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Future-Forward Educators: Crafting Creative Computer Science Teacher Training Programs Through Focus Group Interviews

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ABSTRACT

In today's rapidly evolving technological landscape, there is a growing need for educators equipped with the skills to teach computer science (CS) creatively. This paper aims to address this need by designing and implementing effective CS teacher training programs, drawing insights from the opinions of education and IT professionals. Through qualitative analysis and text mining, the paper provides detailed strategies for developing and executing these training initiatives. Participants were recruited for focus group interviews (FGI) and teacher training. FGI included 11 experts in CS and education, while teacher training involved 25 general teachers and 71 school administrators. Procedures encompassed FGI planning, questionnaire distribution, online interviews, response review, and analysis, followed by teacher training planning, implementation, satisfaction survey, and analysis. The analysis involved refining FGI data using Textom, keyword frequency analysis, semantic network analysis, and satisfaction survey analysis. Based on FGI analysis, the creative CS teacher training focused on integrating AI and EdTech, enhancing participants' digital competencies. Using text mining techniques, meaningful insights were extracted from unstructured data, guiding program design. Implementation included interactive sessions and online platforms, aligning with expert insights. Satisfaction surveys affirmed program effectiveness, highlighting the need for future enhancements like more practical exercises and networking opportunities. This paper delves into the design and implementation of teacher training programs, informed by expert FGI analysis, to meet the demands of the current era. While it sets a path for future-oriented training, the analysis primarily gauged educator satisfaction, prompting a need for further research. Future studies should assess how educator capabilities evolve post-training. Additionally, there's a call for research to pinpoint which competencies are bolstered by training and whether these enhancements directly correlate with program effectiveness. Such investigations would enrich our understanding of effective training strategies for educators in the digital age.

Keywords: Focus group interview, teacher training, Computer science education, Text mining, Metaverse

1. INTRODUCTION

Despite its importance, teacher training tends to progress more slowly than student education. Teacher training colleges have been criticized for not effectively preparing teachers for educating students. Additionally, many argue that education colleges are unresponsive to new demands, detached from practice, and instead act as barriers (Darling-Hammond, 2000). Policy makers in the United States have proposed alternatives to traditional 4-year college teacher education programs for obtaining teacher certification. While this could be an effective method to bring a diverse range of experts into the education field and attract talented individuals from outside education colleges, it is also seen as a policy that amounts to little more than an emergency hiring option (Darling-Hammond, 1992). According to previous studies, teachers who have received formal education and obtained teacher certification have shown higher test scores and achievement among students compared to alternatively certified teachers (Sass, 2015; Larson, 2014; Linek et al., 2012). Moreover, they were perceived to have greater competence in handling students, including those with emotional and behavioral disorders (Sutherland et al., 2010). The preparedness and level of knowledge of teachers significantly impact the quality of education.

Especially in a rapidly changing society driven by advancements in Artificial Intelligence (AI) and Information and Communication Technology (ICT) (Seol et al., 2023), students can easily lose their way. To prepare students for the future and to grow them into the talents needed by society, teachers must be prepared first. Creative

education must be realized to nurture students' creativity and problem-solving skills, and students should be equipped with the capability to easily access information technology (IT), which will act as their future competitiveness (Choi et al., 2023). Therefore, the time is ripe for creative computer science (CS) education for teachers. Research on information education for students has been conducted by various researchers since the development of information communication technology in the early 2000s (Brown et al., 2013; Tedre, 2018; Yang, 2019; Heinze & Procter, 2006). However, for CS education to be effectively conducted for students, it is essential to provide precise guidance on how to conduct CS education for teachers and to enhance teachers' CS education capabilities through training programs. The shift towards a remote society accelerated by the COVID-19 pandemic has made IT, including AI and digital technology, a pivotal factor in determining a nation's competitiveness. Ultimately, the ability to develop and utilize information technology is expected to be crucial for students who will lead the future.

Therefore, it is imperative for teachers who are actively teaching students in the field to prioritize the cultivation of their capabilities to educate on IT (Sentence et al., 2013). Previous studies indicate that in the United States, there is deep interest and discussion regarding strategies to integrate CS education into K-12 classrooms. The National Science Foundation and the private entities (e.g. Google) have provided funding for teacher training and support programs to promote computational thinking education. These professional development programs have played a crucial role in enabling practicing teachers to effectively conduct CS classes (Menekse, 2015). In China, the government has spearheaded the development of AI and programming curricula for K-12 education. One study designed an education program based on the Technical Pedagogical Content Knowledge (TPACK) framework to enhance AI competencies among CS teachers. Through this program, significant improvements were observed in CS teachers' self-efficacy in AI education (Sun et al., 2023). Similarly, in South Korea, the importance of K-12 AI education is growing. The Ministry of Education in South Korea is striving to train teachers, improve K-12 education, and address digital exclusion, aiming to cultivate 100,000 digital talents. In one study, surveys were conducted with teachers who had experience teaching AI to students in AI-leading schools. While most teachers expressed confidence in their pedagogical knowledge, they exhibited the lowest confidence in understanding the basic concepts and components of AI. They pointed out a lack of appropriate methods to comprehensively learn the core concepts and principles of AI (Kim & Kwon, 2023).

