An Investigation of the Social Network System Competencies of High School Students in Japan

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Abstract—We investigated the Social Network System (SNS) competencies of high school students in Japan. Student groups (from cities or regional areas) and the opinions of their teachers were compared. Twenty-five UNESCO criteria in three competency categories were selected. By two-way analysis of variance and paired-comparisons, we detected a significant difference in the opinions of students and teachers. Although the magnitude of the difference was small, by Dunnett's multiple comparisons, the city and regional groups also differed from each other. Performance criteria items of risk awareness were valued the highest and most important in all groups; whereas technical skills and sociocultural skills were reported as less proficient and less important by all groups. Classification of SNS-type was used, and the data of SNS sites with which the students were familiar and the mean values of related performance criteria items were applied to view the situation of students. By this approach, we confirmed that students are savvy in navigating socializing SNSs. Based on our findings, we propose important learning and societal-public activities relevant to SNSs.

Keywords —high school, social network service, media information literacy, students' competencies, UNESCO

1   Introduction

The number of mobile terminal subscriptions has reached 196 million (2016), which exceeds the population of Japan [1]. Also, the cost of network connections has drastically decreased. Currently, in Japan, most grade 10 secondary school students have their own smartphones (94.4%) and actively access Social Network Systems (SNSs) during 58.9% of their online time [2]. Thus, SNSs (e.g., Facebook and Twitter) are attractive to high school students, and teachers were aware of the pros and cons of this in education.

Recent Media Information Literacy (MIL) studies advocate for competencies in social media use to help users adapt to this new information and communication technology- (ICT-) based society. A related study by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) proposed an assessment framework to estimate ICT competencies [3].

Here, we aimed to explore the opinions of high school students about their SNS competencies and to compare these to the opinions of high school teachers. A questionnaire method was used, and items were developed to apply the UNESCO criteria.

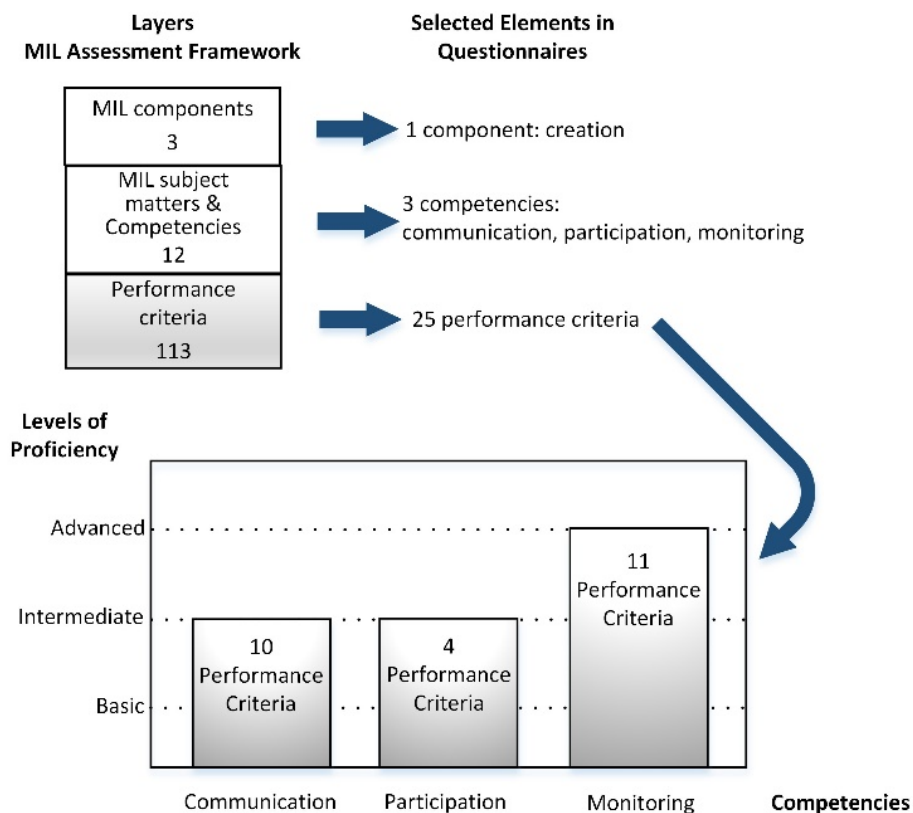## 2 Selection of Items from MIL Assessment Framework

Fig. 1. The layers of the media information literacy (MIL) assessment framework and selected elements of the questionnaire.

