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THE RELATION OF GENDER AND TRACK ON HIGH SCHOOL STUDENTS' ATTITUDE TOWARD CONVERGENCE

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Abstract. *Preparing a positive attitude toward convergence is essential to help students grow into future generations with the ability to solve various complex problems. This research aims to examine high school students' attitude toward convergence and the relation to gender and track. Responses from 1,186 Indonesian students in tenth (10th) and eleventh (11th) grade were purposively collected. Students were administered twenty-three items of attitude toward convergence covering five constructs: knowledge, personal relevance, social relevance, interest, and self-efficacy. Data were analyzed using IRT-Rasch analyses, two-way ANOVA, Pearson correlation analysis, and cluster analyses. The primary finding of this research presented that high school students' attitude toward convergence on the construct of interest and self-efficacy is significantly related to gender and track. Female students show to be more interested in convergence than male students. However, female students have lower self-efficacy. Additionally, science track students tend to be more interested in convergence than humanities track and showing higher self-efficacy. After performing cluster analysis, students are divided into three particular groups according to their attitude toward convergence. Finally, customized learning is proposed to improve students' attitude toward convergence.*
Keywords: *attitude toward convergence, female, humanities track, male, science track.*

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Introduction

Nowadays, problems in our daily life are getting complex, and it can only be understood by pulling together insights and techniques from different disciplines. Knowledge from several disciplines is required to solve the scientific and societal problems, and it has also been recognized as the critical issue of innovation challenge (Hacklin & Wallin, 2013). Knowledge integration is getting a keyword for the 21st century (Godemann, 2008), because it can unify the learning approach that fosters the connections among disciplines in order to build the new knowledge in the form of "integrative" concepts (Klein, 2005; Weinberger, 2007). An innovative study integrates several disciplines through convergence (Hur et al., 2010).

National Science Foundation (NSF) of the USA defined that convergence is knowledge, approach, and expertise, which is integrated deeply from various disciplines to construct broader and latest frameworks to solve the stratified problem. National Research Council (NRC; 2014) of the United States classified the terminologies of convergence: multidisciplinarity, interdisciplinarity, transdisciplinarity. Multidisciplinarity brings together various disciplines, although all these disciplines keep on separated. It focuses on connecting topics and questions to foster broader information, knowledge, and technique. Interdisciplinarity merges diverse expertise and techniques from different disciplines to form new knowledge integration. Transdisciplinarity exceeds disciplinary approaches through more comprehensive frameworks. It is more than interdisciplinary combinations which move beyond discipline-specific approaches to foster the modern worldview. Many kinds of research have been developed from the integration of different disciplines through transdisciplinarity, interdisciplinarity, and multidisciplinarity.

The improvement of knowledge especially in science and engineering makes convergence become very essential. Many researchers conduct the convergence research to test many cases through collaborative working. Collaborative working might generate the broader and newest idea due

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to integrating different insight of the group member especially if they come from the various field (Weinberger, 2007; Yuen et al., 2014). As recognized by Wuchty et al. (2007), there has been a big revolution in the research field through joint research on various topics mainly in the science field. The number of team working has increased immovably each year or even two times more from 1.9 to 3.5 authors per paper over 45 years. The team research yet was cited more than research produced by an individual (Rousseau, 2001; Wuchty et al., 2007; Valderas, 2007). The convergence research has improved significantly and provided many opportunities in the future. Therefore, it is needed to encourage many people to recognize the important of convergence. One of the ways is through convergence education.

Recently integrative approach and convergence in educational context has been emphasised in many countries. The most representative example would be 'STEM Education'. The term 'STEM Education' has been broadly implemented (Marginson et al., 2013; NRC, 2011). This field combines several disciplines, including science, technology, engineering, and mathematics. It emphasizes science and math explicitly to increase technology in school programs and recognition of engineering in K-12 education (Bybee, 2010; NRC, 2011). Moreover, the importance of STEM education has been emphasized as STEM field seems very promising for future careers. According to U.S. Bureau of Labor Statistics (2015) report in May 2015, 6.2% U.S jobs were represented from STEM-related occupation. STEM employment increased by 10.5% between May 2009 and May 2015 compared to 5.2% net growth in non-STEM. Based on the pattern, convergence related occupation will have given more opportunity for a future career.

In order for STEM education to respond effectively to trends of convergence, it is important not only to teach students already integrated knowledge, but also to help students to understand meaning and purpose of convergent approach in this era. In addition, it is required to improve a positive attitude towards convergent approach, in order for students can make a convergent attempt beyond the distinct academic boundaries in STEM on their own in the future. Therefore, this study focuses on students' attitudes toward convergence.

Particularly, this study was conducted with Indonesian students. STEM education has been implemented in Indonesia. Several researches about STEM in Indonesia also have been conducted where there was a significant result of students in attitude towards STEM (Suprapto, 2016; Winarno et al., 2017). The Programme for International Student Assessment (PISA) in 2015 showed that Indonesia is one of the countries which has the lowest performance of the results in science, reading and mathematics than OECD average (OECD, 2016). Trends in International Mathematics and Science Study (TIMSS) 2015 International Results in Science also presented that Indonesian students placed in 44th out of 47 participating countries in mathematics and science as well as numeracy assessment for 4th-grade students (Martin et al., 2016). It is interesting when Indonesian career motivation in STEM compared to Korean Indonesian high school students show higher career motivation in STEM than Korean (Shin et al., 2018). Considering Indonesian students have lower knowledge, but they have a significant interest in STEM. Therefore, this research is intended to examine Indonesian students' attitudes toward convergence.

