondary agreement levels, and tertiary importance.

The initial survey for structuring the sub-factors of expected benefits in the scuba diving education field identified several key elements: creating more customers, temporal flexibility in learning activities, saving educational time for instructors, selective start of education, increased convenience for users, easier access to products, facilitated online

Table 2. Analysis of Expected Benefits of e-Learning Utilization in Scuba Diving Education

Category	1st Delphi (Factors)	2nd Delphi		3rd Delphi	
		M	SD	M	SD
Expected Benefits	Creating more customers	4.10	±.61	4.08	±.64
	Temporal flexibility in learning activities	4.52	±.51	4.48	±.65
	Saving educational time for instructors	4.33	±.57	4.34	±.56
	Selective start of education	3.86	±.89	3.91	±.87
	Increased convenience for users	4.69	±.87	4.55	±.89
	Easier access to products	4.45	±.71	4.46	±.70
	Facilitated online promotional activities	3.67	±.63	3.58	±.61
	Time savings for long-distance travel plans	4.43	±.69	4.46	±.71
	Clear acquisition of learning information	3.98	±.67	3.84	±.78
	Rapid sharing of learning information.	4.12	±.72	4.05	±.61

promotional activities, time savings for long-distance travel plans, clear acquisition of learning information, and rapid sharing of learning information.

The results from the second and third Delphi surveys showed high levels of agreement and importance for increased user convenience (M=4.69/4.55), temporal flexibility in learning activities (M=4.52/4.48), ease of access to products (M=4.45/4.46), time savings for long-distance travel plans (M=4.43/4.46), and saving educational time for instructors (M=4.33/4.34).

As such, the most critical factors affecting the expected benefits of e-learning utilization in scuba diving education turned out to be the convenience for learners, the temporal flexibility, and the ease of access to educational products. This indicates that the marine sports field is well-prepared to fully leverage the fundamental advantages of e-learning, in line with the global trend of expanding internet distribution and IT infrastructure. Prior research also suggests that the system quality of e-learning must be prioritized to ensure ease of use, user-friendliness, and stability [10]. It is agreed that ensuring system quality is crucial for enhancing the expected benefits of e-learning in the scuba diving education context.

Furthermore, scuba diving often involves traveling abroad, making it a sport heavily constrained by time. The use of e-learning can be a significant advantage as it allows most of the time abroad to be allocated for underwater training. Previous research also supports this study by showing that time management strategies in e-learning positively influence class satisfaction [11].

From the instructor's perspective, focusing more on underwater training rather than dividing time between theoretical instruction and practical training can save time and allow for the education of more students. This efficient use of time is expected to have a positive impact on the management dynamics of the marine sports industry.

2. Analysis of Problems with e-Learning Utilization in Scuba Diving Education Settings

(Table 3) presents the results of a survey that explored the problems associated with e-learning utilization in scuba diving education, categorized by primary sub-factors, secondary levels of agreement, and tertiary importance.

The initial survey analysis to structure the sub-factors of issues in e-learning utilization in scuba diving education identified several key concerns: high costs, instructors' lack of understanding of the e-learning system, simplistic feedback resulting in a lack of professionalism, inadequate bidirectional communication between learners and instructors, reliance on simplistic content for each course, limitations in monitoring comprehension, high pass rates in exams that compromise essential understanding, insufficient support systems after course completion, instructors' negative attitudes towards e-learning, and learners' lack of recognition of the value of

Table 3. Analysis of Problems with e-Learning Utilization in Scuba Diving Education Settings

Category	1st Delphi (Factors)	2nd Delphi		3rd Delphi	
		M	SD	M	SD
Problems	High costs	3.76	±.68	3.69	±.61
	Instructors' lack of understanding of the e-learning system	4.03	±.81	4.12	±.79
	Simplistic feedback resulting in a lack of professionalism	4.46	±.55	4.45	±.62
	Inadequate bidirectional communication between learners and instructors	4.34	±.65	4.45	±.61
	Reliance on simplistic content for each course	3.69	±.97	3.55	±.89
	Limitations in monitoring comprehension	4.31	±.71	4.36	±.70
	High pass rates in exams that compromise essential understanding	4.53	±.63	4.52	±.60
	Insufficient support systems after course completion	3.43	±.69	Deletion	
	Instructors' negative attitudes towards e-learning	3.98	±.87	3.80	±.90
	Learners' lack of recognition of the value of e-learning education	3.81	±.82	3.77	±.81

e-learning education.

