Development and Validation of a Leadership Competency Scale for High School Students Using the Partial Credit Model and the Confirmatory Factor Analysis

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Abstract. This study aims to develop and validate a leadership competency scale for high school students using the partial credit model(PCM) and the confirmatory factor analysis(CFA). To do this, based on a comprehensive literature review, three sub-domains were newly set as 'futuristic vision', 'group management', 'lead by example', and a preliminary test consisting of 30 items (10 items for each sub-domain) was developed. In addition, the content validity of the preliminary test was checked by 9 PhDs in educational measurement and evaluation (above 4.33 out of 5.00 for each item). And a preliminary test was conducted on 355 high school students and construct validity and reliability were checked to complete a scale consisting of 15 items. To this end, four competitive models were made: (1) unidimensional 15 items considering only the item fit, (2) unidimensional 15 items considering the item fit and content, (3) three dimensional 15 items considering only the item fit, (4) three dimensional 15 items considering the item fit and content, and construct validity and reliability were compared. As a result, the fourth model showed the best construct validity.

Keywords:PCM, CFA, leadership competency, content validity, construct validity, reliability.

1 Introduction

As the OECD's DeSeCo (Defining and Selecting Key Competencies) project incorporated the concept of competency into school education, the importance of competency-based education has grown globally.A competency can be defined as the capacity to meet complex demands in life by mobilizing not only knowledge and skills, but also attitudes, emotions, functionalities, values, and motivations, which are

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social and behavioral elements[1]. Following the emphasis on the importance of competencies in education, countries around the world, including South Korea, have endeavored to reflect the competencies proposed by the OECD in their national curriculum design. In South Korea, the 2015 revised curriculum introduced a competency-based approach, spurring active discussions and research. This focus has continued through to the 2022 revised curriculum, reflecting ongoing interest in competency education.

Among the competencies proposed in the DeSeCo project, 'key competencies' are applicable in various contexts and universally necessary [1]. These key competencies were integrated into the Korean 2015 curriculum as six sub-areas: 'self-management competence', 'knowledge information processing competence', 'creative thinking competence', 'aesthetic emotional competence', 'communication competence', and 'community competence' [2]. Moreover, Baek et al. [3] identified 'leadership competence' and 'career competence' as essential future key competencies for adolescents.

In particular, 'leadership competency' is considered essential for high school students in the future society. Leadership is a key factor that can shape individual and group behaviors, influence organizational effectiveness, and enable members to perform their duties and achieve goals [4]. For learners to grow into competitive social leaders in the future society, sustained attention to systematic education that enhances the leadership competencies of adolescents is necessary [5].In response to these global trends, various educational programs aimed at nurturing leadership competency among adolescents have recently been proposed in South Korea. For instance, the Ministry of Education recently announced plans to implement a nationwide leadership camp program targeting Korean students, aimed at fostering students' moral character development and enhancing their leadership competency [6]. This is due to the increasing demand for enhanced moral character education in Korea to address emerging social issues and to enable individuals to live together with others and within communities.Furthermore, this plans can be seen as part of efforts to reflect the recognition of the importance of leadership competency, where students are perceived to require autonomy to communicate with others and solve problems collaboratively.

Along with the recognized importance of leadership competency, various definitions and components of leadership competency have been presented in prior research. However, there is a current lack of a objective diagnostic tool specifically designed to measure students' performance abilities in leadership competency as an outcome of school education [3]. Diagnosing the level of students' competencies and abilities is a starting point in education, enabling the planning of educational activities based on these results and potentially maximizing the effectiveness of education [7]. Therefore, it can be said that the development of tools for accurately diagnosing leadership competency should precede education for cultivating students' leadership competency. The development of such leadership competency scale can be expected to make significant contributions, especially in South Korea, where efforts are being made to plan leadership competency education programs.

Thus, the aim of this study is to develop a leadership competency scale for high school students and, furthermore, to validate the scale using PCM (Partial Credit Model) and CFA (Confirmatory Factor Analysis). The PCM model, developed by Masters [8], is one kind of the item response model that can be applied when scoring test items in multiple stages rather than dichotomously, using the one-parameter Rasch model [9]. Generally, in measurement tool constructed with Likert scales, the PCM model can be utilized to accurately determine parameters such as item fit. In this research, PCM was used to assess item fit for the purpose of validating the developed scale.

In summary, this study aims to develop a scale that can systematically and effectively diagnose students' leadership competencyand seeks to validate its validity using PCM and CFA models.

