

Article

Creating a scale for measuring non-cognitive abilities developed through sports for elementary school students

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Abstract

The purpose of this study was to create a scale to measure non-cognitive skills that can be developed through sport. To begin, a draft of a non-cognitive ability measurement scale was developed based on previous research. A preliminary survey of 346 elementary school students (318 males and 28 females, mean age 8.90 ± 1.76 years) was conducted, and a preliminary scale was created using exploratory factor analysis. A subsequent main survey was conducted with 1171 elementary school students (1025 males and 146 females, mean age 8.77 ± 1.73). In the present study, confirmatory factor analysis, reliability testing using cronbach's alpha, and structural validity of the entire scale were examined using structural analysis of covariance. Furthermore, theoretical interpretations were also taken into account, and finally, a non-cognitive ability measurement scale that can be developed through sports for elementary school students was created, consisting of 50 items with 5 factors: "self-management," "problem-solving," "cooperativeness," "leadership," and "greetings/polite".

Keywords: Social emotional skills; life skills; exploratory factor analysis; confirmatory factor analysis (3 - 5 words).

1. Introduction

The field of economics has broadly explored the subject of human capital that enables the economic development and preservation of society. Within that exploration, abilities known as “cognitive abilities” have traditionally received attention as individual factors that predict wages, earnings, advancement, and employment status. These studies found that an individual's subsequent economic success is predicted by the quality of so-called scholastic performance and academic ability such as test results in various subjects. Furthermore, having better cognitive ability has been considered effective for achieving individual success and in turn, the economic development of society (Endo, 2017). However, the Heckman study (Heckman & Rubinstein, 2001), which compared the wages of high school graduates, those who left high school without graduating, and those with qualifications equivalent to a high school diploma, found that cognitive abilities alone cannot explain a difference in wages. This suggests that abilities other than cognitive ones have an impact. Furthermore, research has indicated that such abilities also contribute positively to not only wage levels, but also social behavior (low crime rates) and health (physical and mental) (George, 2003; Heckman et al., 2006). Abilities that are not cognitive are referred to as non-cognitive abilities. Recently, there have been suggestions regarding the importance of these abilities.

Although non-cognitive abilities have received much attention, they are not conceptualized as substantial abilities of their own, but broadly interpreted as “abilities that are not cognitive,” for instance, in the Perry Preschool Project, an

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intervention study discussed in the aforementioned Heckman study that brought public attention to non-cognitive abilities. This project implemented an interventional program that encouraged spontaneous play among preschool children. When outcomes 40 years later were compared for the group that received the intervention program and the control group that did not, the results were significant, showing that the intervention group had higher annual incomes and rates of home ownership as well as lower crime rates and rates of receiving public assistance than the control group. Furthermore, no significant differences were observed in academic ability after the middle grades of elementary school, meaning that academic ability (cognitive abilities) could not explain the differences 40 years later. This suggests that abilities other than academic ones (non-cognitive abilities) probably had an effect. Referring to this fact, Endo et al. (2017) highlight the urgent need to clarify what non-cognitive abilities are.

As mentioned, non-cognitive abilities are interpreted broadly, and as explained later, specific information about important non-cognitive abilities differs depending on developmental stage. Accordingly, operational definitions (specific psychological variables, etc.) should also change depending on the subject. Considering this, standards for determining operational definitions are needed. Therefore, we provide a clear definition of non-cognitive abilities in this study before clarifying specific information about them.

In a report entitled “Skills for Social Progress: The Power of Social and Emotional Skills,” the OECD (2015) classified skills that lead to economic development and individual wellbeing as cognitive and non-cognitive skills (referred to in the report as social and emotional skills). The report describes skills as personal qualities that have three characteristics: productivity, measurability, and potential for growth. Productivity refers to contributing to economic development and individual wellbeing; measurability is the ability to be measured through observation, listening, and the like; and potential for growth refers to changing because of the environment or interventions. The non-cognitive abilities in our study can also be considered “skills,” and can therefore be regarded as having such characteristics. In addition, Nishida et al. (2018) consolidated studies on non-cognitive abilities to develop programs that cultivate these abilities in young children. The Nishida paper narrows down the targets of intervention programs. The standard for this narrowing down was studies that are “measurable, where growth due to intervention is anticipated and said growth is expected to lead to positive outcomes,” which is also similar to the OECD definition of skills.

Furthermore, the OECD report (2015) presumes social and emotional skills that correspond to non-cognitive skills to be thoughts, emotions, and patterns of behavior related to three areas: achievement of long-term goals, cooperation with others, and emotional regulation. These characteristics clearly differentiate social and emotional skills from cognitive abilities, meaning academic abilities. In addition, while the concept of life skills, which have been thoroughly studied in the field of educational psychology, is thought to correspond to non-cognitive skills, the WHO (1997) defines life skills as “the skills necessary to constructively and effectively deal with the various problems and demands that arise in daily life.” Compared to the definition of social and emotional skills from the OECD, this one from the WHO conveys that setting goals effectively, cooperating with others, and managing one’s emotions appropriately are necessary to constructively and effectively deal with the various problems and demands that arise in daily life. As such, the OECD definition is contained within the WHO’s description of life skills.