Based on data of Pew Research Center Religion and Public Life, Indonesia is the country with the highest Muslim population in 2010 with future growth projection for 2010-2050. Approximately 13.1% of the total Muslim population in the world is from Indonesia. Gender is one of the most important influencing factors since Muslim societies typically show a differentiation of gender inequality (Klingorová & Havlíček, 2015). The educational outcome of gender remains a crucial issue to be discussed. Gender is an essential variable related to convergence because as recognized by Patall et al. (2018) female is underestimated in science, technology, engineering, and mathematics (STEM) track and careers. The previous research also showed that female seems to be underrepresented in STEM educational program (Burke & Mattis, 2007). In Korea, gender significantly influenced the students' attitude toward convergence, where a female has a lower attitude toward convergence than male (Lee et al., 2017). The inequality of gender has been debated since the first biological innate gender difference in cognitive capacity remains unclear (Good et al., 2008). However, the issue related to the women demands for STEM professionals in the global marketplace is urgent, especially in facing the 21st-century challenges (National Academy of Sciences, 2007) has become a critical issue. Hence, gender becomes one of the crucial variables that are involved in this research.

Senior High School students have been purposively chosen as the participants in this research because high school students need to prepare their future career, and they have to be ready in facing the real world challenge. A teacher needs to examine students' attitude towards convergence and evaluate them to improve classroom

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instruction. The Indonesian high school student is divided into a different track. Track system in secondary education divides students to a different academic course according to the students' achievement and interest to prepare them for higher education enrollment. Directorate of Development of Indonesia Senior High School (2017) stated that there is academic specialization program aimed to develop students affective and cognitive skills based on their interest skills competencies by following their interests, talents, and academic abilities in a group of related subjects (track). Indonesia Senior High School divides the track into science, humanities, and linguistics track. Hence, the track becomes the second fundamental variable that potentially influences students' attitude toward convergence.

Preparing students' positive attitude toward convergence becomes essential to help students grow into future generations with the ability to solve creatively various complex problems. The authors evaluate effective ways to improve positive students' attitudes towards convergence by classifying students into different groups and investigating each group's characteristics. Clustering method is essential for grouping students and designing a learning model that can cover various constructs of students such as emotion and motivation to provide adaptive learning support (Cha et al., 2006). Different learning style based on students preference in each group should be accommodated to optimize the learning process (Cha et al., 2006). Mismatches between students learning style and teacher common teaching will affect learning effectivity in the classroom where students can become bored and inattentive and perform poorly on the test (Felder & Silverman, 1988). Felder & Silverman (1988) have researched to classify students based on learning style to develop teaching strategies and evaluation customized for students to finally reconfigure adaptively for accommodating students' learning styles. Therefore, this research is intended to uncover how gender and track are related to attitude toward convergence and by classifying students, find effective ways to improve students' attitude toward convergence.

Research Focus

Based on the background, this research focused on the following research objectives:

1. To analyze the validity of students' attitude toward convergence instrument.
2. To explore the relation of gender and track to students' attitude toward convergence.
3. To identify correlation among the five constructs of students' attitude towards convergence based on gender and track.
4. To examine how the group of student is classified based on their attitude toward convergence.

Research Methodology

General Background

The quantitative survey was carried out in this research in August 2018 in Indonesia. The data of attitude toward convergence were collected from Indonesian High School students,' and it was validated by performing IRT-Rasch analysis. The further analysis of relation and correlation of gender and track to students' attitude toward convergence was also examined. The clustering method was also performed in this research. The detailed explanation of the research methodology was described as follows.

Participants

Data were collected from 1,186 Indonesian high school students in tenth (10th) and eleventh (11th) grade. Students were purposively selected from two different tracks: humanities and science track. Among the total participants, 570 (48.06%) were representative of the humanities track, and 616 (51.94%) were representative of the science track. In terms of gender, students consisted of 471 (39.72%) male and 712 (60.03%) female students. Three (0.25%) students did not report their gender. The participants were recruited from three private schools and three public schools.

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Instrument and Procedures

The instrument administered to students was the attitude toward convergence instrument for a high school student developed by Shin et al. (2014b). Appendix 1 showed the instrument of students' attitude toward convergence, which has been translated into the English version. In this research, the convergence covered the five constructs of attitude: knowledge, personal relevance, social relevance, interest, and self-efficacy. Twenty-three items were graded in the 6-point Likert scale from strongly disagree (1) to strongly agree (6). The instrument is beneficial for measuring students' attitude toward convergence because the teacher can estimate the effective teaching instruction of convergence in science learning. It can also measure whether the convergence teaching-learning programs can significantly affect students' attitude toward convergence or whether teaching science through a convergence approach becomes mediating effect on students' learning motivation for science (Shin et al., 2014a).

Data Analysis

Item response theory (IRT) has been admitted as a more advanced psychometrics measurement than classical test theory (CTT) (Embretson & Reise, 2013). In this research, IRT-Rasch analysis of item quality, item and person reliability, and differential item functioning was performed by Winstep V.3.92.1 software. Besides IRT analysis, CTT analysis was also performed to uncover the reliability (Alpha Cronbach) using IBM Statistics 24 software. Result of CTT analysis was presented as consideration for the readers who are relatively new with IRT-Rasch analysis.

The item quality was investigated by examining the infit and outfit mean-square (MNSQ) value. The value of MNSQ value for infit and outfit in productive measurement is from 0.7 to 1.4 (Wright & Linacre, 1994). If data is beyond that range, it is called a misfitting item. The consistency of the item was examined by investigating the item and person reliability and also Cronbach Alpha. The standard indicator of item and person reliability interpretation follows the standard of Fisher (2007) that categorizes the item and person reliability into 'poor' if the value is less than 0.67, 'fair' if the value is between 0.67 and 0.80, 'good' if the value is between 0.81 and 0.90, 'very good' if the value is between 0.91 and 0.94, and 'excellent' if the value is higher than 0.94.

The IRT-Rasch analysis also can be performed to analyze the item bias by testing differential item functioning (DIF). DIF measures whether the instrument could give the same treatment to the compared groups (Boone et al., 2014). Differential item functioning will ensure that the instrument has the same standard to measure the students across the group of gender and track. Boone et al. (2014) stated the DIF value, which is higher than 0.64 or less than -0.64 indicates the occurrence of item bias.

Additionally, the value of person measure (a quantitative measure in the Rasch scale that expresses the ability of the respondent on a uniconstructal scale) was analyzed using IBM SPSS Statistics 24. It was used to explore the relationship between gender and track on students' attitude toward convergence through multivariate two-way ANOVA. The relation is categorized as significant if the p-value is less than 0.05. To examine the correlation of each construct, the Pearson correlation coefficient was calculated. The construct might be significantly correlated with one another if the p-value is less than 0.01 or 0.05.