In this study, we conducted focus group interviews (FGI) with technology and education experts in South Korea to gather and analyze their opinions on how future-oriented and creative CS teacher training should be conducted. Based on these insights, we aimed to design and implement teacher training programs to provide practical guidance for future-oriented CS teacher training tailored to the needs of South Korean educators. The research questions posed in this study are as follows:

RQ1: What are the perceptions of experts regarding creative CS teacher training?

RQ2: How should creative CS teacher training be designed and implemented?

2. MATERIALS AND METHODS

2.1. Participants

This study is broadly divided into FGI and teacher training design and implementation. First, participants in the FGI were required to have expertise in both CS and education. Therefore, we recruited IT experts, education specialists, and current elementary and middle school teachers for the design of training tailored to school settings. The recruited expert group consisted of a total of 11 individuals, who were then subjected to FGI. The research participants recruited included 2 experts in education, 4 experts in IT, and 5 elementary and middle school teachers. [Table 1] presents the background variables of the participants involved in the FGI.

Table 1: Participants Characteristics of FGI

Characteristics		N	%
Gender	Male	11	100
	Female	0	0
Age	30s	4	36.4
	40s	7	63.6
Profession	Professor	2	18.2
	IT company employee	3	27.3
	IT Researcher	1	9.1
	Elementary school teacher	4	36.4

	Secondary school teacher	1	9.1

Secondly, the teacher training designed using the FGI analysis results is divided into elementary and middle school teacher training and school administrator training. A total of 25 participants took part in the elementary and middle school teacher training, consisting of 21 elementary school teachers and 5 middle school teachers. On the other hand, the school administrator training involved 54 principals, 7 vice-principals, 9 school inspectors, and 1 other participant. Looking at the age distribution, it can be observed that school administrators generally have higher age groups compared to regular teachers. [Table 2] presents the background variables of the participants who attended the teacher training.

Table 2: Participants Characteristics of Teacher Training

General teacher training				School administrator training			
Characteristics		N	%	Characteristics		N	%
Gender	Male	19	73.08	Gender	Male	31	43.66
	Female	7	26.92		Female	40	56.34
Age	30s	12	46.15	Age	40s	1	1.41
	40s	10	38.46		50s	38	53.52
	50s	4	15.38		60s	32	45.07
Profession	Elementary school teacher	21	80.77	Profession	Principal	54	76.06
	Secondary school teacher	5	19.23		Vice principal	7	9.86
					School inspector	9	12.68
					Other	1	1.41

2.2. Procedure

The procedures of this study can also be explained in terms of FGI and teacher training. [Figure 1] illustrates the research process of this study. Firstly, the FGI was conducted in six stages by elaborating on the typical steps of FGI (Krueger & Casey, 2008). In the first stage, Planning, survey questions were formulated, experts were recruited, and interview methods and schedules were organized. The composition of the questionnaire is shown in [Table 3].

Table 3: Composition of the Questionnaire for the FGI

Future-oriented creative CS education and teachers' digital competencies	Creative CS education in intelligent information society	• The necessity, importance, and objectives of creative CS education in an intelligent information society • The direction creative CS education should take in an intelligent information society
	Teachers' digital competencies	• Digital competencies that teachers instructing digital native generations should cultivate • Digital-based teaching, learning, and assessment competencies that teachers instructing digital native generations should cultivate
Teacher training implementation methods	Training program operation format	• Effective training program operation format • Effective online training operation platform
	Training program content composition	• Topics to be covered in creative CS teacher training for primary and secondary school educators • The impact of creative CS teacher training on future education

Secondly, in the Distributing Questionnaire stage, survey forms were distributed to FGI participants via Google Forms. At that time, due to the sudden onset of the COVID-19 pandemic, it was difficult to conduct face-to-face interviews. Therefore, we conducted interviews online. Thirdly, during the Interviewing stage, expert opinions were gathered from April 13th to April 20th, 2023. Fourthly, in the Reviewing stage, the research team compiled and reviewed responses to the survey questions. In the final Analyzing stage, it was divided into two parts. For responses regarding future-oriented creative CS education and teachers' digital competencies areas, data collection and cleaning, keyword frequency analysis, and semantic network analysis were conducted. As for the teacher training program operation methods, qualitative analysis was performed.

The teacher training proceeded in three stages. Firstly, in the Planning stage, based on the analysis of FGI results, we designed the content, format, and duration of the training. Additionally, participants for the training were recruited. Secondly, in the Implementing stage, the training was conducted. For the general teacher training, it took place online for five hours from 9:00 AM to 3:00 PM on April 22, 2023. The training utilized both unidirectional Zoom and bidirectional Metaverse platform ZEP spaces, incorporating feedback from the FGI. Additionally, the school administrator training was conducted in person at a hotel in Jeju, South Korea from 1:30 PM to 7:30 PM on June 2, 2023. This also indicates that conducting face-to-face training was determined based on the feedback gathered from the FGI, and it highlights the preference for face-to-face training among administrators, especially considering their older age demographic, compared to online training. Thirdly, after the completion of the education, we conducted a satisfaction survey and concluded the training by deriving insights for future improvement. The questionnaire composition of the satisfaction survey is as shown in [Table 4]. The curriculum, operations, program structure, and contents were evaluated using a 5-point Likert scale, and opinions related to the training were provided freely in open-ended format.