In addition, the report from Endo et al. (2017) considers social qualities that are naturally and deeply tied to building and maintaining relationships with others (e.g., psychological understanding, empathy, morality, pro-social behavior, etc.) an important pillar of the non-cognitive qualities of the mind, because relationships with others and a stable position in groups are directly connected to individual wellbeing. Furthermore, because people are by nature strongly driven by the desires for self-actualization, self-enhancement, and self-preservation, qualities that enable people to effectively fulfill such desires (e.g., self-control, grit, intrinsic motivation, autonomy, etc.) are emphasized as another important pillar. Life skills research has produced similar results regarding these two aspects of non-cognitive abilities (Shimamoto & Ishii, 2006; Ueno & Nakagomi, 1998).

Based on the above, we define non-cognitive abilities in this study as “thoughts, emotions, and patterns of behavior that include individual qualities that enable a person to fulfill desires such as self-actualization, self-enhancement, and self-preservation, and social qualities involved in building and maintaining relationships with others.” These factors are measurable, growth due to intervention is anticipated, and said growth is expected to lead to positive outcomes. In this study, we select specific psychological variables according to this definition.

As mentioned, specific information about important non-cognitive abilities differs depending on developmental stage. The Japan Institute of Lifelong Learning consolidated the non-cognitive abilities recommended by various

organizations in Japan (e.g., life skills proposed by the Ministry of Education, Culture, Sports, Science and Technology (2010) and interpersonal skills proposed by the Cabinet Office (2003)) and created a conceptual diagram (Japan Institute of Lifelong Learning, 2018) showing which skills should be acquired at what age so as to address the following questions: “Are there basic skills required from early childhood through adulthood?” “Do the skills required change based on developmental stage?” “Are there differences in the abilities required for business, culture, and education?” The conceptual diagram uses the classifications “early childhood,” “primary and secondary education stage,” “higher education stage,” and “later years” as developmental stages, and shows abilities needed throughout all stages, abilities that change or develop depending on developmental stage, and abilities that develop when basic skills are acquired. Abilities needed throughout all stages are considered necessary in education from early childhood onward, and it has been demonstrated that these form the foundation for higher order abilities. In addition, the Heckman study (Heckman and Rubenstein, 2001) reported that educational intervention in early childhood led to a better life later. Furthermore, the OECD report (2015) demonstrated that the state of a person’s skills at a certain time predicts the state of that individual’s skills in the future, a pattern the report described as “skills breeding skills.” In another fascinating analysis, the OECD found that individuals with high non-cognitive abilities are expected to have high cognitive abilities later, demonstrating the possibility that non-cognitive abilities can have an effect on improving cognitive abilities. Based on these results, when improving non-cognitive abilities is a goal, early interventions are considered preferable.

Regarding the development and acquisition of non-cognitive skills, there has been great interest in the importance of early education, particularly in the preschool years (Endo et al., 2017). However, in modern society, there is much time between a child starting school and entering society. In particular, during childhood, children join a community larger than any they have belonged to before when they go to school, and form relationships with more people than they have before. Naturally, we should also pay attention to the importance of education for non-cognitive skills during this period. Furthermore, during childhood, studies using written questionnaires become possible as children’s language skills develop. One advantage of questionnaire studies is that they “make it possible to obtain information from many subjects across a wide range, which makes it easier to generalize the results (Toda et al., 2000). As such, questionnaire studies are a useful method for clarifying specific information about non-cognitive abilities and their operational definitions (psychological variables).

In early and middle childhood, participating in sporting activities is considered an effective way to increase non-cognitive skills. In general, the view that sports encourage personal growth is widely accepted. The Natsuhara and Kato (2017) study, which investigated the relationship between non-cognitive skills and experiences with sports, demonstrated that children who participated in sports had better non-cognitive abilities than those who did not. Based on this, sporting activities can be considered an effective tool for improving non-cognitive skills. However, when teaching non-cognitive skills in the specific context of sports, there is also the issue of generalization, i.e., whether these skills can be applied more generally. For example, antisocial behavior by college athletes has been reported in the media in recent years, and such occurrences show that regardless of how much people grow as athletes, it does not mean that their general non-cognitive skills will improve unconditionally and lead to growth as a person. Regarding this problem, Ueno and Nakagomi (1998) investigated the similar concept of life skills in high school students, concluding that the life skills improved in a competitive setting extend to an athlete’s overall behavior outside of competition when his/her coach encourages generalization. Although research on generalization in the improvement of non-cognitive skills should continue, possibly, the non-cognitive skills acquired through sports can be generalized to overall behavior.

2. Creating a Draft for the Non-Cognitive Ability Measurement Scale

2.1 Methods

The goal of this study is to create a scale to measure non-cognitive abilities developed through sports. As such, we gathered accounts of “patterns of behavior observed in actual sports instruction settings considered to have a strong relationship with non-cognitive abilities” and “patterns of behavior observed in prior studies that are closely related to non-cognitive abilities.” We then extracted patterns of behavior with a strong relationship to non-cognitive abilities and created question items. For the former type of data, we collected patterns of behavior by having 33 sports instructors from Leifras give a freeform response to the question: (1) What type of growth do you see in athletes that tells you your instruction has been successful? For the latter type of data, we searched prior studies using “life skills” as the primary keyword and collected patterns of behavior from results obtained via questionnaires. We created items capable of measuring the patterns of behavior collected through these two processes, and used these items as the draft for the non-cognitive ability measurement scale. While gathering patterns of behavior and creating question items,

the validity of extracted data was confirmed by three researchers specializing in sports psychology and three sports instructors working with Leifras.