A cluster analysis was examined to divide students' group based on attitude toward convergence. Multivariate clustering analysis (mclust) using R-software was performed. Mclust is very well-known for clustering based on finite Gaussian mixture modeling. The EM algorithm is applied in Gaussian model-based clustering, which makes easier to be implemented as it has a numerically stable algorithm and reliable global convergence under fairly general conditions. Mclust can provide several mixing components and covariance parameterization selected by using the Bayesian Information Criterion (BIC). The highest BIC will have a better classification (Scrucca et al., 2016). The best model and the number of clusters will be found, and every student is enrolled in their cluster (student's group). Further analysis was conducted to investigate the characteristics of each group by comparing the person measure of the group's member using the IBM Statistics 24 software. Additionally, gender and track as independent variables were applied in the Pearson Chi-square test analysis.

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Research Results

The Validity of Students' Attitude toward Convergence Instrument

The quality of the item was examined using IRT by analyzing the item fit with the Rasch model. Table 1 shows infit, and outfit MNSQ values range from 0.72 to 1.38 logit in knowledge construct, 0.80 to 1.16 logit in personal relevance construct, 0.78 to 1.24 logit in social relevance construct, 0.91 to 1.08 logit in interest construct, and 0.76 to 1.11 logit in self-efficacy construct. Overall, the MNSQ value ranged from 0.7 to 1.4 logit for all items in each construct, which indicated no misfitting item. No misfitting item meant that the attitude towards convergence instrument fit the Rasch model (Wright & Linacre, 1994). The items did not need to be revised because every item had a rational function to measure what should be measured (Sumintono & Widhiarso, 2014).

Table 1. Psychometrical properties based on Rasch Modeling of students' attitude toward convergence instrument.

Construct		Item-fits		Item Reliability	Person Reliability	Cronbach Alpha
		Infit MNSQ	Outfit MNSQ			
Knowledge	Lowest	0.73	0.72	.99	.75	.764
	Highest	1.38	1.38			
Personal Relevance	Lowest	0.83	0.80	.95	.74	.769
	Highest	1.16	1.16			
Social Relevance	Lowest	0.81	0.78	.98	.76	.780
	Highest	1.24	1.22			
Interest	Lowest	0.95	0.91	.98	.77	.805
	Highest	1.08	1.06			
Self-efficacy	Lowest	0.76	0.76	.92	.78	.806
	Highest	1.11	1.11			

Reliability result was presented in Table 1. The IRT-Rasch analysis shows the lowest item reliability in the construct of self-efficacy and the highest item reliability in the construct of knowledge (item reliability values of .92 and .99, respectively). Since the value of item reliability was more than .90, it indicated as very good to excellent reliability (Fisher, 2007). High item reliability indicated that the sample was large enough to place items on the latent variable (Boone et al., 2014).

Regarding the person reliability, the lowest value is in the construct of personal relevance, and the highest value is in the construct of self-efficacy (person reliability value .74 and .78, respectively). The person reliability value was between .74 and .78, meaning that it was categorized as fair reliability (Fisher, 2007). Person reliability indicates how well the student performs based on the Rasch-model (Tornabene et al., 2018). Cronbach Alpha (CTT) analyses show that the construct of knowledge has the lowest reliability value, and the construct of self-efficacy has the highest reliability value (reliability value .764 and .806, respectively). Since reliability was over than .70, it meant that the reliability value was categorized as fair to good reliability (Fisher, 2007).

Besides checking the misfitting item, item and person reliability, and the Cronbach Alpha, the IRT-Rasch model also examined item bias or differential item functioning (DIF). It shows whether each item in the instrument can generalize different groups of the test administered or not. The DIF value was shown in Table 2. DIF gender contrast value in knowledge construct ranges from 0.00 to 0.29. It ranges from 0.00 to 0.11 in personal relevance construct, 0.05 to 0.13 in social relevance construct, 0.05 to 0.21 in interest construct, and 0.02 to 0.28 in self-efficacy construct. These DIF gender contrast values in different constructs were lower than 0.64 and higher than -0.64 (Boone et al., 2014). Therefore, there was no gender bias regarding students' attitude toward convergence items.

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Table 2. Differential item functioning (DIF) gender and track of students' attitude toward convergence.

Construct of 'Attitude toward Convergence'	Code	DIF Gender Contrast	DIF Track Contrast
Knowledge	K_1	0.16	0.08
	K_2	0.00	0.00
	K_3	0.08	0.15
	K_4	0.29	0.27
Personal Relevance	R_P_1	0.11	0.51
	R_P_2	0.00	0.23
	R_P_3	0.08	0.05
	R_P_4	0.08	0.58
	R_P_5	0.11	0.17
Social Relevance	R_S_1	0.05	0.20
	R_S_2	0.05	0.10
	R_S_3	0.13	0.08
	R_S_4	0.11	0.00
Interest	A_I_1	0.17	0.18
	A_I_2	0.05	0.30
	A_I_3	0.19	0.11
	A_I_4	0.21	0.45
	A_I_5	0.16	0.23
Self-Efficacy	A_SE_1	0.02	0.07
	A_SE_2	0.28	0.16
	A_SE_3	0.13	0.00
	A_SE_4	0.02	0.19
	A_SE_5	0.08	0.25

DIF track contrast value ranges from 0.00 to 0.27 in knowledge construct, 0.05 to 0.58 in personal relevance construct, 0.00 to 0.20 in social relevance construct, 0.11 to 0.45 in interest construct, and 0.00 to 0.25 in self-efficacy construct. These DIF contrast values were also lower than 0.64 and higher than -0.64. Therefore, there was no track bias regarding students' attitude toward convergence items.

The Relation of Gender and Track on Students' Attitude towards Convergence

The data of relation between the two independent variables and the five constructs of attitude toward convergence based on multivariate two-way ANOVA were presented in Table 3. The significant value of gender and track in relations with students' attitude toward science was discussed.

Table 3. Result of two-way ANOVA of test gender and track.