2 Literature Review

2.1 Key Competencies

Key competencies are deemed essential capabilities for a member of society to adapt to society, belong to a community, and navigate life. Among various competencies, key competencies are seen as particularly necessary and important. Such key competencies can evolve with time and circumstances. Notably, the 21st-century key competencies, transcending global and entering a glocal era, especially post-COVID-19 pandemic, represent a comprehensive set of abilities - knowledge, skills, expertise - required for individuals to lead successful lives in this expanded new normal era.

Specifically, Trilling and Fadel [10] introduced the 4C competency model, consisting of ‘Critical Thinking’, ‘Creativity’, ‘Communication’, and ‘Collaboration’. These four competencies are consistently highlighted in previous research as pivot, and studies have become more intensive since the introduction of the 4C model. To elaborate, Critical Thinking involves the ability to identify issues and view them from new perspectives to develop solutions. Creativity refers to the capacity to think uniquely or find innovative approaches without being confined to existing paradigms. Communication signifies the ability to share thoughts, questions, and ideas, while Collaboration encompasses the ability to work with others towards a common goal, encapsulating all these competencies.

Furthermore, beyond the 4Cs, other vital competencies have been identified, including literacy competencies such as information, media, and technology, and life skills like flexibility, leadership, initiative, productivity, and social skills.

Additionally, there exists a 6C model, incorporating two more community-specific key competencies into the 4C model. Fullan and Scott [11] included Character and Citizenship in their 6C model. The Korea Youth Work Agency [12] introduced a model for youth activity key competencies, adding Social-emotional Competency and Career Development Competency to the 4Cs. In addition, Emotional Thinking, Relationship-building, and Community Citizenship were also included.

On the other hand, research on these key competencies, directly linked to our lives, has been more active since the OECD's DeSeCo project. The project emphasized

competencies such as ‘the ability to interact in socially heterogeneous groups’, ‘the capacity for autonomous action’, and ‘the ability to use tools interactively’ [1]. After this project's announcement, most developed countries have been striving to develop and implement competency-based curricula. In Korea, the revised 2015 educational curriculum introduced six key competencies [2], and the recently announced 2022 curriculum continues this trend by maintaining five key competencies and expanding communication competency to collaborative communication competency [13].

2.2 Leadership Competency

Among the emphasized key competencies, leadership competency is particularly important, as it is included in the Life and Career Skills section of the 21st-century competencies framework proposed by Trilling and Fadel [10]. They highlighted leadership and responsibility, indicating a shift from the era of charismatic leadership, where a single leader was responsible for everything, to the present, where each member of society should possess individual leadership skills and engage in mutual communication.

On the other hand, leadership competency, emphasized for its importance, is crucial not only in adulthood but also during adolescence. Considering that adults need to exhibit leadership in decision-making, it is necessary to develop leadership competency during the teenage years before entering society.

2.2.1. Definition of Leadership Competency Leadership refers to qualities necessary for leaders in every community. Thus, leadership competency can generally be described as a comprehensive set of skills required for a leader. However, the definition can vary depending on the nature of each community or the role of a leader within it. For instance, the competencies needed for a school leader may differ from those required for a corporate leader. A school principal might need competencies like inclusiveness and collaboration, whereas a corporate leader might need competencies like direction-setting and problem-solving. Over time, the skills and attributes required of leaders can also change. For example, a leader's charisma and vertical leadership were valued in the past, but now, the ability to interact and horizontal leadership are more emphasized.

Various definitions of leadership can be considered depending on the community and context, and these are as follows. Stogdill [14] defined leadership as ‘the process of influencing the behavior of a community to achieve goals’, and Choi [15] defined it as ‘skills useful and applicable in interdependent societies through experiential learning’. Jeong et al. [16] described it as ‘qualities that a leader possesses or should possess’, and Northouse [17] defined it as ‘the process by which an individual (leader) influences members of a community to achieve common goals’. However, these definitions are too general and do not significantly aid in research such as identifying specific traits or developing measurement tools. More specifically, Park et al. [18] defined leadership as ‘the skill or influence to induce and facilitate collaborative efforts of organizational members to efficiently achieve organizational

objectives or to coordinate and motivate individuals and groups to achieve pursued goals'. Kim et al. [19] defined youth leadership as 'a combination of internal personal traits such as future vision and drive, a spirit of challenge towards novelty, decision-making ability for rational problem-solving, honesty and trust, task responsibility, and external interpersonal characteristics such as smooth and influential interpersonal relationships, operational skills, and consideration and cooperation for others and the community'. Lastly, Jeon et al. [20] defined it as 'guiding a group or organization by providing vision and direction and influencing various activities of the members to bring about positive changes'.