Table 4: Composition of the Questionnaire for the Satisfaction Survey

Curriculum	• Understanding aid in creative CS education direction • Program satisfaction • Appropriateness of instructors • Necessity of training • Personal training participation diligence	
Operations	• Appropriateness of administrative procedures • Suitability of training methods • Appropriateness of training support • Appropriateness of training schedule arrangement	
Program structure and contents	General teacher training	• AI and EdTech in future education • Understanding and application strategies of Jeju National University's hyper blended practical model • Convergent talent and future capabilities • Creative elective training - AI Humanities • Creative elective training - Forensic Sciences • Creative elective training - Digital Therapeutics
	School administrator training	• Utilizing generative AI and ChatGPT • AI technology and the future of EdTech education • ChatGPT: How? Like this!
Opinion	• The most impressive or enjoyable program and why • Programs that need improvement and areas for improvement • Programs you would like to see included in the next training • Advice for the development of the training	

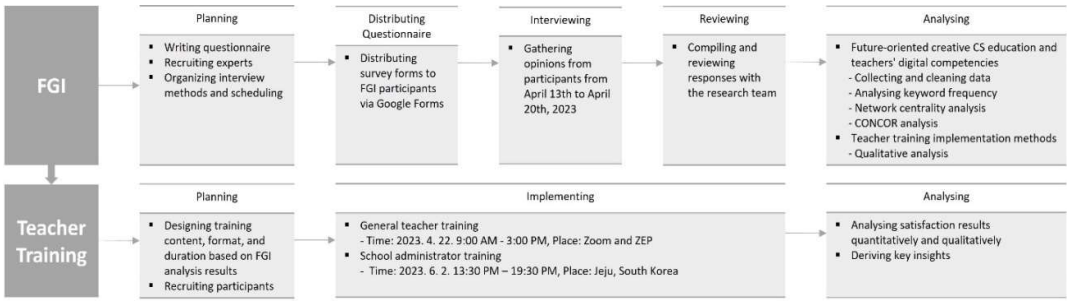

Figure 1. Research Procedure

2.3. Analysis

We refined the unstructured response data collected from experts during the FGI using the Textom program, and then calculated frequencies using text mining to select keywords. Text mining is the process of discovering new knowledge from large, unstructured collections of text. It is a technique for finding useful information within documents, which involves extracting useful words, calculating their frequencies, and uncovering meanings (Gaikwad et al., 2014). These keywords were transformed into matrix data and used for semantic network analysis. For analysis, we employed Ucinet 6 to conduct network centrality and CONvergence of iterated CORrelations (CONCOR) analysis on the text data. Keyword centrality analysis included degree centrality, eigenvector centrality, and betweenness centrality measurements. This was performed during the final stage of the FGI, the Analysis stage.

Additionally, satisfaction with the training was assessed using the teacher training satisfaction survey provided

by the Korea Foundation for the Advancement of Science & Creativity (KOFAC) (Han et al., 2020). This survey consisted of both multiple-choice and open-ended questions, and we conducted quantitative and qualitative analyses of the response data.

3. RESULTS

3.1. Analysis of Experts' Perceptions on Creative CS Teacher Training

To analyze the results of the FGI, we first conducted a spell-check and removed meaningless stop words. Additionally, we consolidated words that expressed the same meaning but were phrased differently into a single term. Only nouns were extracted from the collected data, resulting in a total of 63 words. With these words, we conducted keyword frequency analysis, centrality analysis, and structural equivalence analysis.

To conduct text mining, we first checked for spelling errors and removed meaningless stop words. Additionally, we consolidated words that expressed the same meaning but were phrased differently into a single term. Only nouns were extracted from the collected data, resulting in a total of 110 words. With these words, we performed keyword frequency analysis, centrality analysis, and structural equivalence analysis.

The results of the FGI analysis for perceptions regarding future-oriented creative CS education and teachers' digital competencies among IT and education experts yielded 110 nominal words. We organized keywords based on their frequency of occurrence and Term Frequency-Inverse Document Frequency (TF-IDF) criteria. TF-IDF is a widely used weighting factor in information retrieval and text mining, indicating the statistical measure of how important a word is within a specific document. It is utilized to extract major words from documents or determine the ranking of search results in search engines, where a higher value signifies a more important word (Qaiser & Ali, 2018).

3.1.1. Future-Oriented Creative CS Education and Teachers' Digital Competencies

Firstly, we confirmed experts' perceptions regarding future-oriented creative CS education and teachers' digital competencies through analysis of the FGI results. As participants provided in-depth responses, we utilized text mining techniques to analyze the response data, making it easier to discover meaningful information within the unstructured text.

Upon examining the top 10 words with high frequency, they appear in the following order: technology (15), education (13), problem (12), society (11), skill (11), information (9), student (8), intelligence (7), creativity (7), and knowledge (7). Additionally, among the top 10 words with high TF-IDF values, they appear in the following order: technology (19.74), education (17.10), problem (16.93), skill (16.68), society (14.47), student (14.14), information (13.65), knowledge (13.45), creativity (13.45), and idea (12.62). The keyword frequency analysis results for the top 40 words are presented in [Table 5]. The visualization of the network reflecting the distribution and frequency of the top 40 keywords is presented in [Figure 2].