Construct	Gender			Track			Gender x Track		
	F	*p-value*	η_p^2	*F*	*p-value*	η_p^2	*F*	*p-value*	η_p^2
Knowledge	0.209	.647	.000	0.615	.433	.001	0.477	.490	.000
Personal Relevance	1.938	.164	.002	2.964	.085	.003	0.167	.683	.000
Social Relevance	0.278	.598	.000	23.757	.0001	.020	1.494	.222	.001
Interest	31.891	.0001	.026	57.591	.0001	.047	0.413	.521	.000
Self-efficacy	5.026	.025	.004	4.982	.026	.004	0.002	.965	.000

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Knowledge. Based on the result, significant gender effect was not found regarding students' knowledge on attitude toward convergence (F [1, 1179] = 0.209, p = .647, ηp^2 = .000). Significant effect of track (F [1, 1179] = 0.615, p = .433, ηp^2 = .001) was also not found either. Based on the result of combined analyses, there was no significant relation between gender and track on attitude toward convergence (F [1, 1179] = 0.477, p = .490, ηp^2 = .000). A non-significant result for the interaction between gender and track indicated that students' attitude toward convergence in knowledge construct was not related to gender or track. The mean of person measure (logit) difference was shown in Figure 1. Male students in humanities track have higher mean value than those in the science track. In contrast, female students in humanities and science tracks have almost the same mean value.

Personal relevance. Based on the result, significant effect of gender was not found regarding student's personal relevance on attitude toward convergence (F [1, 1179] = 1.938, p = .164, ηp^2 = .002). Significant effect of track was not found either (F [1, 1179] = 2.964, p = .085, ηp^2 = .003). In combined analyses, the relation between gender and track was also not significant (F [1, 1179] = 0.167, p = .683, ηp^2 = .000). A non-significant result for gender and track indicated that students' attitude toward convergence in personal relevance construct was not related to gender or track. Mean differences in person measure (logit) were shown in Figure 1. Both male and female students in the science track have higher mean value than those in humanities track. However, the difference is not significant.

Social relevance. There was no significant effect of gender regarding student's social relevance on attitude toward convergence (F [1, 1179] = 0.278, p = .598, ηp^2 = .000). In contrast, significant effect of track (F [1, 1179] = 23.757, p = .0001, ηp^2 = .020) was found. Results of combined analyses showed the relation between gender and track was not significant (F [1, 1179] = 1.494, p = .222, ηp^2 = .001). A significant result for track indicated that a difference in the track related students' attitude toward convergence in social relevance construct. Mean differences in person measure (logit) were shown in Figure 1. Both male and female students in the science track have both gap different mean value with humanities track.

Interest. Based on the result, significant effect of gender was found regarding student's interest in attitude toward convergence (F [1, 1179] = 1.938, p = .0001, ηp^2 = .026). Significant effect of track (F [1, 1179] = 57.591, p = .0001, ηp^2 = .047) was also found. In combined analyses, the relation between gender and track was not significant (F [1, 1179] = 0.413, p = .521, ηp^2 = .000). This indicated that students' interest in attitude toward convergence was affected by gender and track. Mean differences in person measure (logit) were shown in Figure 1. Female students have higher interest than male students. Science track students also have more interest in attitude toward convergence than humanities track students.

Self-efficacy. Based on the result, gender affected significantly regarding students' self-efficacy on attitude toward convergence (F [1, 1179] = 5.026, p = .025, ηp^2 = .004). Significant effect was also found for track (F [1, 1179] = 4.982, p = .026, ηp^2 = .004). In combined analyses, the relation between gender and track was not significant (F [1, 1179] = 0.002, p = .9653, ηp^2 = .000). A significant result on the interaction between gender and track indicates that students' attitude toward convergence in the self-efficacy construct was related to gender or track. Mean differences in person measure (logit) are shown in Figure 1. Male students have higher mean values in self-efficacy rather than female. Both male and female students in the science tracks also have higher mean values than those in humanities track in self-efficacy construct.

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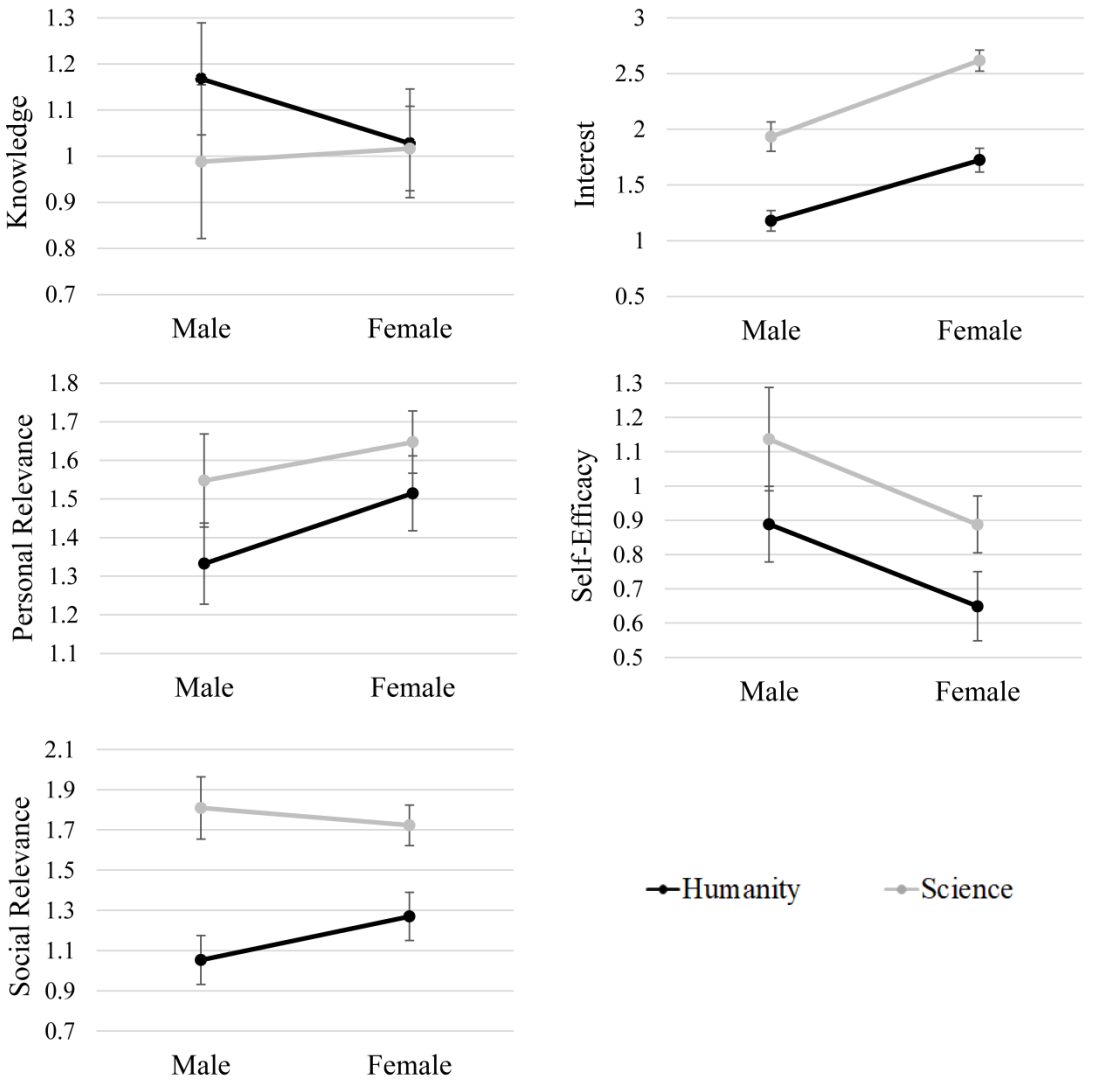