2.2 Results of Creating a Draft for the Non-Cognitive Ability Measurement Scale

We extracted the following 10 patterns of behavior from the results of the sports instructor survey: “fortitude and perseverance,” which refers to “continuing to compete even when things are tough rather than giving up”; “autonomy and self-motivation,” namely “the ability to take action on one’s own”; “altruism,” “the ability to act for the sake of others”; “willingness to take on challenges,” “the ability to take action without being afraid of failure”; “politeness and manners,” “the ability to greet others properly”; “communication,” “the ability to listen to the opinions of others and share one’s own opinions”; “collaboration and cooperation,” which refers to “working together with friends to take action”; “goals,” which represents “having goals and taking action to achieve them”; “leadership,” which refers to “leading or supporting teammates”; and “problem-solving,” namely “reflecting on oneself and recognizing problems to grow, and then solving these problems.”

Then, from prior research, we used 10 studies such as Yamaguchi et al. (2005) and Shimamoto and Ishii (2006), that appeared in the search results for the keyword “life skills,” and measured and investigated behavior strongly related to non-cognitive abilities. After carefully examining the content of each study, we extracted the following five patterns of behavior: independence, compassion and cooperation, politeness, ability to self-regulate, and problem-solving ability.

Creating items capable of measuring each pattern of behavior from the above results produced 167 items.

Table 1. Behavioral patterns extracted from prior studies

Keywords	Behavioral patterns	Keywords	Behavioral patterns
Decision-making	Independence	Manners toward others	Politeness
Communication		Grateful mindset	
Planning		Politeness	
Leadership		Greetings	
Goal-setting		Rules/norms	
Ability to think		Coping with emotions	Ability to self-regulate
Determining future plans		Stress management	
Self-driven learning		Goal-setting	
Information-gathering		Positive thinking	
Independence/autonomy		Planning	
Interpersonal relationships	Compassion/cooperation	Self-driven learning	
Compatibility/sensitivity		Staying healthy	
Gratitude		Performing tasks	
Group activities		Fortitude, perseverance	
Prosocial behavior		Decision-making	
Cooperation		Ability to think	
		Ability to summarize information	
	Problem-solving		

3. Pilot Study

3.1 Study Subjects

There were 346 subjects in the pilot study (318 male, 28 female, average age 8.90 years \pm 1.76). The subjects were children enrolled at a sports school operated by Leifras. According to the Sasakawa Sports Foundation (2016), the enrollment rate of sports schools tends to be higher among boys. The school operated by Leifras also has a high participation rate of boys, and the ratio of target students is biased. However, at the same school, there is no change in teaching methods and coping methods for men and women, and there are times when guidance is given at the same time. It was judged that there was no need to consider the male-female ratio.

3.2 Study Methods and Study Period

A web form was used to conduct the survey. Responses were provided using the respondent's own computer or smartphone, and we requested in advance that a guardian be present in case there was wording in the question items that the respondent could not understand. The pilot study was conducted in July 20XX.

3.3 Study Content

Study content part (1): Demographic factors

We asked subjects about their sex, age, school year, history of enrollment at a sports school run by Leifras, family structure, and favorite sporting event.

Study content part (2): Draft of the non-cognitive ability measurement scale

We used the questionnaire created as a draft of the non-cognitive ability measurement scale. It included 167 items comprising items related to the 10 patterns of behavior mentioned earlier: fortitude and perseverance, autonomy and self-motivation, altruism, politeness and manners, communication, collaboration and cooperation, goals, leadership, problem-solving, independence, compassion and cooperation, politeness, ability to self-regulate, and problem-solving ability. Responses were measured on a five-point scale ranging from "1 = Does not fit me at all" to "5 = Fits me extremely well."

3.4 Ethical Considerations

Although this study was not approved by an ethical review board, informed consent was obtained from all study subjects and their parents.

In order to obtain informed consent, the following information were written on the top page of the web form for the survey"

1. This survey contains questions related to family, and the content of these responses will be completely encrypted before aggregation. Accordingly, individuals will not be identified in any way during the aggregation and analysis stages.
2. Aggregated response data will be saved in a storage medium where access to view the data is controlled by a password. In addition, the response data will be viewed only by a very small number of people involved in the study.
3. The results of this study may be made public for research purposes. Any information made public will only include averages of all response data, and individuals will not be identified in any way.
4. Furthermore, responding to all survey items will be considered consent to participate in the study, and respondents may withdraw from or stop responding at any time.

3.5 Statistical Analysis

In the pilot study, we first confirmed the ceiling and floor effects for each item and calculated the correlation coefficients between the items. For the ceiling and floor effects, we determined that items with very low average response scores of 5.00 or 1.00 have little discriminability and thus excluded these items from subsequent analyses. Regarding the correlation coefficients, we determined that items with R-values extremely close to 1.00 are homogeneous and thus excluded one of the items from subsequent analyses. As an exploratory factor analysis, we conducted a factor analysis using the maximum likelihood method/equamax rotation, and after excluding items where the factor loading was less than 0.40 or where it was considered high for multiple factors, we performed an additional factor analysis. The final number of items was about 60. We confirmed the reliability of the extracted factors and items by calculating Cronbach's α .