The results from the second and third Delphi surveys indicated high levels of agreement and importance for problems such as simplistic mandatory test passing (indicative of reduced comprehension) (M=4.53/4.52), lack of professionalism due to simplistic feedback (M=4.46/4.45), inadequate bidirectional communication between learners and instructors (M=4.34/4.45), limitations in monitoring learners' understanding (M=4.31/4.36), and instructors' poor grasp of the e-learning system (M=4.03/4.12).

Analyzing the problems related to e-learning utilization in scuba diving education revealed that the mandatory theoretical exams crucial to scuba diving education often lack clear differentiation and are too simplistic, making them so easy to pass. This poses a serious problem as it can degrade the essential understanding needed to prevent diving accidents and risks. Related prior research indicates that the question banks used in e-learning assessment systems generally employ an automatic question generation method based on difficulty levels. Since the difficulty of questions at the time of assessment is central to the integrity of the exams, managing this difficulty dynamically with more advanced algorithms is considered effective and necessary. This type of approach is crucial as it aims to objectively and efficiently manage the challenges presented by the questions, addressing a common problem highlighted in this study [12].

It has been identified that the simplicity and repetition of incorrect items and the feedback provided thereon lack the depth of expertise that direct teaching by instructors would offer, thus not sufficiently enhancing understanding. Another identified problem is the absence of a system capable of assessing learners' comprehension levels, although their progress can be tracked. These issues point to a systemic problem: the lack of bidirectional communication between learners and instructors during e-learning sessions. Current research into e-learning providers shows that they are implementing online education services but struggling with real-time bidirectional communication and the inability of learners to ask questions promptly. To address these challenges, they are developing systems that combine the efficiency of immediate response available offline with the openness of online platforms, allowing for real-time, free-form questions and answers in both online and offline settings [13]. The scuba diving education industry should also endeavor to develop systems in line with this contemporary trend.

It has been observed that scuba diving instructors show a lack of understanding of the e-learning systems, which is attributed to older instructors being accustomed to offline education, thereby experiencing difficulties in utilizing e-learning systems. To address this issue, it is essential for scuba diving educational organizations to continuously conduct refresher training for instructors on how to use e-learning effectively.

Table 4. Analysis of Improvement Measures for e-Learning Utilization in Scuba Diving Education Settings

Category	1st Delphi (Factors)	2nd Delphi		3rd Delphi	
		M	SD	M	SD
Improvement Measures	Enhancing bidirectional communication between learners and instructors	4.24	±.59	4.22	±.56
	Developing monitoring analyses for learner comprehension	4.06	±.76	4.14	±.71
	Conducting mandatory exams offline	4.42	±.59	4.48	±.58
	Raising awareness of e-learning usage among learners	3.94	±.80	3.74	±.88
	Exploring methods to integrate e-learning with practical training	3.82	±.62	3.90	±.68
	Applying reasonable costs	3.76	±.74	3.88	±.75
	Utilizing help desks	4.19	±.60	4.20	±.69
	Enhancing communication through diverse online communities	4.47	±.61	4.51	±.54
	Developing varied content	4.32	±.68	4.37	±.76
	Applying these measures to global dive sites	3.94	±.72	3.84	±.78

3. Analysis of Improvement Measures for e-Learning Utilization in Scuba Diving Education Settings

(Table 4) presents the results of a survey that examined improvement measures for e-learning utilization in scuba diving education, categorized by primary sub-factors, secondary levels of agreement, and tertiary importance.

The initial survey aimed to structure the sub-factors for improving e-learning in scuba diving education and identified several key areas: enhancing bidirectional communication between learners and instructors, developing monitoring analyses for learner comprehension, conducting mandatory exams offline, raising awareness of e-learning usage among learners, exploring methods to integrate e-learning with practical training, applying reasonable costs, utilizing help desks, enhancing communication through diverse online communities, developing varied content, and applying these measures to global dive sites.