The MIL assessment framework includes layers that can be used to structure the profile of performance criteria items. These layers involve a wide range of ICT competencies and consist of the following elements (with the numbers of questions in parentheses):

─ Components (3): Three overarching categories (Access, Evaluation, and Creation).
─ Subject matters (12): These matters explain the activities needed to use competencies below. Each component above has four middle-ranking classifications. For example, within Creation, there are Creation, Communication, Participation, and Monitoring.

— Competencies (12): These are paired with subject matters above and capture a person's competencies.
— Performance criteria (113): Details of competency criteria.
— Levels of proficiency (3): Three levels of mastering MIL components (Basic, Intermediate, and Advanced).

Here, we selected the "Creation" MIL component, three MIL subject matters, and competencies as the targets of this investigation, using findings regarding target competencies which were extracted from survey reports of students' situation to use SNS in the preceding study [4].

Figure 1 shows the layers of the UNESCO assessment framework, as well as the profile of the parts selected for this study.

3 Method

Twenty-five performance criteria items were arranged into the following three questionnaires, which consisted of two styles.

3.1 Selected Criteria Items

To focus on SNS competencies in measurement, the term "media" in performance criteria items was substituted to SNS.

Communication competency: Ten items (see C1–C10, shown in Table 3). These items address how users communicate information, media content, and knowledge in an ethical, legal, and effective manner using SNS. This competency was selected to estimate the basic level of recognition.

Monitoring competency: 11 items (see M1-M11, shown in Table 7). These items address monitoring the impact of created and distributed information, SNS content and knowledge, as well as the use of existing media and other information providers. This competency was selected to estimate the advanced level of recognition.

Participation competency: Four items. These items address how users engage with SNSs for self-expression, intercultural dialogue, and democratic participation in an ethical, effective, and efficient manner. This competency was used to know recognition of importance to participate in and monitor democratic processes of online society. These criteria "Involve", which recognizes the importance of being engaged and involved in SNSs; "Risk", which measures the awareness of the consequences and risks of participating in SNSs; "Interact", which measures how users share content and interact with other users of SNSs, physically or online; and "Tool", which measures how users engage and participate in SNS activities through various online tools.

3.2 Scales and Analyses

According to the Weber-Fechner law, a subjective sensation is proportional to the logarithm of the stimulus intensity; the relationship between stimulus and perception is logarithmic [5]. Moreover, when a stimulus varies in a geometric manner, the corresponding perception is altered in an arithmetic progression. Therefore, here we use geometric scores for the intensity of students' and teachers' opinions.

Questionnaires of communication competency and monitoring competency. Questionnaires were developed based on the items shown in section 3.1, using the intensity of scale proposed by Saaty [6] (Table. 1). The collected data were log-transformed and used for two-way analysis of variance (ANOVA) and post hoc tests.

A questionnaire of participation competency. Based on the four performance criteria of participation competency shown in section 3.1, a questionnaire with six paired comparison items was designed to measure their perceived importance. As was done for Table 1, the following intensity of importance was used in the paired comparison (Table 2).

We performed an additional two types of analysis Sheffe's paired comparison and Sheffe's paired comparison. Sheffe's paired comparison (analytic approach) [7] is a statistic-based sensory evaluation, in which the log-transformed data of each group was used for Nakaya's variation of Scheffe's analysis of variance for paired comparison. For Saaty's paired comparison (holistic approach) [8], to measure the importance of each item, the data of each group were introduced into the calculation of geometric means.

Table 1. Intensities of performance criteria items.

Intensity	Definition
9	Absolutely students / I can do
7	Very much students / I can do
5	Much more students / I can do
3	Somewhat students / I can do
1	Neutral
1/3	Somewhat students / I cannot do
1/5	Much more students / I cannot do
1/7	Very much students / I cannot do
1/9	Absolutely students / I cannot do

Table 2. Intensity of importance to compare paired items.

Intensity	Definition
1	Equal importance
3	Somewhat more important
5	Much more important
7	Very much more important
9	Absolutely more important

3.3 Implementation

A total of 72 valid responses were collected from the following three groups and on the date of investigation in Chiba prefecture, Japan: (CT) 24 high school students in the prefectural capital, city area, 14 May 2016; (RE) 24 high school students in the regional area, 90 km away from CT, 13 May 2017; and (TE) 24 high school teachers in charge of ICT education who attended a seminar, 23 October 2015.