Figure 1. The interaction between gender and track on students' attitude toward convergence in each construct.

Regarding the relation between gender and track on students' attitude toward convergence, the essential information emphasized that female students had a higher (significant) interest than male in attitude toward convergence both in humanities and science track. It was interesting to see the evidence that female students had a higher interest in the attitude toward convergence while they had lower self-efficacy in both science and humanities track. In the term of the track, it showed a significant difference regarding attitude toward convergence in interest and self-efficacy construct. Science track students had higher (significant) attitude toward convergence than humanities track students both in interest and self-efficacy construct.

Correlations among Five Constructs of Attitude toward Convergence based on Gender and Track

Association of each construct was determined based on correlation coefficients. Students' attitudes toward convergence constructs are significantly correlated with each other if the r value was less than 0.01 ($r < 0.01$). Result of correlation could be seen in Table 4.

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Table 4. The correlation coefficient (*r*) for every variable.

Construct Correlation		Gender x Track			
		Male		Female	
		Humanities	Science	Humanities	Science
K	R_P	.544**	.528**	.516**	.517**
K	R_S	.364**	.419**	.368**	.441**
K	A_I	.318**	.337**	.247**	.246**
K	A_SE	.390**	.424**	.380**	.424**
R_P	R_S	.528**	.670**	.584**	.683**
R_P	A_I	.426**	.504**	.462**	.432**
R_P	A_SE	.417**	.411**	.237**	.398**
R_S	A_I	.476**	.574**	.417**	.450**
R_S	A_SE	.333**	.214**	.261**	.414**
A_I	A_SE	.398**	.214**	.274**	.377**

Male students in humanities track show the highest correlation coefficient between knowledge and personal relevance construct (r = .544) meanwhile, the lowest correlation coefficient is between knowledge and interest construct (r = .318). Males in science track shows the strongest correlation coefficient between personal relevance and social relevance construct (r = .670) meanwhile the weakest correlation coefficient is between social relevance and self-efficacy and also between interest and self-efficacy construct (r = .214).

Both humanities and science track shows that female students have the strongest correlations coefficient between personal relevance and social relevance (r = .584 and r = .683, respectively). The weakest correlation coefficient for female students in the humanities track is between personal relevance and self-efficacy construct (r = .237). For those in science class, the weakest correlation coefficient is between knowledge and interest construct (r = .234).

Overall, correlation coefficients among five constructs of attitude toward convergence of male participants in both humanities and science tracks were higher than those of female students in humanities and science tracks. Regarding correlation coefficients among constructs of attitude toward convergence between the two tracks, science class had higher correlation coefficients than humanities track.

Group Classification based on Students' Attitude toward Convergence

The software suggested classifying students based on the highest value of BIC. The possibility of 1 – 10 groups was inputted. Results showed that the highest BIC was two-groups. When students were enrolled in two groups, the group was only divided into high and low person measure of the five constructs of attitude toward convergence. Three-groups were analyzed for further analyses and resulted in the declination lines (BIC difference) of two-groups and three-groups, which was not a significant difference. Three-groups resulted in the unique characteristics of each group, as presented in Figure 2. The number of students in each group was also substantial enough to represent their group. The author decided to use three-groups to classify the group of students based on their attitude toward convergence. VEE model was best fitted to three groups, which indicated an ellipsoidal, equal shape, and orientation with BIC value of -22657.02. Characterization and naming were determined for every group by examining the highest mean value of each construct. The distribution of each group by gender and track can be seen in Table 5.