The results from the second and third Delphi surveys showed high levels of agreement and importance for enhancing communication through diverse online communities (M=4.47/4.51), conducting mandatory exams offline (M=4.42/4.48), developing varied content beyond simple processes (M=4.32/4.37), enhancing bidirectional communication between learners and instructors (M=4.24/4.22), and utilizing help desks (M=4.19/4.20).

Upon comparative analysis of the factors for improvement in e-learning utilization in scuba diving education settings, it appears necessary to enhance communication through various online communities. If individual learners are supported not just by e-learning alone but also through educational organization community sites, email, and SMS, it is expected that both learning effectiveness and participation will improve. Examining related prior studies reveals that community activities during e-learning processes can build intimacy, and tools like SMS and email are shown to influence participation levels [14]. This supports the view that online community activities in e-learning can significantly impact learning outcomes. Moving forward, it is deemed necessary to develop distinctive online community activities that can enhance satisfaction and participation rates in scuba diving e-learning education.

There was a significant consensus among experts that mandatory exams conducted within e-learning should be carried out offline. The reason for this is that e-learning-based mandatory exams often consist of repetitive questions, allowing learners with insufficient understanding to pass easily after several retakes. To address this issue, it is suggested that these exams should be conducted in person at the training site, directly under the supervision of an instructor. Educational organizations need to evaluate and compare exams conducted online and offline and consider developing and segregating scuba diving education programs to decide whether mandatory exams should be conducted online, offline, or through a

Table 5. Analysis of Future Development Directions for e-Learning Utilization in Scuba Diving Education

Category	1st Delphi (Factors)	2nd Delphi		3rd Delphi	
		M	SD	M	SD
Future Development Directions	Development of AI-enhanced learning functions	4.02	±.79	4.12	±.71
	Regular program quality evaluations	4.45	±.66	4.35	±.63
	Utilization of existing purchasers during program upgrades	3.41	±.57	Deletion	
	Analysis of e-learning students' needs	3.94	±.81	3.74	±.88
	Development of diverse content such as 3D and augmented reality	3.87	±.62	3.91	±.78
	Recognition of quality by learners	4.06	±.74	3.98	±.75
	Pursuit of learner enjoyment	3.85	±.60	3.68	±.59
	Guarantees of lifelong usability	3.47	±.61	Deletion	
	Integration with various diving communities	4.32	±.78	4.47	±.76
	Assignment of dedicated tutors	4.24	±.62	4.35	±.58

blended approach, applying different methods as deemed appropriate.

Currently, scuba diving e-learning education is being developed to support learning via mobile devices such as smartphones, netbooks, and tablet PCs, using U-learning. However, this education often involves a simple integration of videos, photos, and explanatory texts. It is believed that if content is developed in collaboration with marine biology organizations, climate-related bodies, and marine conservation groups, integrating these resources with e-learning could lead to more effective educational progress and increased satisfaction.

4. Analysis of Future Development Directions for e-Learning Utilization in Scuba Diving Education

(Table 5) presents the results of a survey that explored the future development directions for e-learning utilization in scuba diving education settings, categorized by primary sub-factors, secondary levels of agreement, and tertiary importance.

The initial survey aimed to structure the sub-factors for future development directions in e-learning utilization in scuba diving education and identified several key areas: development of AI-enhanced learning functions, regular program quality evaluations, utilization of existing purchasers during program upgrades, analysis of e-learning students' needs, development of diverse content such as 3D and augmented reality,

recognition of quality by learners, pursuit of learner enjoyment, guarantees of lifelong usability, integration with various diving communities, and assignment of dedicated tutors.

The analysis from the second and third Delphi surveys indicated that regular program quality evaluations (M=4.45/4.41), integration with various diving communities (M=4.32/4.41), assignment of dedicated tutors (M=4.24/4.35), development of AI-enhanced learning functions (M=4.02/4.12), and ensuring quality recognized by learners (M=4.06/4.08) were highly agreed upon in terms of importance and agreement levels.