4 Results

4.1 Result of Communication Competency

Figure 2 shows the mean values of the log-transformed data. During the statistical analysis, the range of the scale was rearranged, from 1/9–9 to -3–3.

As a result, both the CT and RE student groups showed positive recognition in communication competency and had larger scores than TE. However, the magnitude of the differences between the groups was small.

Table 3 shows differences in the calculated mean values of each performance criteria item. C8 shows the highest mean value for all items, and an item was related to competencies of risk awareness and related to the potential threats to communicate in SNS. This score corresponds to 3.94 (=exp(1.370)) in the intensity of scale. We found that students were fairly aware of the consequence of cyber threats and were convinced of their ability to manage this. On the other hand, C2 showed the lowest mean value, and the item involved technical data processing skills.

Next, the calculated mean values and variances were subjected to further analysis. By two-way ANOVA, we detected significant differences in items and in groups (Table 4).
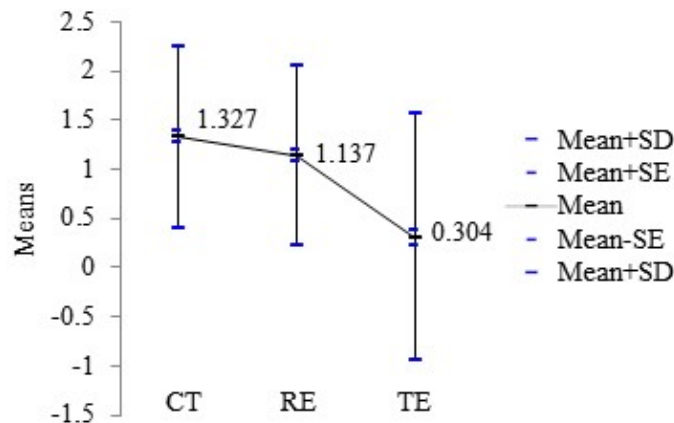

Fig. 2. The mean values of the log-transformed data of communication competency.

Table 3. Mean values and standard deviation of items in communication competency.

Item	Means	SD	SE	Description
C1	1.039	1.023	0.121	Knows that new knowledge should be shared, distributed, and communicated in SNSs
C2	0.596	1.180	0.139	Chooses the data format that best supports the communication, distribution, and sharing of data and knowledge, taking into account the data size and type of users
C3	0.972	1.186	0.140	Uses various online tools to communicate and for distributing and sharing data and knowledge
C4	0.671	1.143	0.135	Identifies, copies, communicates, distributes, and shares information, data, and knowledge in contextually relevant settings to SNS users
C5	0.748	1.107	0.131	Communicates data and messages in an ethical way
C6	1.210	0.965	0.114	Communicates data and messages in a legal way
C7	0.880	1.150	0.136	Knows how to protect privacy and intellectual rights
C8	1.370	0.963	0.113	Aware of the consequences and risks of communicating, distributing, and sharing knowledge on SNSs
C9	0.631	1.284	0.151	Understands the interdependencies between users and victims/perpetrators/bystanders/witnesses on SNSs
C10	1.108	1.073	0.127	Shares data and knowledge through various SNSs

Table 4. Comparison of items of communication competency by two-way ANOVA.

Source	Type III SS	df	MS	F	p
#Items	44.70	9	4.97	4.76	p<0.001
#Groups	142.10	2	71.05	68.06	p<0.001
Interaction	14.98	18	0.832	0.797	0.705
Error	720.33	690	1.044		
Total	922.11	719			

Table 5. Comparison of items of communication competency by multiple comparisons (Scheffe).

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
CT vs RE	.591	.435	.988	.995	.266	.358	.995	.699	.619	.718
CT vs TE	**	**	*	**	*	*	**	**	**	.141
RE vs TE	*	**	*	**	.489	.312	**	**	.113	*

*: p<0.05, **p<0.01

Next, we made multiple-comparisons using the Scheffe's test. From all pairwise comparisons, two pairs of items were identified as having significant differences between the groups ($F_{C2, C8} = 2.30$, $p < 0.05$; $F_{C8, C9} = 2.09$, $p < 0.05$). Next, Table 5 shows the result of Scheffe's multiple comparison tests of groups in each item. By this approach, many significant differences were detected when comparing the TE groups against the other student groups.