3.6 Results and Discussion

When we checked the average response value for each item, three items had an average of more than 4.80. A ceiling effect was observed for these items, which led us to determine that the questions had no discriminability. We thus excluded them from subsequent analyses. We did not observe a floor effect for any of the items. In a correlation analysis between all items, two pairs had R-values exceeding 0.90, and we therefore excluded one item in each pair from subsequent analyses.

The results of four rounds of exploratory factor analysis using the maximum likelihood method/equamax rotation left five factors (F1–F5) and 52 items (Table 2). A description of each factor, details about the items, and information on reliability are provided below.

F1. A cluster of 12 items, including “I can follow through with anything without giving up” (factor loading 0.75–0.45). This factor was named “ability to self-regulate” because it includes statements about setting goals, the self-discipline to get things done, and ability to see things through. Cronbach’s α , which measures reliability, was 0.92 for this factor.

F2. A cluster of 13 items, including “I can follow rules that have been set” (factor loading 0.67–0.44). This factor was named “cooperation” because it includes cooperation with others and maintaining norms. Cronbach’s α was 0.92 for this factor.

F3. A cluster of 10 items, including “I can figure out the reasons for success or failure in my own way” (factor loading 0.66–0.42). This factor was named “problem-solving ability” because it includes statements related to skills that are necessary for solving problems, like reflecting on one’s behavior and ability to take action and considering problems. Cronbach’s α was 0.91 for this factor.

F4. A cluster of 9 items, including “I can organize everyone’s opinions in a discussion” (factor loading 0.74–0.40). This factor was named “leadership/independence” because it includes independent behavior and behaviors for organizing groups. Cronbach’s α was 0.90 for this factor.

F5. A cluster of 8 items, including “I can take the initiative to greet people” (factor loading 0.80–0.44). This factor was named “greetings/interactions” because it includes greeting other people and manners. Cronbach’s α was 0.86 for this factor.

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Table 2. Pilot study results

Factor name	Item details	Factor					Commonality	α
		1	2	3	4	5		
Ability to self-regulate	I can follow through with anything without giving up	.74	.15	.13	.23	.18	.67	
	I don't give up and work on things until the end	.64	.16	.31	.08	.23	.59	
	Even when things aren't going very well, I'm able to believe in myself and keep doing my best	.62	.10	.28	.11	.20	.53	
	Even if something isn't going well, I can keep challenging myself without giving up	.60	.12	.29	.25	.15	.54	
	I can set goals based on my determination to succeed rather than my desire to do something	.59	.08	.29	.35	.07	.57	
	Even when something feels difficult, I can still do my best	.57	.22	.33	.13	.14	.53	
	I can keep making an effort one step at a time to achieve my goals	.57	.21	.15	.31	.06	.47	
	I can set goals and work to achieve them	.51	.18	.15	.42	.04	.51	
	Even without recognition from the people around me, I can keep doing my best	.51	.22	.28	.17	.16	.45	
	I can find ways to improve myself on my own	.51	.15	.37	.37	.05	.57	
	I can take action to complete tasks	.50	.27	.36	.30	.02	.57	
I can work on easy tasks over and over without getting tired of them	.45	.25	.24	.10	.05	.34	.92	
Cooperation	I can follow rules that have been set	.30	.67	.10	.05	.08	.57	
	I can follow the rules when doing something with a group	.13	.65	.29	.10	.13	.58	
	I can cooperate with my friends	.03	.62	.12	.33	.34	.61	
	I can coordinate my actions with the people around me	.19	.61	.20	.12	.24	.54	
	I can work cooperatively during group activities	.02	.59	.29	.29	.29	.60	
	I can act with respect for my friends	.18	.59	.12	.34	.33	.62	
	I don't do things that cause trouble for the people around me or make them feel bad	.33	.58	.07	.00	.23	.51	
	I can listen well when my teachers or friends are talking	.20	.53	.26	.29	.07	.48	
	I can consider my friends and the people around me, not just myself	.19	.50	.24	.35	.20	.51	
	I can forgive my friends when they make a mistake	.16	.45	.09	.07	.33	.36	
	When I play with my friends, I don't insult them or say mean things	.25	.45	.14	.05	.11	.32	
I can think of my friends in the same way I think of myself	.10	.45	.30	.39	.22	.51		
I always keep the promises I make to my friends	.08	.44	.10	.05	.25	.29	.92	
Problem-solving ability	I can figure out the reasons for success or failure in my own way	.23	.13	.66	.25	.25	.63	
	When something didn't go well, I can figure out what wasn't working	.21	.15	.65	.30	.23	.64	
	I can take action myself to avoid failure	.27	.20	.63	.28	.08	.59	
	I can understand what's important to me and sort those things in order of importance	.18	.16	.63	.30	.13	.55	
	I can think for myself to find an answer	.32	.18	.60	.33	.12	.64	
	When I'm given a task, I think about it by myself before relying on others for help	.28	.15	.57	.18	.17	.48	
	I can work hard even when no one else is around me	.29	.18	.51	.16	.15	.44	
	I can take action immediately	.32	.05	.50	.24	.33	.51	
	I can talk things over with people around me in order to complete a task	.19	.26	.46	.36	.26	.51	
	Even if something unpleasant happens, I can keep doing my best	.32	.20	.42	.25	.17	.38	.91
Leadership/independence	I can organize everyone's opinions in a discussion	.18	.00	.29	.74	.24	.73	
	I can lead other people with my actions	.15	-.08	.31	.64	.27	.62	
	I can use my friends' thoughts as a foundation to come up with my own answer	.21	.21	.43	.56	.12	.62	
	When I'm acting as part of a group, I can take the lead for other people	.17	-.05	.18	.55	.40	.53	
	I can incorporate my friends' thoughts to come up with an answer of my own	.29	.22	.24	.51	.21	.51	
	I can lead other people who are having a hard time	.19	.32	.20	.48	.29	.50	
	I can compare different opinions from my friends and try them out	.22	.32	.27	.45	.22	.51	
	I can consider my friends' thoughts and feelings	.24	.42	.19	.42	.33	.56	
	I can do things in a way that feels right to me	.35	.19	.39	.40	.12	.52	.90
Greetings/interactions	I can take the initiative to greet people	.15	.21	.23	-.03	.80	.76	
	I can greet my friends properly	.11	.26	.16	.07	.67	.58	
	I can make an effort to talk to people, even ones I'm meeting for the first time	.07	-.09	.07	.21	.64	.50	
	I can greet adults properly	.28	.23	.21	.09	.61	.58	
	I can get along with people in a new group right away	-.03	.12	.07	.25	.58	.41	
	I can sincerely express feelings of gratitude	.09	.24	.07	.16	.46	.35	
	I speak up and say thank you to people	.15	.34	.10	.26	.46	.42	
	I can get along well with people of any age	-.03	.19	.06	.25	.44	.29	.86