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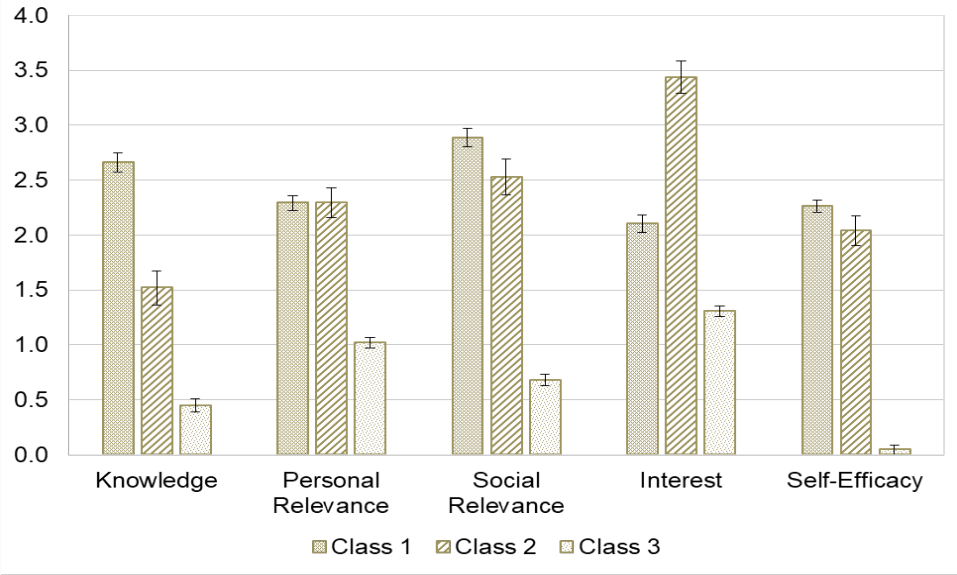

Figure 2. Results of cluster analysis using mclust.

Group 1 consists of 15.18% (180) participants. It has a high mean value in knowledge ($M = 2.66$, $SD = 1.14$) and the lowest mean value in interest ($M = 2.10$, $SD = 1.10$) of attitude toward convergence. Based on these characteristics, group one was further called 'High-Knowledge Convergence (HKC) group. Group 2 consists of 24.45% (290) participants. It has the highest mean value in interest ($M = 3.44$, $SD = 2.47$) and the lowest mean value in knowledge ($M = 1.52$, $SD = 2.67$) of attitude toward convergence construct. Based on these characteristics, group two was further called High-Interest Convergence (HIC) group. Names of these groups were considered based on the difference in knowledge and interest. Personal relevance, social relevance, or self-efficacy was not considered because the two groups did not have significant mean value in the result. Group 3 consists of 60.37% (716) participants. It had the lowest mean value among all groups, especially in self-efficacy construct ($M = 0.05$, $SD = 1.18$). Based on these characteristics, group three was further called Low Self-Efficacy Convergence (LSeC) group. The group members distribution based on their demographic was shown in Table 5.

Table 5. The student distribution in each group based on gender and track.

Group	Gender				Track			
	Male	Female	Total	Percentage	Humanity	Science	Total	Percentage
HKC	77	103	180	15.21	86	97	180	15.18
HIC	106	184	290	24.51	123	167	290	24.45
LSeC	288	425	713	60.27	364	352	716	60.37
Total	471	712	1183*	99.99	570	616	1186	100.00

**3 students didn't report their gender*

The group characteristic based on the demographic variable was analyzed by performing the Chi-squared test. Attitude toward convergence of the groups was not related to students' gender ($\chi^2 = 2.047$, $p = .359$). However, it was significantly associated with the track ($\chi^2 = 6.208$, $p = .045$).

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Discussion

Results of this research demonstrate that Indonesia senior high school students' attitude toward convergence was related to both gender and track in interest and self-efficacy construct. This section would discuss evidence of this research regarding the four research questions.

The Validity of Students' Attitude toward Convergence Instrument

One of the essential sections when applying an instrument is validation testing. Messick (1995) has stated that validation was a process of evaluating empirical and theoretical judgment justification to support the score interpretation precisely. Messick (1995) on psychological assessment proposed six aspects of validity such as content, substantive, structural, generalizability, external, and consequential. This research applied several constructs, which will be described as follows.

The content validity presents that the domain construct (content) is relevance and representative to measure students' ability and related to the purpose of the instrument (Messick, 1995). Students' attitude toward convergence instrument adopted from a journal published by Korean had conducted content validation. The content validity of the instrument had been verified by experts in science education and science teachers in high school (Shin, 2014). A total of 23 valid items in five constructs of students' attitude toward convergence were produced.

The second is a substantive construct which describes indirect data as a result of participants in response to the measurement. The substantive aspect of validity includes item and person infit and outfit statistical evidence engaged by students who are representative and relevant to the study assumed (Ravand & Firoozi, 2016). This research performed IRT-Rasch analysis to investigate infit and outfit MNSQ. Following the standard of Wright & Linacre (1994), it is presented that the items did not produce the misfitting in students' attitude towards convergence instrument. No misfitting item in the instrument indicated that students' cognitive processes are appropriate to be measured with items included in the construct (Ravand & Firoozi, 2016). Items fit with students' ability indicated that they understand these items of the instrument (Fisher, 2000).

The consistency was presented in the form of a person and item reliability (IRT-Rasch) as well as Cronbach alpha (CTT). Results showed that the item reliability was in the criteria of very good to excellent. The item reliability value was more than 0.90, indicating that the participant was big enough to confirm the apparent difficulties of the latent variable (Tornabene et al., 2018). Meanwhile, person reliability was categorized as fair. If the person reliability value was bad, Linacre (2017) suggests that items might not be able to distinguish the ability of students precisely, but this research was fair enough to present the performance of each student. As a comparison point, the value of Cronbach alpha was also in the fair to good category.

Generalization ensures that the instrument is not violent to a particular sample or group (e.g., gender), but it can be generalizable across the groups to make the valid data interpretation (Messick, 1995; Tornabene et al., 2018). Differential item functioning (DIF) using the IRT-Rasch analysis was conducted in this study to investigate whether the items can generalize across the group of gender and track. Results of DIF indicated invariance of item calibrations across the population of students (Ravand & Firoozi, 2016). Following the standard of Boone et al. (2014), no DIF was detected in this research, meaning that the instrument of students' attitude towards convergence was generalizable both for males or females in humanities or science class.

The Relation of Gender and Track on Students' Attitude towards Convergence

This research examined the interaction between the two most significant contributing variables regarding students' attitude towards convergence: gender and track. These variables are significantly related to the attitude towards convergence, particularly in the dimension of interest and self-efficacy. This section is going to discuss the findings in the two discussion parts. The first, female students have significant interest but lower self-efficacy than male students in attitude toward convergence for both in humanities and science track. The second is the higher interest and self-efficacy of science track students than humanities in the attitude toward convergence.