Table 5: Top 40 Keywords List

Rank	Word	Frequency	Word	TF-IDF
1	technology	15	technology	19.74
2	education	13	education	17.10
3	problem	12	problem	16.93
4	society	11	skill	16.68
5	skill	11	society	14.47
6	information	9	student	14.14
7	student	8	information	13.65
8	intelligence	7	knowledge	13.45
9	creativity	7	creativity	13.45
10	knowledge	7	idea	12.62
11	idea	6	intelligence	12.37
12	ability	6	ability	11.53
13	literacy	4	competence	9.31
14	competence	4	literacy	9.31
15	advancement	3	assessment	9.06
16	talent	3	device	9.06
17	process	3	platform	9.06
18	individual	3	process	7.84
19	platform	3	advancement	7.84
20	device	3	talent	7.84
21	teaching	3	teaching	7.84

22	processing	3	individual	7.84
23	assessment	3	processing	7.84
24	step	2	content	7.43
25	program	2	step	7.43
26	background	2	understanding	7.43
27	foundation	2	self	6.04
28	growth	2	program	6.04
29	reproduction	2	foundation	6.04
30	competency	2	growth	6.04
31	self	2	reproduction	6.04
32	understanding	2	competency	6.04
33	element	2	background	6.04
34	teacher	2	element	6.04
35	ethic	2	citizenship	6.04
36	learning	2	teacher	6.04
37	citizenship	2	method	6.04
38	method	2	trend	6.04
39	trend	2	learning	6.04
40	content	2	ethic	6.04

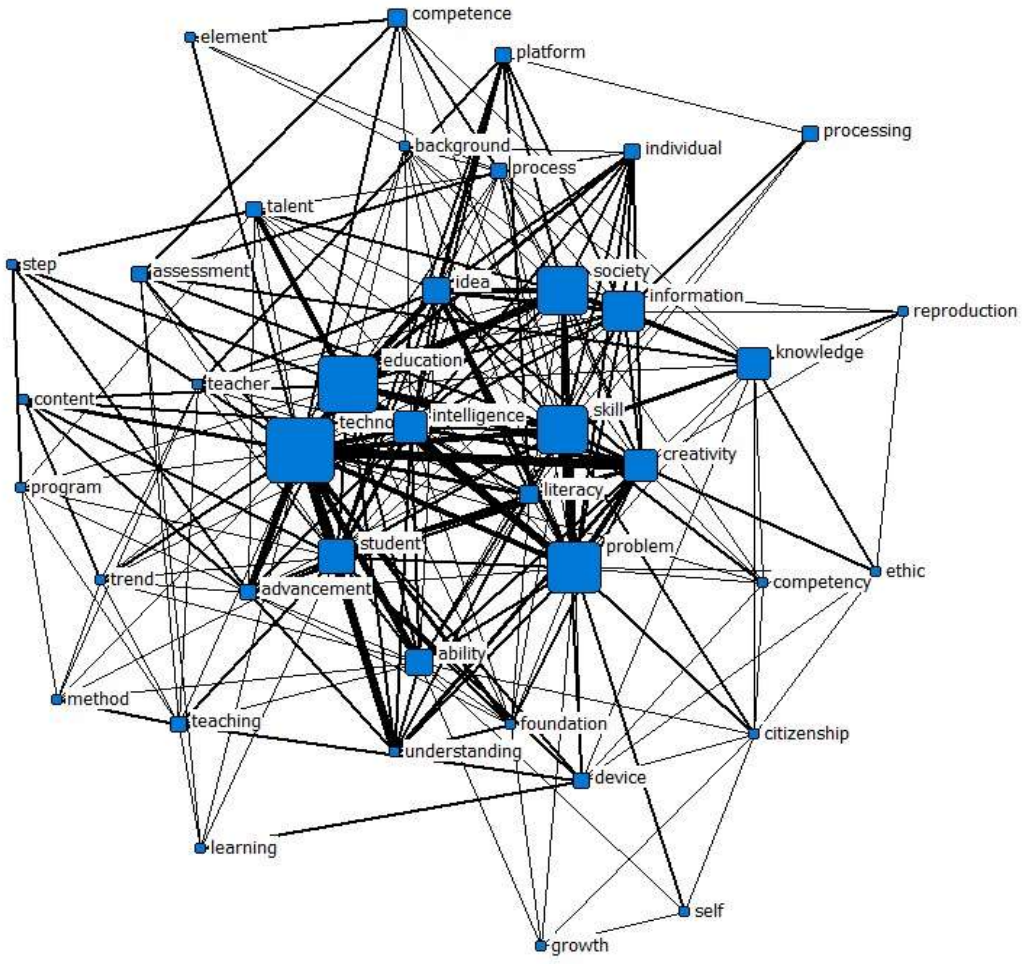

Figure 2. Keywords Visualization of Network Analysis

Next, the analysis of the frequency of associated words and degree centrality, eigenvector centrality, betweenness centrality for the top 20 words with high frequency is presented in [Table 6]. Degree centrality indicates the extent

to which a word has many connections and serves as a central point. A higher degree of centrality value suggests a greater influence on other words (Saxena et al., 2016). Words with high degree centrality values are technology (0.72), education (0.59), problem (0.64), society (0.49), skill (0.64), information (0.49), student (0.62), intelligence (0.54), creativity (0.54), and idea (0.44), in descending order. Eigenvector centrality is a more advanced analysis than degree centrality, considering not only the connectivity of a word but also the connectivity of other words, indicating words with high eigenvector centrality values have a significant influence within the data (Ruhnau, 2000). The words with high eigenvector centrality values are technology (0.27), problem (0.26), skill (0.26), education (0.26), intelligence (0.25), student (0.25), creativity (0.24), information (0.22), society (0.22), and ability (0.22), in descending order. Betweenness centrality calculates the centrality between words and other words (Barthélemy, 2004). The words with high betweenness centrality values are technology (0.14), problem (0.09), skill (0.08), student (0.07), ability (0.06), education (0.05), creativity (0.03), information (0.03), society (0.03), and intelligence (0.03), in descending order. The colors within the table indicate discrepancies between the rankings of the centrality values compared to the rankings based on word frequency.