4. Main Study

4.1 Study Subjects

The main study included 1,171 subjects (1,025 male, 146 female, average age 8.77 years \pm 1.73). The subjects were children enrolled at a sports school operated by Leifras and were distinguished from respondents in the pilot study to ensure there was no overlap. In addition, as in the pilot study, there is a bias in the male-female ratio, but this was not taken into consideration.

4.2 Study Methods and Study Period

The main study was conducted in November 20XX using the same procedures as the pilot study.

4.3 Study Content

Study content part (1): Demographic factors

We asked subjects about their sex, age, school year, history of enrollment at a sports school run by Leifras, family structure, and favorite sporting event.

Study content part (2): Non-cognitive ability measurement scale

To adjust the number of items and improve reproducibility, we used a scale in which 15 items were added to the 52 items for the 5 factors extracted in the pilot study. The scale included the five factors ability to self-regulate, cooperation, problem-solving ability, leadership/independence, and greetings/interactions. Responses were measured on a five-point scale ranging from “1 = Does not fit me at all” to “5 = Fits me extremely well.”

4.4 Ethical Considerations

We approached ethical considerations in the same ways as in the pilot study.

4.5 Statistical Analysis

As a confirmatory factor analysis, we conducted a factor analysis using the maximum likelihood method/promax rotation. After excluding items where the factor loading was less than 0.40 or was considered high for multiple factors, the factor structure was stable. We concluded the factor analysis when the number of items totaled 50. We confirmed the reliability of the extracted factors and items by calculating Cronbach’s α . Regarding the structural validity of the scale as a whole, we conducted a covariance structural analysis and made a determination based on the values for the fit indicators GFI, AGFI, CFI, and RMSEA.

4.6 Main Study Results

The results of two rounds of factor analysis using the maximum likelihood method/promax rotation left 5 factors (F1–F5) and 50 items (Table 3). However, the structure of the scale changed significantly from the pilot study version, with F1 having 20 items, F2 and F3 having 10, F4 having 6, and F5 having 4. We believe the results differed from those in the pilot study because of issues pertaining to factor loading and sample size.

The interpretation and naming of factors in a factor analysis require careful consideration from researchers. Reportedly, in some cases, items with a high factor loading on multiple factors should not be excluded and important factors that are good representations of the concept researchers are trying to measure should be kept even if the factor loading is not appropriate (Shimizu & Shojima, 2017). In other words, if a highly valid explanation is possible, the results of a factor analysis can be interpreted with an emphasis on the hypothesis. Thus, while referencing the results of the confirmatory factor analysis, we summarize the definition of non-cognitive abilities in this study and the results of the pilot study to interpret the results of the factor analysis.

First, F1 was a cluster of items related to ability to self-regulate and problem-solving ability in the pilot study. In addition, all 10 items with a high factor loading were included in the ability to self-regulate category in the pilot study, and the 10 items with a low factor loading were included in the problem-solving ability category in the pilot study. Factor loading is the strength of the effect of a latent variable, i.e., the factor, on the actual measured variables (Shimizu & Shojima, 2017). As such, we can interpret that F1 is a factor that measures the ability to self-regulate. Items interpreted as thinking and acting for oneself were also included in the problem-solving ability factor in the pilot study, which led to those items being consolidated into F1. However, we emphasized the results of the pilot study and theoretical context for making factors independent. Therefore, we separated the 10 items with a high factor loading in F1 into a factor named “ability to self-regulate” and separated the 10 items with a low factor loading into a factor named “problem-solving ability.”