In this study, the researchers utilize the definition by Baek et al. [3], who, after comprehensively referring to various prior studies, defined the leadership competency of middle and high school students as 'the ability to propose new visions and directions for the development of one's own group, effectively manage the group in various situations, and lead positive changes within the group by responsibly and proactively taking the lead and coping appropriately'.

2.2.2. Leadership Competency Construct Map The sub-elements of leadership competency have been defined by various researchers, and the results of prior studies related to these sub-domains are as follows:

Jung et al. [21], in their study developing a leadership diagnostic tool for all age groups in South Korea, identified the sub-elements of leadership through literature research and factor analysis as 'goal achievement ability, re-creation ability, command, interpersonal skills, and sense of purpose'. Han et al.[22] developed a leadership skill test to compare the leadership skills and social maturity of gifted and general students, categorizing leadership skills into 'communication skills, decision-making skills, interpersonal skills, problem-solving skills, self-development skills, group activity skills, and planning skills'.

Kim [23], in her study developing a leadership behavior(skill) test for college students' leadership education status and needs analysis, divided leadership behavior(skill) into decision-making domain (planning and organizing ability, problem-solving ability, counseling ability, delegation ability), information provision and pursuit domain (ability to clarify roles and goals, information provision ability, checking and evaluation ability), relationship building domain (support capability, ability to develop and guide others' careers, conflict management and team building ability, relationship building and expansion ability).

Nohand Jyung[24], in their study to derive and develop a diagnostic tool for college students' leadership, divided leadership into self-leadership and super leadership. Self-leadership includes self-behavior induction domain (goal-setting domain, self-observation domain, self-cue domain, self-reward domain) and self-thinking leading domain (self-awareness domain, self-talk domain, successful performance imagination domain, challenging thinking domain, self-efficacy domain). Super leadership includes behavior facilitation domain (trust formation domain, communication domain, interpersonal relationship domain, motivation domain) and challenge pursuit domain (excellence pursuit domain, behavior induction domain, insight domain).

Self-leadership, as validated by Shin et al.[25] for Korean college students, is categorized into behavior-oriented strategies (self-goal setting, self-reward, self-observation, self-cue, self-punishment), natural reward strategies (natural reward), and constructive thinking strategies (successful performance imagination, self-talk, belief and assumption analysis). Lee [26] also developed a test tool to verify the effects of NLP counseling programs on elementary students' self-leadership, dividing it into behavioral strategy factors (self-observation, goal setting, cue management, practice), internal reward strategy factors (internal reward), and thinking strategy factors (self-talk, positive thinking).

Additionally, Kim [27] conducted a basic study for the development of a leadership program for the gifted, categorizing leadership of the gifted into personal characteristics and interpersonal characteristics based on meta-analysis, perception studies of community members, and studies of adult leader characteristics. Personal characteristics include vision and drive (vision, confidence, drive, self-management), adventurous spirit (curiosity, adventurousness), decision-making ability (situational judgment, fairness), righteousness (honesty, faith), task responsibility (diligence, responsibility), and interpersonal characteristics include interpersonal and organizational ability (interpersonal relationships, expression, organizational management, charisma), consideration for others and the community (consideration for others, social dedication, teamwork).

Lastly, Van Wart [28], in his study presenting the Leadership Action Cycle for administrative agency managers, explained leadership as Traits, Skills, and Behavioral skills. Traits are innate or long-term tendencies, including self-confidence, decisiveness, resilience, energy, need for achievement, willingness to assume responsibility, flexibility, a service mentality, personal integrity, and emotional maturity. Skills are broadly applicable learned traits, including communication skills, social skills, influence skills, analytic skills, technical skills, and continual learning. Behavioral skills are specific actions, divided into Task-Oriented Behaviors (monitoring and assessing work, operations planning, clarifying roles and objectives, informing, delegating, problem-solving, managing technical innovation and creativity), People-Oriented Behaviors (consulting, planning and organizing personnel, developing staff, motivating, building and managing teams, managing conflict, managing personnel change), and Organizational-Oriented Behaviors (scanning the environment, strategic planning, articulating the mission and vision, networking and partnering, performing general management functions, decision-making, managing organizational change).

3 Research Method

3.1 Data Collection

This study aims to develop and validate a scale to systematically assess the leadership competency of high school students. For this purpose, new sub-domains of leadership competency were established, and the validity of the developed scale was verified using the PCM (Partial Credit Model) and CFA (Confirmatory Factor Analysis)

models. For this, a survey was conducted among first-year students (355 students in total) attending J High School in S city, South Korea (see Table 1).