Upon comparing factors for the future development of e-learning in scuba diving education, regular quality evaluations appeared as the most critical aspect. Previous research has also been conducted on e-learning software evaluation, which, although not standardized according to any established standards, has often resulted in subjective evaluation criteria based on the researchers' perspectives; the prior research deems continuous improvements and adjustments to these standards necessary to establish a systematized set of evaluation criteria that aligns with practical usage, supporting the results of this study [15]. Moving forward, it is deemed essential to explore methods that can secure certification within an international quality evaluation system.

Secondly, it has been identified as crucial to establish connections with various diving communities. In modern society, social networking sites such as Instagram, Facebook, YouTube, and

blogs have evolved, with most people engaging daily. It is considered necessary to integrate or develop new ways within the e-learning process to share opinions and experiences at the learning stage, enabling them to be shared among many people. Related research indicates that educational environments based on social networking require systematic feedback provision, optimal learning activity driven by learner analysis, and the development of comprehensive strategies to maximize instructional efficiency [16].

Additionally, assigning dedicated tutors and developing AI-enhanced learning functions have emerged as important factors. Prior research has also shown the need for e-tutor support services to improve academic performance within e-learning environments [17], and it suggests identifying problems with existing e-learning content and remote teaching methods, improving student engagement, and increasing educational outcomes. Proposals include designing an AI-based instruction system using web servers [18]. It is concluded that the scuba diving education industry should also strive to develop e-tutor and AI education systems in line with improvements in the e-learning environment.

IV. Conclusions

This study aimed to analyze the current use and improvement strategies of e-learning in scuba diving education settings using Delphi analysis and to provide foundational data for future research related to scuba diving education. To achieve these objectives, three rounds of Delphi surveys were administered with 25 professionals, including business executives and education team leaders from 20 scuba diving centers and resorts affiliated with scuba diving education organizations. The final conclusions drawn are as follows:

Firstly, the factors expected to affect the utilization of e-learning in scuba diving education

settings were found to be the convenience for learners, temporal flexibility, and ease of access to educational products. These are seen as the primary important factors. Moving forward, it is essential that system quality, including ease of use, user-friendliness, and stability, is ensured to enhance the expected benefits of e-learning utilization.

Secondly, the key problems identified with the use of e-learning in scuba diving education include simplistic mandatory test passing (indicative of reduced understanding), lack of expertise due to simplistic feedback, and inadequate bidirectional communication between learners and instructors. It is necessary to use enhanced algorithms to manage the difficulty levels of questions to make mandatory exams effective. Additionally, there is a need to develop a real-time bidirectional learning question and answer system that allows for free interaction of questions online and offline, tailored to the unique characteristics of the scuba diving education setting.

Thirdly, the factors for improvement in e-learning in scuba diving education settings include enhancing communication through various online communities, conducting mandatory exams offline, and developing diverse content beyond simple processes. Moving forward, it is essential to develop distinctive online community activities, such as SMS and email, that can increase satisfaction and participation rates in scuba diving e-learning. Moreover, educational organizations need to consider whether to conduct mandatory exams online, offline, or blend both approaches, tailoring this to the specific scuba diving education programs. Additionally, there is a need to develop content in collaboration with various marine-related organizations to integrate effectively with e-learning education.

Fourthly, the factors influencing the future direction of e-learning utilization in scuba diving education include regular program quality evaluations, integration with various diving

communities, assignment of dedicated tutors, and development of AI-enhanced learning functions. Efforts should be made to explore methods for certification within an international quality evaluation system, develop collaborative learning environments based on social networking sites (SNS), and design and build e-tutor and AI education systems.

This study was conducted solely with Korean experts currently engaged in scuba diving education through e-learning, which limits the research to a Korean perspective during the Delphi analysis. In the future, research needs to be conducted from the perspectives of various countries, including insights from international scuba diving education experts, to encompass a broader range of viewpoints and enhance the global relevance of the findings.

In addition, research on e-learning development and improvement measures should be continuously conducted in the field of sports education that has introduced e-learning. Therefore, it is necessary to help develop the changing educational environment.

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