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Table 3. Main study results

Factor	Item details	Factor					Commonality	α
		1	2	3	4	5		
Ability to self-regulate	I can keep making an effort one step at a time to achieve my goals	.88	-.02	-.10	-.06	.00	.60	
	Even when something feels difficult, I can still do my best	.88	-.07	-.15	-.04	.16	.61	
	Even if something isn't going well, I can keep challenging myself without giving up	.86	-.09	-.16	.01	.12	.58	
	I don't give up and work on things until the end	.83	-.04	-.15	.07	-.01	.55	
	I can follow through with anything without giving up	.79	-.04	-.12	.02	-.02	.49	
	I can set goals based on my determination to succeed rather than my desire to do something	.78	-.10	.01	.06	-.03	.55	
	I can set goals and work to achieve them	.76	.00	.03	.02	-.06	.59	
	Even when things aren't going very well, I'm able to believe in myself and keep doing my best	.75	-.01	-.10	.04	.06	.53	
	Even without recognition from the people around me, I can keep doing my best	.73	.01	-.08	-.07	.15	.50	
	I can take action to complete tasks	.72	-.02	.14	-.06	.00	.59	.93
Problem-solving ability	I can prepare to avoid failure	.55	.13	.16	-.05	-.08	.50	
	I can find ways to make sure that things go well	.52	-.01	.30	-.05	-.02	.51	
	I can take action myself to avoid failure	.52	.10	.16	.01	-.03	.49	
	When I'm given a task, I think about it by myself before relying on others for help	.50	.09	.14	.01	-.09	.40	
	I can figure out the reasons for success or failure in my own way	.48	.05	.19	.02	-.09	.40	
	When something didn't go well, I can figure out what wasn't working	.46	.18	.15	-.01	-.09	.45	
	I can think for myself to find an answer	.43	.08	.26	.08	-.12	.48	
	I can take action immediately	.39	.06	.19	.05	.05	.39	
	I can understand what's important to me and sort those things in order of importance	.38	.18	.12	.00	-.05	.34	
	I can talk things over with people around me in order to complete a task	.31	.16	.20	-.01	.07	.38	.89
Cooperation	I don't do things that cause trouble for the people around me or make them feel bad	-.03	.87	-.15	-.05	-.08	.57	
	I can coordinate my actions with the people around me	-.03	.84	-.01	-.11	-.01	.58	
	I can consider my friends and the people around me, not just myself	.00	.72	.00	-.01	.13	.58	
	I can follow the rules when doing something with a group	.02	.72	-.02	.04	-.14	.51	
	I can follow rules that have been set	.04	.69	-.10	.06	-.16	.44	
	When I play with my friends, I don't insult them or say mean things	.06	.69	-.24	-.03	.03	.40	
	I can act with respect for my friends	.01	.67	-.06	.00	.21	.53	
	I can consider my friends' thoughts and feelings	-.04	.63	.02	.10	.02	.46	
	I can work cooperatively during group activities	-.02	.63	.19	-.05	.05	.52	
	I can cooperate with my friends	.01	.61	.07	.00	.14	.51	.90
Leadership	When I'm acting as part as a group, I can give directions to others	-.06	-.08	.97	-.03	.00	.78	
	I can act as a leader for everyone	.02	-.16	.97	-.08	.06	.80	
	When I'm acting as part of a group, I can take the lead for other people	-.05	-.12	.91	-.01	.06	.72	
	I can lead other people with my actions	-.01	-.09	.85	.02	.04	.69	
	I can give directions to my friends	.05	-.11	.79	-.04	.05	.59	
	I can organize everyone's opinions in a discussion	-.02	.10	.73	.07	-.13	.57	
	I can lead other people who are having a hard time	-.02	.20	.44	.01	.21	.46	
	I can teach my friends things	.03	.23	.35	.05	.17	.43	
	I can incorporate my friends' thoughts to come up with an answer of my own	.24	.24	.33	.06	-.09	.48	
	I can use my friends' thoughts as a foundation to come up with my own answer	.20	.24	.32	.10	-.11	.45	.92
Greetings/politeness	I can take the initiative to greet people	.01	-.15	-.02	.94	-.06	.71	
	I can greet adults properly	-.01	-.13	-.03	.94	-.01	.74	
	I speak up and say thank you to people	.04	.10	-.05	.68	.05	.58	
	I can greet my friends properly	-.07	.10	.05	.68	.01	.53	
	I can sincerely communicate feelings of gratitude	.03	.15	-.02	.56	.12	.53	
	I can reply to people properly	.09	.16	.01	.53	.06	.52	
	I can have friendly conversations with anyone	-.04	.04	-.01	.05	.82	.71	
	I can get along with people in a new group right away	.07	-.03	.08	-.05	.77	.64	
	I can get along well with people of any age	.06	.14	-.03	-.05	.70	.53	
	I can make an effort to talk to people, even ones I'm meeting for the first time	-.05	-.29	.18	.19	.62	.58	.89

F2 was a cluster of items related to cooperation in the pilot study, and accordingly, we named the factor “cooperation.”