Table 6: Network Centrality Analysis

Word	Frequency		Degree centrality		Eigenvector centrality		Betweenness centrality	
	Frequency	Rank	Coefficient	Rank	Coefficient	Rank	Coefficient	Rank
technology	15	1	0.72	1	0.27	1	0.14	1
education	13	2	0.59	5	0.26	4	0.05	6
problem	12	3	0.64	2	0.26	2	0.09	2
society	11	4	0.49	10	0.22	9	0.03	9
skill	11	5	0.64	3	0.26	3	0.08	3
information	9	6	0.49	9	0.22	8	0.03	8
student	8	7	0.62	4	0.25	6	0.07	4
intelligence	7	8	0.54	7	0.25	5	0.03	10
knowledge	7	9	0.36	15	0.13	20	0.02	11
creativity	7	10	0.54	6	0.24	7	0.03	7
idea	6	11	0.44	12	0.21	11	0.01	17
ability	6	12	0.51	8	0.22	10	0.06	5
literacy	4	13	0.44	11	0.21	12	0.02	14
competence	4	14	0.18	31	0.07	32	0.00	25
device	3	15	0.26	21	0.08	25	0.01	15
assessment	3	16	0.21	27	0.07	33	0.01	21
processing	3	17	0.10	38	0.05	36	0.00	35
teaching	3	18	0.26	22	0.08	26	0.01	16
platform	3	19	0.21	30	0.10	24	0.00	29
process	3	20	0.38	14	0.17	14	0.02	13
talent	3	21	0.26	23	0.12	21	0.01	22
advancement	3	22	0.41	13	0.18	13	0.02	12
individual	3	23	0.28	19	0.15	18	0.00	30
element	2	24	0.10	39	0.04	39	0.00	39
trend	2	25	0.26	24	0.11	22	0.00	26
method	2	26	0.18	32	0.07	31	0.00	31
citizenship	2	27	0.23	25	0.07	30	0.01	18
learning	2	28	0.13	35	0.05	38	0.00	33
ethic	2	29	0.21	29	0.07	29	0.00	28
teacher	2	30	0.31	17	0.14	19	0.01	20
competency	2	31	0.23	26	0.10	24	0.00	27
understanding	2	32	0.28	20	0.16	16	0.00	36
self	2	33	0.10	40	0.04	40	0.00	40
reproduction	2	34	0.13	36	0.06	35	0.00	34
growth	2	35	0.13	34	0.05	37	0.00	32
foundation	2	36	0.31	18	0.16	15	0.01	23
background	2	37	0.31	16	0.15	17	0.01	19
program	2	38	0.21	28	0.08	28	0.00	24
step	2	39	0.13	37	0.06	34	0.00	38
content	2	40	0.15	33	0.08	27	0.00	37

Structural Equivalence Analysis refers to an analytical technique that groups actors exhibiting similar positions and describes relationships between these groups (Breiger et al., 1975). CONCOR is a method that iteratively performs correlation analysis to identify appropriate levels of similarity groups. In this study, based on the results of semantic network analysis, CONCOR analysis was conducted. In this research, correlation analysis was performed to identify similarity groups, resulting in four distinct groups. The Teaching and learning group includes words such as learning, element, method, teaching, and program. The Environment group comprises words like background, platform, society, information, and process. The Capability group consists of words such as creativity, literacy, talent, ability, and trend. Lastly, the Objective group contains words like citizenship, self, assessment, knowledge, and growth. The words belonging to each group can be found in [Table 7], and a visualization of this is depicted in [Figure 3].

Table 7: CONCOR Analysis

Group	Word
Teaching and learning	learning/element/method/competence/teaching/program
Environment	background/platform/idea/skill/processing/problem/individual/ society/information/process
Capability	step/foundation/advancement/technology/understanding/ creativity/literacy/intelligence/content/education/talent/ability/ teacher/trend/student
Objective	citizenship/self/competency/assessment/knowledge/growth/ device/ethic/reproduction