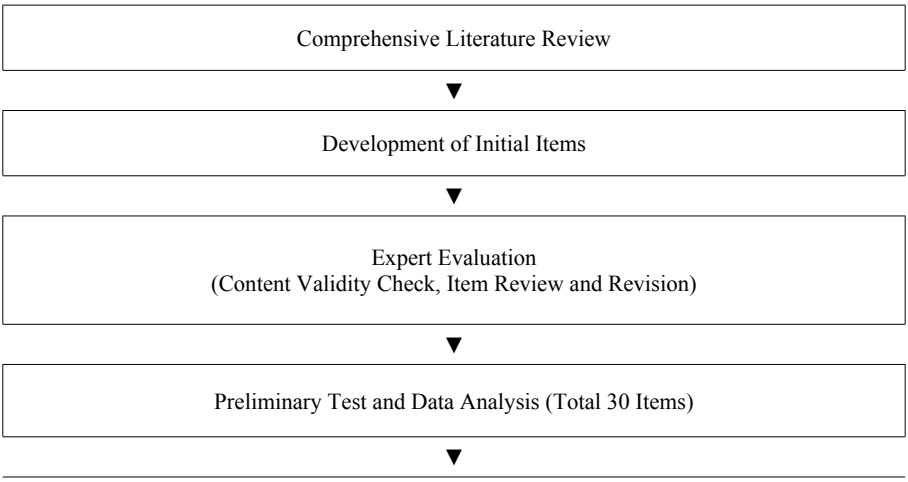
Table 1. The respondents'Information.

		N	%
Gender	Male	185	52.1
	Female	168	47.3
	Not Answered	2	0.6
Total		355	100

3.2 Development Procedure of the Leadership Competency Scale

The development procedure for the leadership competency scale for high school students was as follows (see Table 2). First of all, an operational definition and sub-domains of leadership competency were established through the analysis of domestic and international research on leadership competency. Subsequently, 30 preliminary items (twice the number of the final items) were created based on the established sub-domains. Second, a panel of experts (9 PhDs specializing in educational measurement and evaluation) was convened to verify the content validity of the developed scale. Third, a preliminary test was conducted with 355 high school students using the 30 items revised according to expert feedback. Fourth, after checking the item validity and item fit through PCM and CFA, the final 15 items were selected for the final leadership competency scale.

Table 2. Leadership Competency Scale Development Procedure.



Validation of Finalized Scale (Total 15 Items)
(Construct Validity Analysis using the PCM and the CFA, Reliability Analysis)

3.3 Preliminary Test Items

In this study, leadership competency was defined according to Baek et al. [3] as 'the ability to propose new visions and directions for the development of one's own group, effectively manage the group in various situations, and lead positive changes within the group by responsibly and proactively taking the lead and coping appropriately'. The sub-domains were composed of 'Futuristic Vision', 'Group Management', and 'Lead by Example', with their definitions presented in Table 3. Subsequently, a scale consisting of 30 preliminary items (twice the number of the final items), with 10 items for each sub-domains, was developed. Each item was structured as a 5-point Likert-type scale: 1) Strongly disagree, 2) Disagree, 3) Neutral, 4) Agree, 5) Strongly agree. Specific examples of individual items are as shown in Table 4.

Table 3. Definition of Leadership Competency and Sub-domains.

Competency	Definition
Leadership Competency	The ability to propose new visions and directions for the development of one's own group, effectively manage the group in various situations, and lead positive changes within the group by responsibly and proactively taking the lead and coping appropriately.
	Sub-domains
Futuristic Vision	The ability to propose future-oriented goals and tasks for the development of one's own group, encourage members to actively participate and successfully accomplish them. ◆ Sub-elements: Goal Setting, Motivation, Willingness to Take on Challenges, Driving Force, Situational Judgement
Group Management	The ability to delegate roles so that all members can participate effectively in collaborative tasks of the group, coordinate diverse opinions, and systematically manage necessary resources. ◆ Sub-elements: Understanding Members, Task Allocation, Resource Management, Conflict Management, Performance Management

Lead by Example	The ability to take the lead with a sense of responsibility during collaborative group tasks, foster a collaborative atmosphere based on respect and trust for members. ◆ Sub-elements: Setting an Example, Responsibility, Encouragement, Trust, Flexibility

Table 4. Examples of Preliminary Items of Leadership Competency Scale.