F3 was a cluster of items related to leadership and independence in the pilot study, but items such as “I can do things in a way that feels right to me,” which carried the nuance of “acting on one’s own” were removed, leaving only items related to “acting as part of a group.” We therefore named the factor “leadership.”

For F4 and F5, items related to greetings and interactions were separate in the preliminary survey. Although both these factors describe communication, the factors were separated because F4 emphasizes greetings and saying thank you, while F5 emphasizes getting along. As such, we emphasized the pilot study for these factors and combined the two into a factor named “greetings and politeness.”

As described above, although the results of the factor analysis in this study showed that the factor structure was slightly different from that of the preliminary study, the results could still be interpreted as five factors. Reliability for each factor was high, as evidenced by the respective Cronbach's α values: 0.93 for ability to self-regulate, 0.89 for problem-solving ability, 0.90 for cooperation, 0.92 for leadership, and 0.89 for greetings and politeness. In addition, for the structural validity of the scale as a whole, the results of a covariance structural analysis showed that GFI=0.81, AGFI=0.79, CFI=0.88, and RMSEA=0.06, with GFI, AGFI, and CFI scoring slightly below the standard 0.90. We believe one reason for this was that ability to self-regulate and problem-solving ability, which were combined in the factor analysis, were subsequently split, and the error correlation between them was very high at 0.90. Therefore, despite some uncertainty about the structural validity of the scale, we decided to emphasize the results of the pilot study, as mentioned, and adopt those findings as the results of the study.

As a result of confirmatory factor analysis, We Found several items with relatively high covariance. In confirmatory factor analysis, when high covariance was observed, the alpha coefficient may be overestimated even if there are items with low correlation (Kano, 2002). However, in this survey, items with relatively high covariance show a commonality of .50 or more, which can be identified as being influenced by factors. Furthermore, the contents of the items can also be interpreted as closely related. For the above reasons, it is considered that the α coefficient is not overestimated.

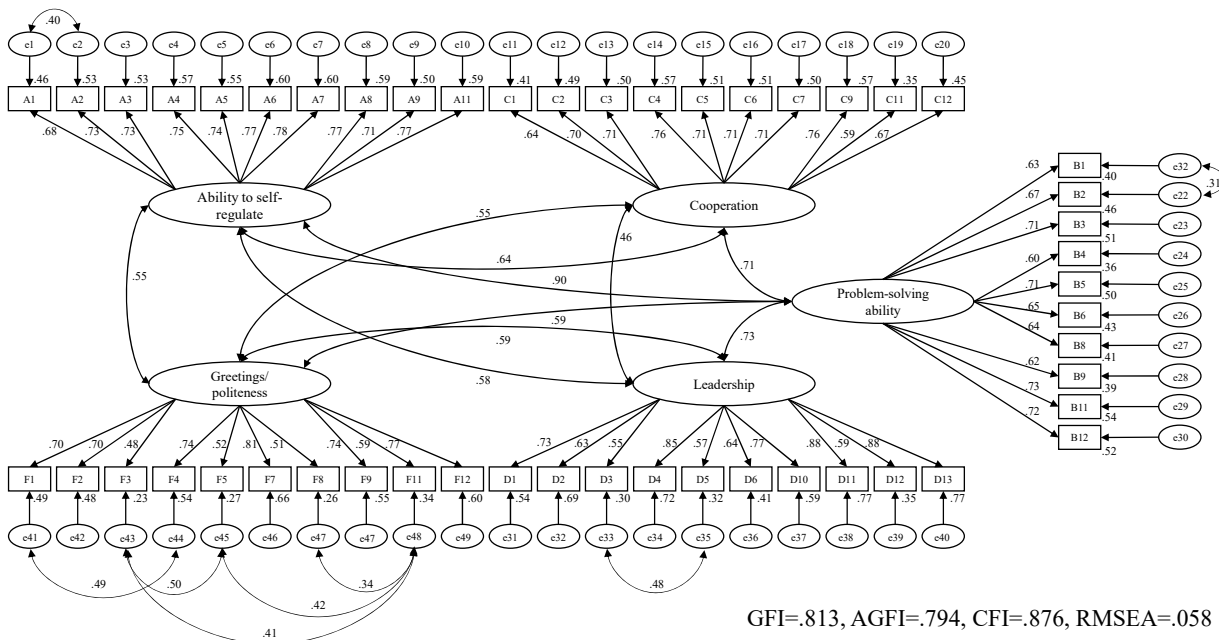


Figure1 Result of Confirmative factor analysis

5. Overall Discussion

5.1 Limitations of research

One of the limitations of this study was the male/female ratio of the survey subjects. According to the Sasakawa Sports Foundation (2015), there is a difference in the participation rate of men and women in sports clubs. Considering the teaching policy of the target school, we decided not to consider gender differences in this study. However, considering the developmental stages in childhood, it is quite possible that the difference between men and women affects the results. In the future, it will be necessary to increase the number of women's data and examine it.

5.2 Factor Structure in the Scale

The results of the factor analysis in this study did not point to the five factors we intended. However, as Shimizu and Shojima (2017) emphasize, factor interpretation is not achieved through the factor analysis itself, but by researchers based on the results thereof. Furthermore, this study included in its investigation instructors who work in the field, and we interpreted factors in a way that is valid considering real-world perspectives. In our factor interpretation, this led us to split F1 into the two factors of ability to self-regulate and problem-solving ability, and to combine F4 and F5 into greetings and politeness. These interpretations fit the results of the pilot study.