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It has been recognized that interest refers to a behavioral factor that affected students' curiosity in learning, and they will involve more in their assignments. It also encourages students to study and engage in a more in-depth level of thinking (Hayden et al., 2011). This research indicates that female students tend more to get themselves involved in convergence than male students. Female students are likely to enjoy creating a new idea and work together with other people. Group working will allow students to share ideas and expertise to solve a particular problem (Taylor & Greve, 2006). Hence, group working can contribute to knowledge integration (convergence). The research by Stump et al. (2011) also shows that female students engage more when they learn together in collaborative learning. The previous research supports the result of this research by Woolley et al. (2010) which stated that the group performance is not determined by the average intelligence level of a group member, but it is determined by the proportion of female in the group. Furthermore, the result of the group performance improves when more females are in the group (Bear & Woolley, 2011; Woolley & Malone, 2011). It is because a female shows a better score on social sensitivity (Woolley & Malone, 2011) and conversational expropriations. Social sensitivity is the personal capability in accepting and perceiving others' thinking, mood, and behavior (Bender et al., 2012; Woolley et al., 2010). Woolley and Malone (2011) also state that the most important thing for a collaborated group is having people with high social sensitivity, whether they were males or females. However, previous research showed that females had a higher score on social sensitivity test than males. This result of the research should be considered by teachers when designing gender proportion of collaborative groups in the classroom to have better students' convergence knowledge and how to improve group performance.

It is interesting to have the evidence that females have a higher interest; in contrary, they also have lower self-efficacy in attitude toward convergence for both science and humanities track. Females want to involve their mind in the convergence, but they do not have any confidence to be more active or persist longer in their effort. This might be because of the views that a female is underestimated in science, technology, engineering, and mathematics (STEM) both in college majors and employment (Patall et al., 2018). Jordan and Carden (2017) also report that females in the STEM track had less confidence in their academic ability than males. It is easy for females to have stress with low self-efficacy (Goel & Bardhan, 2016). The research of Cavallo et al. (2004) also show that female students have less self-efficacy than males in science learning, especially in physics. The research of Glynn et al. (2011) has also claimed that, among both science track and nonscience track, male students show higher self-efficacy than female students.

Students with low self-efficacy will lead them to have high anxiety (Glynn et al., 2011). It is also reported that self-efficacy has a positive correlation to GPA. It influences students' achievement because it can encourage students to have learning persistence in achieving their academic goals (Britner, 2008). The low female student self-efficacy in convergence remains a critical challenge for educators. Students' experiences in high school were very crucial in shaping beliefs and determining whether students pursue a STEM college track and career or not. Thus, it should be considered by teachers when designing teaching instruction to discuss this issue to increase female students' self-efficacy in the classroom, especially in convergence topic.

Most students in the science track have a higher attitude toward convergence preferably those in humanities track both in interest and self-efficacy construct. This is in line with the previous research, which stated that students' attitude toward convergence of science track was relatively higher than those of the humanities (Shin, Ha, & Lee, 2014). Science is one of the tracks that involves many collaborative activities, and it might influence positively to the students' attitude towards convergence (Prince, 2004; Bowen, 2000). Collaborative learning can provide a learning experience for students by effectively implementing knowledge integration (Jeong & Chi, 2007; Willey & Gardner, 2012) so as students can generate the new idea (Yuen et al., 2014). Students' knowledge and experience to the particular learning program also could maintain the positive attitude and improving the interest and motivation than those who do not implement the particular learning program (Gibson & Chase, 2012; Nugent, 2010; Weinberger, 2007). The example of collaborative learning by applying the STEM approach is the robotic project. This kind of activity imitates how engineers and scientists from different disciplines work together on a single project (e.g., De Vault, 1998; Kitts & Quinn, 2004). This kind of activity can encourage students' interest in convergence as their idea and capabilities complement each other in the group membership (Yuen et al., 2014) and the new product generated from work can increase their confidence.

The researchers in science fields also tend to have collaborative research with others. Even in the same area, collaborative work among scientists all over the world is needed (Lee et al., 2013). The example of the research that has been conducted was the research in the human genome project (Vermeulen et al., 2013), research on

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SARS, and new CERN particle physics. Those research involved intellectual resources through the cooperation of various countries in the world. Collaboration in scientific research has improved rapidly. For almost five decades, 90% of paper is dominated by the collaborative team authors. Generally, social science papers are written in pair followed by a positive trend from more extensive team authors. In contrary, for about 90% research in art and humanities are generated from the single author (Wuchty et al., 2007). Besides, science students also believe that attitude toward convergence is beneficial to be applied in their field, especially for working in a team. It is well recognized that social environment has a high influence on the formation of an individual's self-beliefs, especially their abilities to obtain their development goals and the collective intelligence (Bossche et al., 2006).

Correlations Among Five Constructs of Attitude towards Convergence based on Gender and Track

Correlations among all constructs need to be analyzed to know whether a difference in the other construct follows the change in one construct. Results of this research showed that correlation among constructs for gender and track exerted significant effects on students' attitude toward convergence. Male students in humanities and science tracks showed stronger correlations among constructs than female students. This result suggested that when male students showed high value in one construct of attitude toward convergence, other components might also have high scores. When female students show high value in one construct of attitude toward convergence, other parts might not have high scores as male.

Regarding correlations among constructs for two tracks, those with science class had stronger correlations among constructs than those with humanities class for both males and females. This result suggested that, when science students showed high value in one construct of attitude toward convergence, other components might also have high scores. When humanities students show high value in one construct of attitude toward convergence, other parts might not have high scores as science track. The overall positive correlation of each construct and gender and track indicated that the instrument associated well with the research variables.

Group Classification based on Students' Attitude toward Convergence

Based on findings, there were three types of the group according to students' attitude toward convergence, namely High-Knowledge Convergence (HKC), High-Interest Convergence (HIC), and Low Self-Efficacy Convergence (LSeC). Besides, the group is not differentiated based on gender, but it is significantly associated with the track. These findings show the impact of the track on constructing students' attitude towards convergence. Science students dominated the group of HKC which the member has high knowledge of convergence. They also dominated the group of HIC which the member has a high interest in convergence. However, group LSeC with lower knowledge and interest, especially in self-efficacy of convergence, was dominated by students on humanities track.