Sub-domains	Sub-elements	Item (example)
Futuristic Vision	Goal Setting	I am good at suggesting goals that the members can collectively strive for.
	Motivation	I help each member find their own meaning in collaborative tasks.
Group Management	Understanding Members	I strive to identify the strengths and weaknesses of each individual in our group.
	Task Allocation	I make an effort to distribute the workload of each member fairly.
Lead by Example	Setting an Example	I strive to be a role model for the members.
	Responsibility	I am inclined to take on any task without complaining and complete it quietly.

3.4 Model Setup and Comparison of Model Fit

In this study, the validity of the preliminary 30 items for the leadership competency scale for high school students was verified by evaluating their fit using PCM (Partial Credit Model) and CFA (Confirmatory Factor Analysis). For this purpose, Winsteps 3.66 software was utilized to check item fit for the preliminary items using PCM.

To select the final 15 items, four different models were established and analyzed, considering item fit, item content (sub-elements), and dimensions. The first and second models were based on a unidimensional assumption, with the first model considering only item fit and the second model considering both item fit and content. The premise of a unidimensional model implies that the scale for high school students' leadership competency is not composed of three sub-areas (vision presentation, group management, leading by example) but is assumed to be a single domain. Considering

item content means selecting the item with higher item fit among the two assigned per sub-element. This approach was taken because the content of the two items allocated to each sub-element in the preliminary items was set similarly, and the choice of one item with higher item fit was intended to consider both item fit and content.

The third and fourth models, on the other hand, were based on a three-dimensional assumption. The third model considered only item fit, while the fourth model took into account both item fit and item content. The established four models are as follows (see Table 5 and Figure 1).

Table 5. Model Setup Criteria.

	Dimension	Criteria
Model 1	Uni-dimension	Item Fit
Model 2		Item fit and Item Content
Model 3	Three-dimension	Item Fit
Model 4		Item fit and Item Content

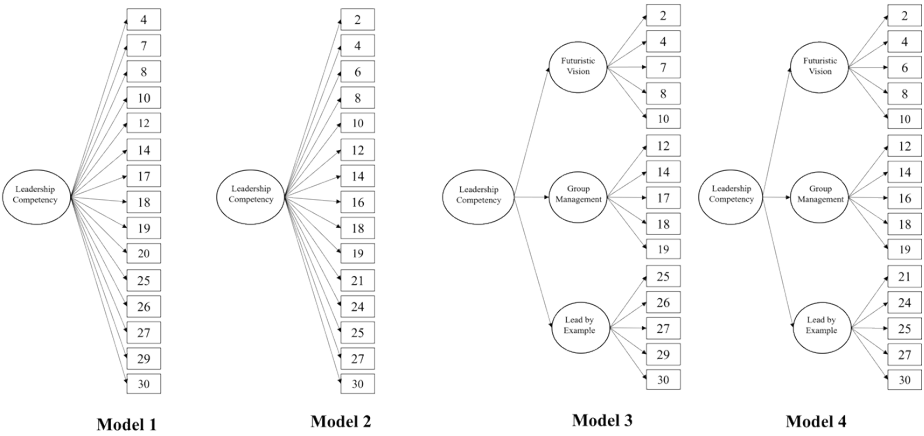


Fig. 1. Comparison of 4 Models (Visualization).

Next, to compare the models, CFA (Confirmatory Factor Analysis) was conducted to select the model with the best model fit as the final model (see Table 6). Model fit was compared using indices such as $\chi 2/df$, RMSEA, SRMR, TLI, and CFI. Generally, if the normed chi-square value ($\chi 2/df$) which is $\chi 2$ divided by degrees of freedom is less than 3, the model is considered to be a good fit. Additionally, lower values of RMSEA (below 0.8) and SRMR (below 0.05) and higher values of TLI and CFI (above 0.9) are indicative of a close fit [29] [30]. Considering all these factors, it was

found that Model 4 had the best fit indices. This indicates that the three-dimensional model, which considers both item fit and content, is the most appropriate model.

Table 6. Model Comparison.