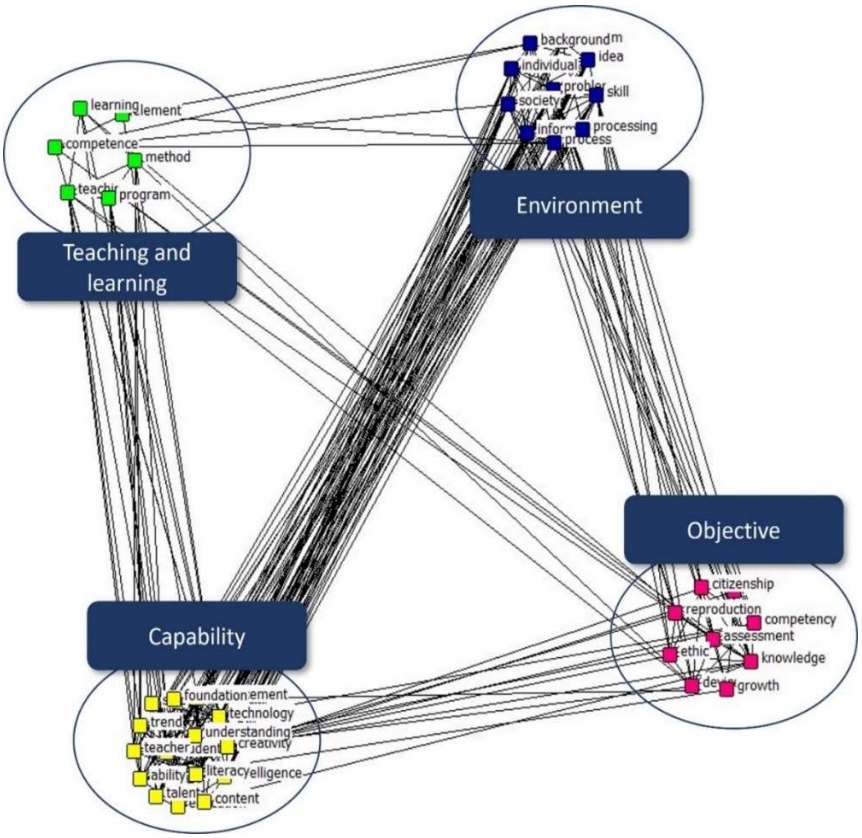

Figure 3. Keywords Visualization of CONCOR Analysis

3.1.2. Teacher Training Implementation Methods

Many participants in the FGI responded to questions about teacher training program operation methods with brief and straightforward answers compared to their responses regarding future-oriented creative CS education and teachers' digital competencies. Therefore, qualitative analysis was conducted for this area of inquiry. Before describing the analysis results, it is noted that participants were labeled as follows: professors were denoted as P(rofessor) 1, 2, IT company employees as C(ompany employee) 1, 2, 3, IT researchers as R(esearcher) 1. Additionally, elementary school teachers were labeled as E(lementary school teacher) 1, 2, 3, 4, and secondary school teachers as S(econdary school teacher) 1.

Firstly, among the 11 participants, 7 (C2, E1, E2, E3, E4, S1, P2) responded that interactive two-way lectures should be conducted, while one participant (R1) answered that one-way lectures are sufficient. Additionally, 2 participants (C1, P1) stated that both one-way and two-way lectures are necessary. "Both one-way and interactive lectures have their own advantages. Depending on the content and environment of the training, it seems necessary to choose the appropriate method. However, fundamentally, it is important to open a channel of communication through interactive lectures for interaction (P1)." One participant expressed the opinion that face-to-face training is preferable for effective training (C3). In summary, experts' opinions suggest that active communication between instructors and learners is essential, and if necessary, a distinction should be made between online and offline, one-way and interactive two-way approaches for effective training. On the other hand, three participants (R1, C1, C2) answered that an online platform is effective for training operations, suggesting platforms such as Zoom and Microsoft Teams. Additionally, six participants (E1, E2, E4, C3, P1, P2) suggested operating training sessions on Metaverse platforms, where interaction is emphasized more than traditional online lectures. Proposed Metaverse platforms included ZEP, Zepeto, and Roblox. Furthermore, two participants (E3, S1) mentioned the blended format, combining online and offline components depending on the training topic. It was predominant that the training platform should allow sufficient interaction for effective training operations.

Regarding the content of teacher training, there was a consensus among participants that the curriculum should be designed to enable teachers to understand new future technologies or systems. This suggestion was proposed by 7 participants (R1, C1, C2, E3, E4, P1, P2). Some participants specifically mentioned certain technologies in their responses, including information security technology, EdTech, Metaverse, AI, and ChatGPT. Additionally, S1 and C3 argued that education should focus on developing competencies rather than specific content. They advocated for fostering proactive problem-solving skills and logical reasoning abilities. E1 did not provide a response, while E2 suggested incorporating AI education design and integrated education approaches into teacher training. They mentioned that this training could enhance teachers' professionalism and foster professional educators (C1, C2, E1, E2, P1). Moreover, they stated that this approach could expand students' thinking and contribute to nurturing creative talents (R1, C1, C2, S1, E3, E4). "An increase in teachers' digital-based teaching and learning competencies could lead to effective student engagement, stimulation of interest, and enhancement of digital ethics awareness (C1)." Additionally, P2 anticipated that teacher training would elevate teachers' understanding of new technologies, enabling them to propose better directions for future education through peer exchange among teachers. In other words, they believed that in creative CS teacher training, teachers should be enabled to understand new technologies and systems, and student education should be realized through improved teacher competencies.

3.2. Analysis of the Results from Creative CS Teacher Training Operations

3.2.1. General Teacher Training

After conducting expert FGI, we conducted Creative CS Teacher Training for general teachers. The purpose of this training was to enhance future-oriented CS education practices that align with smart educational environment changes and to train teachers to expand educational field. To operate this training, we produced promotional pamphlets and advertised through the research institute's website and school notifications, attracting 25 participants. The training was conducted on the online conference platform Zoom and the metaverse space ZEP, taking place from 9 AM. to 3 PM. on Saturday, April 22, 2023, for a total of 5 hours, referencing responses regarding the operational format of experts' training. Based on FGI opinions, the training program for general teachers commenced with exploring ways to integrate AI and EdTech into education, focusing on educational models that utilize AI technology in education and the competencies that teachers and students should strive to acquire. Additionally, a 90-minute session was dedicated to elective topics such as AI Humanities, Forensic Science, and Digital Therapeutics, allowing participants to delve into the latest future technologies not commonly encountered in public education curricula. To facilitate active interaction and communication among teachers, seminars were conducted alternately between Zoom and ZEP spaces. Finally, the training concluded with the satisfaction survey. Detailed schedules of the Creative CS Education Program for general teachers can be found in [Table 8].