We now consider the division of F1 into ability to self-regulate and problem-solving ability. These two factors are strongly correlated, and thus, impacted the fit indicators during the confirmatory factor analysis. Although ultimately divided into different factors, their factor correlation was also high at 0.75 in the pilot study. However, it is reasonable to consider these two factors two different abilities. For example, a study by the Japan Institute of Lifelong Learning (2018) extracted 16 elements of abilities that correspond to categories of non-cognitive abilities. Among these, the Institute defined problem-solving ability as “the ability to think for oneself, find the real problem, make a plan to solve the problem, and execute that plan in an adaptable and appropriate manner.” This is similar to the conceptualization of problem-solving ability in this study. The Institute also defined the ability to self-regulate as “the ability to control, manage, and analyze oneself to achieve one’s goals and objectives, or to perform one’s role within the rules of a group.” This resembles the definition of ability to self-regulate in this study. These two abilities were treated separately in the study report from the Institute. In addition, several studies on life skills (Yamaguchi et al., 2005; Shimamoto et al., 2013) have also treated abilities similar to these two separately. Considering this, the decision to split F1 into ability to self-regulate and problem-solving ability in this study can be considered sufficiently valid from a theoretical perspective.

5.3 Importance of the Five Factors

Non-cognitive skills can contribute to an individual’s success in society as well as their physical and mental health, and there is a desire for educational interventions to develop these skills in elementary school students. This study defined non-cognitive abilities as “thoughts, emotions, and patterns of behavior that include individual qualities that enable a person to fulfill desires such as self-actualization, self-enhancement, and self-preservation, and social qualities involved in building and maintaining relationships with others.” We also developed a scale to measure non-cognitive abilities, which comprises five factors, based on sports for elementary school students.

The five factors used in this scale were created based on prior research and a survey of sports instructors who work directly with children. These abilities are needed from early childhood onward and form the foundation for higher order abilities (Japan Institute of Lifelong Learning, 2018).

Furthermore, an analysis of the correlation between the five factors obtained in this study and age showed a significant but small correlation (0.14–0.18). As such, we consider these abilities as those influenced by parents, teachers, and instructors at home, school, and the sports club the children attend, rather than abilities that are simply acquired as children grow. Thus, intentional intervention may improve these abilities.

5.4 Significance of Creating a Scale

Some aspects of this study that render it highly significant include that the study provided a definition for non-cognitive abilities (which was not yet clear) and clarified the specific related psychological variables. Furthermore, the study specified five factors important for elementary school students. It is also significant that a scale was created that can be used in actual educational settings involving sports.

One major challenge when using psychological variables such as the non-cognitive abilities investigated in this study in real-life settings is visualization. In short, results cannot be provided in the form of visible feedback, which is possible in the case of physical training. To solve this visualization problem, creating a scale that can assign a score to the non-cognitive abilities in question is significant from the perspective of real-world education.

For example, Iida and Ishikuma (2002) developed a life skills scale for school for middle school students, and Yamaguchi et al. (2005) developed a similar scale for elementary school students. These scales can be used by teachers and other assistants to understand how children are doing and to examine the effects of skills training. Children and students can use the scales to understand themselves better by responding to the questions. In addition, the improved self-awareness that is the goal for students and children using the scales is expected to improve these skills later on. In other words, improving self-awareness in students and children also improves their skills. Mental training programs in the field of sports psychology conduct self-evaluations using psychological tests. It has been suggested that this can inspire intentional action and realizations in athletes about themselves, which can change behavior and as a result, encourage the acquisition of skills (Choi & Nakagomi, 2009).

In this way, the scale for measuring non-cognitive abilities developed through sports for elementary school students in this study can be helpful in various real educational settings involving sports, such as local sports communities and school sports clubs. It can enable instructors to understand how children are doing and verify the effects of educational

programs for non-cognitive skills, and increase the awareness children responding to the scale have of their own non-cognitive skills, encouraging them to improve these skills.

6. Future Research

As a future task, it will be necessary to reexamine the factor structure that resulted in some uneasiness, taking into account the male-female ratio. Furthermore, as discussed in the introduction, the question of whether non-cognitive abilities acquired through sports can be generalized to daily life needs further study. As such, there will also likely be a need for non-cognitive ability scales that target a wider range of elementary school students other than those enrolled in sports schools, such as students at elementary schools or in childcare facilities. Another possible subject for future research involves the main factors that contribute to improving the five abilities measured by the scale created in this study. Clarifying these main factors could contribute to the development of effective educational programs for elementary school students.

Author Contributions

K.K., S.S. and H.I. substantially contributed to the study conceptualization. K.K., S.S., D.M., Y.I. and H.I. significantly contributed to data analysis and interpretation. K.K. substantially contributed to the manuscript drafting. All authors critically reviewed and revised the manuscript draft and approved the final version for submission.

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Informed Consent Statement

Informed consent was obtained from all participants involved in the study.

Conflicts of Interest

The authors declare no conflict of interest.

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