Model	Normed χ^2	RMSEA (90% confidence interval)	SRMR	TLI	CFI
Model 1	3.133***	0.078 (0.067~0.088)	0.038	0.934	0.943
Model 2	2.601***	0.067 (0.07~0.078)	0.038	0.944	0.952
Model 3	2.571***	0.067 (0.056~0.077)	0.033	0.951	0.959
Model 4	1.799***	0.048 (0.035~0.059)	0.030	0.972	0.977

****p<.001*

4 Research Results

In this study, a leadership competency scale for high school students was developed, and the final model consisting of 15 items was selected using PCM and CFA. The results of the validity and reliability analysis of the final model are as follows:

4.1 Descriptive Statistics

To assess the level of data collected for a leadership competency scale for high school students, a descriptive statistical analysis was conducted. The results for each variable are as follows (see Table 7). First, the average for the sub-domains of leadership competency, 'Futuristic Vision', was found to be 3.68 with a standard deviation of 0.64. Next, the average for 'Group Management' was 3.72 with a standard deviation of 0.67, and the average for 'Lead by Example' was 3.73 with a standard deviation of 0.65. The overall average for leadership competency was 3.71, with a standard deviation of 0.60.

Table 7. Descriptive Statistics.

	Mean (SD)	Min	Max
Futuristic Vision	3.68 (0.64)	1.00	5.00
Group Management	3.72 (0.67)	1.60	5.00

Lead by Example	3.73 (0.65)	1.20	5.00
Overall	3.71 (0.60)	1.27	5.00

4.2 Content Validity Analysis

The results of the Content Validity Index (CVI) analysis for the final items are presented in the Table 8. Here, the content validity index was calculated based on the responses of educational measurement and evaluation experts (N=9), determined by the proportion of experts who rated each item as 'valid' (4 or 5 points) [31].The range of CVI values for each item was between 0.89 and 1.00, with an average value of 0.95. The average content validity of the 15 items was 4.71 out of 5, with a standard deviation of 0.48. The content validity of each individual item ranged from 3.0 to 5.0, with averages from 4.33 to 5.00. This indicates that the validity of both the overall items and individual items was very good.

Table 8. Content Validity Index of Finalized Scale.

Sub-domains	Sub-elements	Item No.	CVI	Min	Max	Mean (SD)
Futuristic Vision	Goal Setting	2	1.00	4.00	5.00	4.78 (0.44)
	Motivation	4	0.89	3.00	5.00	4.67 (0.71)
	Willingness to Take on Challenges	6	0.89	3.00	5.00	4.56 (0.73)
	Driving Force	8	0.89	3.00	5.00	4.33 (0.71)
	Situational Judgment	10	0.89	3.00	5.00	4.78 (0.67)
Group Management	Understanding Members	12	0.89	3.00	5.00	4.56 (0.73)
	Task Allocation	14	1.00	5.00	5.00	5.00 (0.00)
	Resource Management	16	1.00	4.00	5.00	4.78 (0.44)
	Conflict Management	18	1.00	5.00	5.00	5.00 (0.00)
	Performance Management	19	1.00	4.00	5.00	4.89 (0.33)
Lead by Example	Setting an Example	21	0.89	3.00	5.00	4.44 (0.73)
	Responsibility	24	0.89	3.00	5.00	4.44 (0.73)
	Encouragement	25	1.00	4.00	5.00	4.78 (0.44)

	Trust	27	1.00	5.00	5.00 (0.00)
	Flexibility	30	1.00	4.00	5.00 4.67 (0.50)
Total			**0.95**		**4.71 (0.48)**

4.3 Construct Validity Analysis

In this study, to verify the construct validity of the leadership competency scale for high school students, analyses using the correlation between sub-domains and total score, as well as inter-correlations among the sub-domains, and CFA were conducted. First, the Pearson product-moment correlation coefficients between the sub-domains of the leadership competency scale and the total score, and among the sub-domains themselves, are as presented in Table 9. According to the analysis results, the correlations between 'Futuristic Vision', 'Group Management', 'Lead by Example', and the total score of leadership competency were statistically significant, with coefficients of 0.906, 0.938, and 0.919 respectively, indicating that the sub-domains collectively form a single construct. Furthermore, the correlations among the sub-domains were also statistically significant, with coefficients ranging from 0.729 to 0.810. This also indirectly suggests that the sub-domains are organically related and collectively form the construct of leadership competency.

Table 9. Correlation between the Sub-domains and Overall Leadership Competency Scale.

	Futuristic Vision	**Group Management**	**Lead by Example**
Group Management	0.778**		
Lead by Example	0.729**	0.810**	
Overall	0.906**	0.938**	0.919**

***p<.01*

Next, to analyze the validity of the factor model that sets leadership competency as three sub-domains, confirmatory factor analysis was conducted. CFA is a model-based approach where the researcher first establishes the number and structure of factors theoretically and then checks how well the data fits this model. The factor model of leadership competency assumed a hierarchical model, as shown in Figure 2, divided into five sub-elements within each sub-domain. Furthermore, as previously examined, the fit indices of the final model were found to be very good (see Table 10). First, the normed chi-square value of the final model was 1.799, which is less than 3. And the RMSEA value was 0.048, SRMR was 0.030, TLI was 0.972, and CFI was 0.977, all indicating a very good fit.