Table 8: Creative CS Teacher Training Programs for General Teachers

Time	Content
08:50-09:10 (20')	Welcoming remarks
09:10-10:30 (80')	[Special lecture by future technology education experts] AI and EdTech in future education
10:30-11:10 (40')	[Hyper blended practical model] Understanding and application strategies of Jeju national university's hyper blended practical model
11:10-12:00 (50')	[Online special lecture by future education experts] Convergent talent and future capabilities I

12:00-13:00 (60')	[Online special lecture by future education experts] Convergent talent and future capabilities II with lunch			
13:00-14:30 (90')	Creative elective training	AI Humanities	Forensics Sciences	Digital Therapeutics
		Non-face-to-face teaching, learning, and assessment methods	Dynamic quantum teaching, learning, and assessment methods	Tailored teaching, learning, and assessment methods using AI
14:30-15:00 (30')	Future creative CS education seminar			
15:00-15:10 (10')	Satisfaction survey			

After the training, participants rated the training curriculum at 4.66 out of 5 points in the satisfaction survey, with the overall program satisfaction and instructor quality receiving the highest scores. The satisfaction with the training operations was 4.63, and participants rated the training support as the most well-implemented aspect. Additionally, the content satisfaction of the program was the highest at 4.87, with AI and EdTech and AI Humanities of creative elective training receiving the highest ratings among the specific programs. The detailed satisfaction survey results of the creative CS teacher training for general teachers are shown in [Table 9].

Table 9: Satisfaction Survey Result Analysis of Teacher Training Programs for General Teachers

Curriculum	**Understanding aid in creative CS education direction**	**Program satisfaction**	**Appropriateness of instructors**	**Necessity of training**	**Personal training participation diligence**	**Overall**
	4.67	4.72	4.72	4.67	4.50	4.66

Operations	Appropriateness of administrative procedures	Suitability of training methods	Appropriateness of training support	Appropriateness of training schedule arrangement	Overall
	4.61	4.67	4.72	4.50	4.63

Program structure and contents	AI and Edtech in future education	Understanding and application strategies of Jeju national university's hyper blended practical model	Convergent talent and future capabilities	Creative elective training			Overall
				AI Humanities	Forensics Sciences	Digital Therapeutics	
	4.94	4.89	4.89	4.94	4.89	4.78	4.87

Before describing the key opinion survey results related to the training, it should be noted that participants in the training were referred to as T(eacher). Since the survey was conducted anonymously, participant identification numbers were not used. First, regarding the question about the most impressive or favorite program, participants mentioned that they found the description of creative CS textbooks that can be directly applied in classes and the application methods of ChatGPT and AI in education particularly impressive. Additionally, some participants expressed that they enjoyed the practical exercises in the metaverse space. "The explanation about ChatGPT was good (T)," and "ZEP practice (the characters are cute, and it feels like a combination of metaverse and Zoom, so it seems highly useful (T)." Second, when asked about programs or areas that need improvement in the training or suggestions for improvement, there were generally many responses indicating no specific areas for improvement. However, some participants expressed a desire for face-to-face training, and there were opinions stating that more than 5 hours of training time would be needed. "More training is needed. 5 hours feels insufficient (T)." Third, regarding programs that participants wished to be included in future training sessions, suggestions included programs related to future classroom management methods and school violence prevention. Finally, in terms of advice for the improvement of the training, there were opinions calling for more practical exercises and emphasizing the need for field-focused training. "I could think about the direction of future creative CS education. I wish there had been more field-focused training in Jeju (T)."

3.2.2. School Administrator Training

We designed creative CS teacher training for school administrators based on the expert FGI results. Based on the expert FGI results, there was an opinion that face-to-face training is effective, and we also took into account the desire for on-site training expressed in general teacher training. Therefore, we rented a hotel in Jeju to conduct the training. The training took place on Friday, June 2, 2023, from 1:30 PM to 7:30 PM, totaling 5 hours. 71 school administrators participated in this training. Similar to the teacher training, we produced promotional

pamphlets and distributed official letters to schools to encourage administrators' participation. The content of the training included strategies for utilizing generative AI and ChatGPT, as well as discussions on AI and EdTech future education, which had elicited positive responses in general teacher training. Additionally, to address the need for practical training mentioned in both the FGI and general teacher training, we arranged hands-on sessions. During these sessions, instructors demonstrated how to utilize ChatGPT in real educational settings, allowing participants to follow along and gain insights into how technology can be applied in education. They also had the opportunity to understand the principles of generative AI. To encourage interaction among the many school administrators in attendance, we organized panel discussions and provided comfortable meals at the hotel. Finally, we concluded the training with a satisfaction survey. [Table 10] presents the detailed schedule of the Creative CS Education program for school administrators.