The previous discussion stated that science track had many collaborated activities in the classroom. It showed the teaching-learning process at the school could build the knowledge and interest of students' attitude toward convergence. Therefore, it is suggested to provide a program of 'customized learning' by the school to improve students' attitude toward convergence, particularly for these three types of group. Customized learning might adjust the learning process based on students' various needs and their abilities to provide an effective environment for education (Park & Kim, 2008). Customize learning is related to the differentiation instruction program where the instruction is designed based on "whom the teacher teach" or the need of each group of student. This learning can promote the students' creative idea, problem-solving, respectful with a different environment, challenges skill since it is designed based on students' learning preference and personal interest (Tomlinson & McTighe, 2006).ba

For these three cases of groups, a different learning strategy could be implemented by a teacher. The HKC group is the group with high knowledge but low interest in attitude toward convergence. A teacher should emphasize to improve students' interest by encouraging them through motivation. Glynn et al. (2009) have recognized career motivation as one of the extrinsic motivations, which could influence students' conviction regarding the relation of knowledge gained and future career. This future career motivation might increase students' interest in convergence because intrinsic motivation and career motivation were strongly correlated. Therefore, it is recommended to involve career motivation in learning instruction (Glynn et al., 2011), especially for HKC group.

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The HIC group is the group with high interest but low knowledge of convergence. Many factors could influence students' knowledge (e.g., teacher's knowledge, teaching model). Knowledge of a teacher is one of the essential elements that influenced what is being conducted in classrooms, and it gives major effect on what students learn (Fennema & Franke, 1992; Hill et al., 2005). That is why a teacher should be familiar not only about the knowledge of convergence but also about how to implement it in the classroom (various learning models in convergence). Furthermore, the LSeC group had lower mean values for all constructs compared to other groups. The most important thing about this group is a large number of students (60.37%) with very low self-efficacy in convergence. This group could combine the learning strategy from groups HKC and HIC. However, teachers need to emphasize on how to improve students' self-efficacy. Several types of research showed the implementation of vicarious learning used to enhance students' confidence (Albion, 1996; Ertmer et al., 2003; Wang and Newby, 2004). However, Schunk (2001) suggested that increasing self-efficacy could be conducted by evaluating self-performance and making realistic goals. It is because when students achieve a realistic goal, they tend to be more confident to reach other goals.

Conclusions

Due to increasingly complex problems around the world such as global warming, integrated and multidisciplinary approaches that transcend boundaries to traditional academic fields are becoming increasingly important. This movement of convergence has strengthened a variety of integrated approaches in the education field recently. Particularly in current science education, different contents from previously separated scientific disciplines are connected in teaching and learning through an integrated approach. Based on these approaches, students are expected to grow into future generations with the ability to overcome disciplinary barriers and solve creatively various complex problems in the world. However, to achieve this purpose effectively, it is crucial to focus on integrated content and students' positive attitude toward convergence such as knowing the meaning and purpose of convergence well, understanding the relation to their life, and having interest and confidence in convergence. Positive attitude toward convergence is expected to be a driving force for attempting a newly convergence.

This study uncovered the relationship of attitude toward convergence with gender and track in Indonesia Senior High School students. The responses provided empirical data that gender was significantly related to students' interest in convergence, where female students had a higher interest in convergence than male students because females had more social sensitivity in working collaboratively. This finding suggests that a learning group will have a better result if more female students are in the group. However, female students were less confident in attitude towards convergence. The teacher needs to be noticed when designing a teaching design to improve female students' confidence in convergence education. Furthermore, the track was also significantly related to students' interest in convergence where science track students had higher interest than humanities track. It is because the science track had more collaborative learning activity which can make students more interested in working together. Science class students also tend to believe that the attitude toward convergence is very good and beneficial for their future career. Customized learning based on students' class characteristics is proposed in this study to optimize effective teaching-learning, specifically to create students' good attitude toward convergence. However, for effective improving students' attitude toward convergence, further researches regarding on educational environment and teaching program are needed to be conducted in the future.

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Appendixes

Appendix 1. The instrument of attitude toward convergence in the English version.

Construct of 'Attitude toward Convergence'	Code	No	Statement in English Version
Knowledge	K_1	1	I can explain the meaning of "convergence" to others.
	K_2	2	We can mention the case of convergence.
	K_3	3	I can explain the difference between learning convergence with other learning.
	K_4	4	The attitude toward convergence can be used in everyday life.
Personal Relevance	R_P_1	5	Convergence is related to what I learned.
	R_P_2	6	Understanding convergence can help me in learning.
	R_P_3	7	Convergence will be related to my life in the future.
	R_P_4	8	Convergence helps in understanding the things I am curious about and interested in.
	R_P_5	9	Convergence will solve the problems of my daily life.
Social Relevance	R_S_1	10	Convergence will help to solve the complex problems of modern society.
	R_S_2	11	Convergence will help society to develop in the future.
	R_S_3	12	Convergence will help me understand modern civilization and society.
	R_S_4	13	Convergence will help us to prepare future society of the 21st century

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Construct of 'Attitude toward Convergence'	Code	No	Statement in English Version
Interest	A_I_1	14	Finding the connection between a field of knowledge and other fields of knowledge is interesting.
	A_I_2	15	I enjoy the process of getting to know various fields of science related to the subject that I am interested in.
	A_I_3	16	Participating in the process of creating ideas with people who have different ideas is fun.
	A_I_4	17	It is very interesting if experts from various fields can collaborate to solve problems.
	A_I_5	18	The experience of people who have applied their ideas creatively from one field to another is interesting.
Self-Efficacy	A_SE_1	19	I am good at finding links between knowledge in one field and other fields.
	A_SE_2	20	I know well the various fields of knowledge that are related to the subject I am interested in.
	A_SE_3	21	I am good at solving problems using knowledge from various fields.
	A_SE_4	22	I am good at seeing one problem from various points of view.
	A_SE_5	23	I am good at using knowledge from various fields when trying to solve the problems.

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