Additionally, the parameter estimates of the factor model for the leadership competency scale for high school students are as follows (see Table 11). First, the

unstandardized coefficient estimates of the 1st factor loadings, which represent the relationship between sub-domains and individual items, were statistically significant. The range of standardized coefficient estimates was 0.573-0.798, indicating good results. Second, the unstandardized coefficient estimates for the 2nd factor loadings, which illustrate the relationship between leadership competency and its sub-domains, were found to be statistically significant. Additionally, the range of standardized coefficient estimates was notably high, between 0.906 and 0.992.

In summary, the construct validity of the leadership competency scale developed for high school students in this study can be considered excellent.

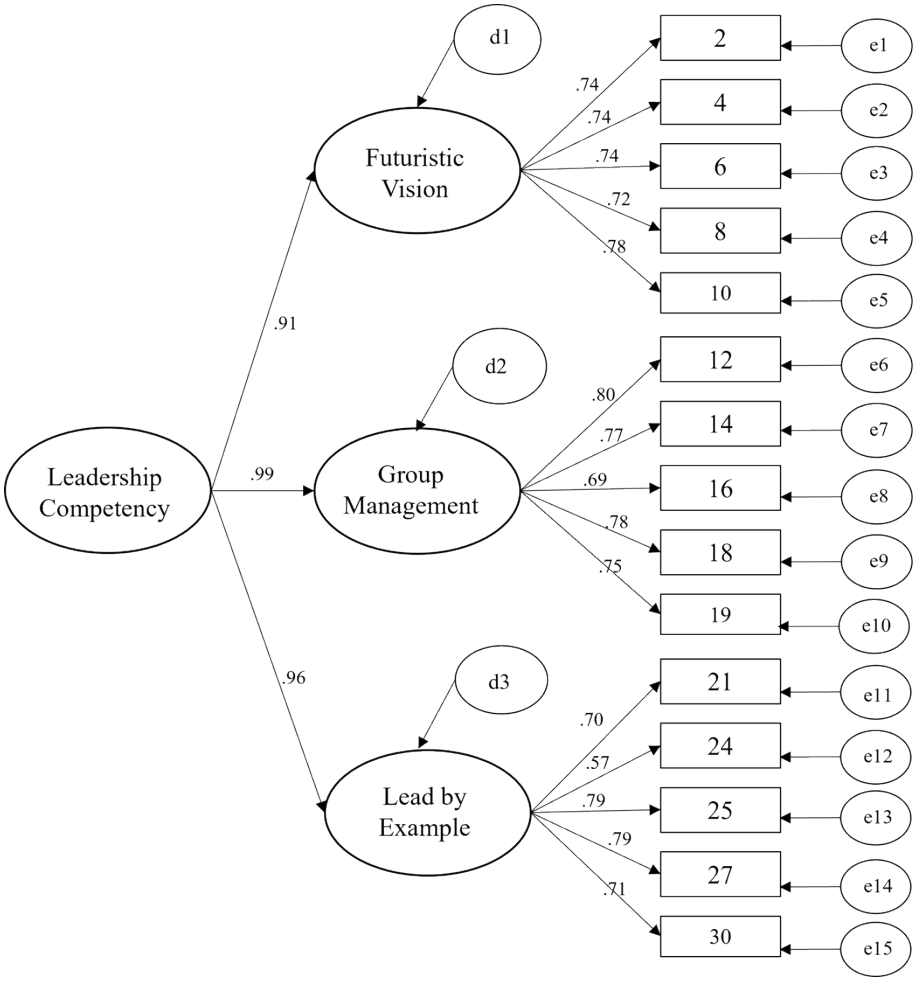


Fig. 2.CFA Model for Leadership Competency Scale.

Table 10. Model Fit of Final Model.

Normed χ^2	RMSEA (90% confidence interval)	SRMR	TLI	CFI
1.799***	0.048 (0.035~0.059)	0.030	0.972	0.977

***$p<.001$

Table 11. Parameters Estimated by Confirmatory Factor Analysis.