Table 10: Creative CS Teacher Training Programs for School Administrators

Time	Content
13:30-13:50(20')	Microlearning spot
13:50-14:00(10')	Welcoming remarks
14:00-54:20(80')	[Expert lecture] Utilizing generative AI and ChatGPT
15:20-15:25(5')	Break
15:30-16:30(60')	[Expert lecture] AI technology and the future of EdTech education
16:40~17:40(60')	[Creative hands-on learning] ChatGPT: How? Like this!
17:40-18:40(60')	Future creative CS education seminar
18:40-19:30(50')	Dinner with Jeju: A Visual Journey
19:30-19:40(10')	Satisfaction survey

The satisfaction survey results for the training indicated a curriculum satisfaction score of 4.82, with the highest satisfaction score of 4.86 recorded for the training necessity item. The satisfaction rating for operations was calculated at 4.76, with the operational suitability of the training receiving the highest score of 4.84. In terms of program satisfaction, AI Technology and EdTech for Future Education achieved the highest score of 4.78. Overall, the program garnered a satisfaction rating of 4.74. Detailed satisfaction survey results for the Creative CS Teacher Training for school administrators are presented in [Table 11].

Table 11: Satisfaction Survey Result Analysis of Teacher Training Programs for School Administrators

Curriculum	**Understanding aid in creative CS education direction**	**Program satisfaction**	**Appropriateness of instructors**	**Necessity of training**	**Personal training participation diligence**	**Overall**
	4.81	4.82	4.82	4.86	4.79	4.82
Operations	Appropriateness of administrative procedures	Suitability of training methods	Appropriateness of training support		Appropriateness of training schedule arrangement	Overall
	4.74	4.74	4.84		4.75	4.76
Program structure and contents	Utilizing generative AI and ChatGPT		AI technology and the future of EdTech education		ChatGPT: How? Like this!	Overall
	4.68		4.78		4.77	4.74

Upon examining the key feedback related to the training, participants highlighted the ChatGPT: How? Like this!. To practical session as a positive aspect, noting that the facilitators' assistance throughout the sessions was highly appropriate. "The assistant facilitators were very helpful during the practical sessions, ensuring smooth progress (T)." Additionally, there were comments expressing that the training increased understanding of ChatGPT and AI. Areas for improvement included selecting instructors preferably from non-profit organizations and extending the duration of the program to allow for additional time for participant interaction and networking. "Considering the age and position of the administrators, it would be beneficial to extend the duration to 2 nights and 3 days and include more opportunities for participant interaction and networking (T).", "It would be great to schedule some sightseeing activities in Jeju (T)." Regarding programs for future sessions, participants expressed interest in including more case studies demonstrating the direct integration of technology into teaching and learning. Lastly, advice for the advancement of the training included the desire for continuous training opportunities and providing simple guidance for participants to prepare in advance before attending the training.

4. CONCLUSION

This paper aims to provide a framework for designing and implementing creative CS teacher training. To achieve this, we recruited education and IT experts and conducted FGI, analyzing their opinions in detail using text mining and qualitative analysis techniques. Based on the analyzed FGI results, we designed and implemented teacher training for both general educators and school administrators. The FGI analysis revealed a high frequency of technology-related discussions and indicated a high coefficient in centrality analysis. Furthermore, according to CONCOR analysis, teacher training should not only focus on teaching methods but also establish a conducive environment, emphasizing competency-based education rather than mere comprehension of knowledge. In other words, it was emphasized that future-oriented creative CS education is crucial for adapting to rapidly changing societies, and there is a need to enhance problem-solving skills and critical thinking through a diverse range of future technologies and ideas.

Therefore, in the training, various future technologies such as AI Humanities, Forensic Sciences, and Digital Therapeutics, which may be challenging for general educators to grasp easily, were explained in a simple and engaging manner. Additionally, in accordance with the opinion that educators should possess the ability to understand the latest technologies and tools, content related to EdTech was incorporated into the training. The format of teacher training encompassed both unidirectional and bidirectional approaches, and in line with the suggestion to utilize online and metaverse platforms, Zoom and ZEP were integrated into the general educator training. Furthermore, to establish interactive platforms, discussions were held in metaverse spaces, and seminars were arranged offline for administrator training to foster camaraderie among educators and facilitate networking. The content of teacher training included avenues for applying EdTech, utilizing AI in education, incorporating ChatGPT, among others, in classroom settings, reflecting these topics in the design of the training program. Through such education, educators expressed satisfaction levels of 4.6 or higher across all domains, thus addressing RQ 1 and 2.

In discussing the operation of the training program, it was observed that while only 25 participants attended the general educator training held online over the weekend, a remarkable 71 participants joined the school administrator training despite being scheduled on weekdays. Furthermore, one educator who participated in the general educator training expressed a preference for face-to-face sessions. This indicates a preference among educators for in-person training over online-only sessions. Additionally, the high response rate of 4.86 points in satisfaction surveys regarding the necessity of the training during the school administrator training suggests a strong need for creative CS educator training. Moreover, it became evident that on-site training requires the support and assistance of multiple facilitators.

This paper provides detailed insights into designing and operating teacher training programs needed in this era, based on the analysis of expert FGI, thus setting a direction for future-oriented training. However, since the analysis only focused on the satisfaction of educators participating in the training, future research should examine how the capabilities of educators have improved as a result of attending the training. Furthermore, research is needed to identify which competencies have been enhanced through educator training and whether there is a direct correlation between these competencies and the training program's effectiveness.

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