Item				coefficient	
				Unstandardized	Standardized
1st factor loadings	Futuristic Vision	→	Item no. 2	1.000	0.738
			Item no. 4	0.988 ***	0.740
			Item no. 6	0.974 ***	0.735
			Item no. 8	0.889 ***	0.718
			Item no. 10	1.002 ***	0.777
	Group Management	→	Item no. 12	1.000	0.798
			Item no. 14	0.976 ***	0.770
			Item no. 16	0.888 ***	0.694
			Item no. 18	0.964 ***	0.779
			Item no. 19	1.035 ***	0.789
	Lead by Example	→	Item no. 21	1.000	0.699
			Item no. 24	0.827 ***	0.573
			Item no. 25	1.108 ***	0.791
			Item no. 27	1.039 ***	0.786
			Item no. 30	0.893 ***	0.707
2nd factor loadings	Leadership Competency	→	Futuristic Vision	1.000	0.906
			Group Management	1.157 ***	0.992
			Lead by Example	1.057 ***	0.960

***$p<.001$

4.4 Reliability

To verify the reliability of the leadership competency scale developed for high school students in this study, the Cronbach's alpha coefficient, representing the internal consistency among the items included in the test, was calculated. The results are as follows (see Table 12). The overall reliability of the items was 0.939, and the reliability of each sub-domain ranged from 0.837 to 0.877, which is relatively high. Therefore, the leadership competency scale developed in this study has been confirmed to be a reliable scale.

Table 12. Cronbach's Alpha Coefficient of Final Scale.

	Futuristic Vision	Group Management	Lead by Example	Total
Cronbach's alpha	0.859	0.877	0.837	0.939

5 Summary and Discussion

Since the emphasis on competency-based education in the OECD's DeSeCo project, there has been a growing recognition of the importance of key competencies in Korean education, along with continuous educational discussions to enhance them. Particularly for high school students, who are in the process of discovering and striving for their career paths, it is crucial to develop key competencies that will lead them in future society. Among various key competencies, leadership competency is especially important for high school students, who will take on roles as members of society and communicate with diverse people within communities. For nurturing such leadership competency, not only is it important to strengthen competency enhancement education and programs, but it is also crucial to precede these with a diagnostic process to assess one's level of competency and identify areas for improvement. Despite its importance, there was a significant lack of research in Korea on the development of leadership competency scale for high school students. Therefore, this study aims to create a scale for assessing leadership competency of high school students, and to validate the reliability and validity of the scale developed through various methods.

First, after a comprehensive review of previous studies, three sub-domains of leadership competency were identified: 'Futuristic Vision', 'Group Management', and 'Lead by Example'. Subsequently, 30 preliminary items (twice the number of the final 15 items) were created (2 items per each sub-domains), and these were modified and refined through a panel of 9 experts specializing in educational measurement and evaluation. A preliminary test was then conducted on 355 first-year students at J High School in S city, South Korea. To select the final model consisting of 15 items, four different models were established and compared. Item fit was verified using PCM, and four models were established considering dimensions, item fit, and content of the

sub-elements. The first model was a unidimensional model considering only item fit, and the second model was a unidimensional model considering both item fit and content. The third model assumed three dimensions according to sub-domains and considered only item fit, while the fourth model considered both item fit and content within a three-dimensional framework. After comparing the fit indices of these four models, the fourth model with the best indices was selected as the final model.

The results of the content validity analysis of the final model showed that the average content validity of the 15 items was 4.71 out of 5, and each item's average ranged from 4.33 to 5.00, indicating very good content validity. In the construct validity analysis, the correlations between the sub-domains and the total score of leadership competency were statistically significant, with coefficients of 0.906, 0.938, and 0.919, confirming that the sub-domains form a single construct. Additionally, the inter-correlations among the sub-domains were also statistically significant, ranging from 0.729 to 0.810. The results of the CFAfor the final model showed the best model fit (RMSEA= 0.048, SRMR=0.030, TLI=0.972, CFI=0.977), and the reliability was also high.

However, there are some limitations and suggestions for future research. First, since this study involved only 355 high school students in South Korea, generalizing the results to other populations is inappropriate. Therefore, further research involving high school students from diverse backgrounds is necessary to generalize the findings. Second, future studies aiming to diagnose the leadership competency of high school students more accurately should consider conducting profile analyses based on the sub-domains derived from this study or developing standardized norms for the levels of leadership competency among high school students. Third, using the leadership competency scale developed in this study, further analyses should be conducted on the relationships between various variables (e.g., interpersonal relationships or academic achievement) that are expected to be related to leadership competency. Lastly, using the leadership competency scale developed for high school students in this study, it is possible to develop educational programs for specific sub-domains. Since the leadership competency scale can identify which sub-domain an individual scores high or low in, it is expected that personalized educational programs can be provided after utilizing this scale.

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