When comparing CT and RE, no significant differences were detected (Table 5). Next, we introduced Dunnett's multiple comparison tests of a group vs. control groups.

By this approach, we found that CT > TE, RE > TE, and CT > RE (Table 6). Interestingly, by this method, we detected a significant difference between the CT and RE groups by contrast.

Table 6. A group versus control groups comparison by multiple comparisons (Dunnett).

Comparison	Difference	SE	Observed q'	p
TE < CT	-1.023	0.0933	-10.966	**
TE < RE	-0.833	0.0933	-8.932	**
CT > RE	0.190	0.0933	2.034	*

*: p<.05, **p<.01

4.2 Result of Monitoring Competency

Log-transformed data were introduced into the statistical analyses, and Figure 3 shows the mean values of the monitoring competency of the three groups.
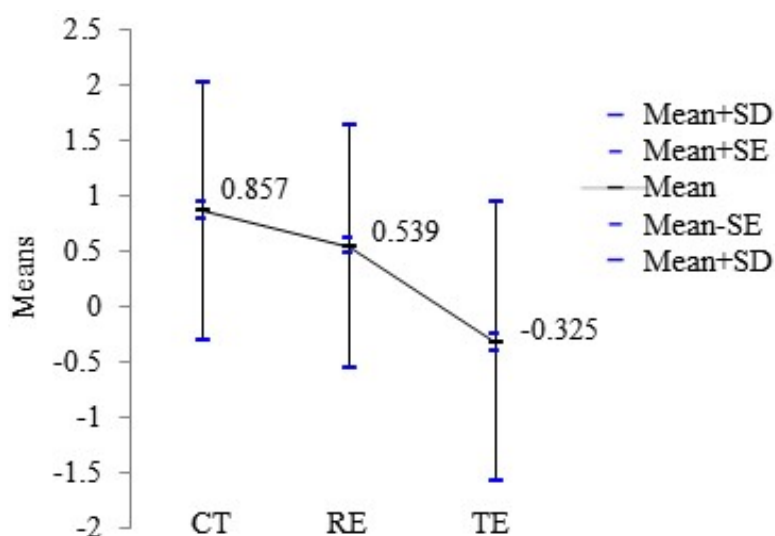

Fig. 3. Mean values of log-transferred data of monitoring competency.

As a result, both the CT and RE groups showed little positive recognition in monitoring competency, while the TE showed a slightly negative recognition. Moreover, the differences between the student groups were small.

Table 7 shows the identified differences in the calculated mean values of each of the performance criteria items. M1 shows the highest mean value in all items. Although M1 does not involve the technical skills of monitoring, it does address the understanding of the need for monitoring. This score corresponds to 2.36 (=exp(0.858)) in the intensity of scale, and it was found that students had self-efficacy

on the basic literacy of monitoring. M9 showed the lowest mean value; this item requires proficiency in socio-cultural skills.

Next, the calculated mean values and variances were subjected to two-way ANOVA (Table 8).

Table 7. Mean values and standard deviation of items in monitoring competency.

Item	Means	SD	SE	Description
M1	0.858	1.159	0.137	Knows about the need and importance of monitoring SNS for shared data and knowledge
M2	0.764	1.193	0.141	Uses or establishes monitoring method and skills for periodical assessment of the effectiveness of intended impacts
M3	0.653	1.164	0.137	Monitors and makes judgments on shared data and knowledge, such as quality, impact, and integrity of practices
M4	0.315	1.290	0.152	Identifies and analyses how SNS users respond to data and knowledge and impact
M5	0.411	1.265	0.149	Knows and uses available SNS monitoring services and tools
M6	0.092	1.198	0.141	Knows how the results of monitoring could be used to improve or create new data and knowledge
M7	0.156	1.279	0.151	Knows how to monitor SNS ownership and its implications
M8	0.409	1.251	0.147	Understands the functions and role of institutions providing public relations services and how institutions influence users and decision making
M9	- 0.313	1.213	0.143	Monitors the functions of public relations services and lobbyists
M10	0.184	1.367	0.161	If required, redirects and recasts data and messages based on the comparison of actual results with intended results
M11	0.397	1.277	0.150	Knows how and where to communicate appreciation or complaints

Table 8. Comparison of items of monitoring competency by two-way ANOVA.

Source	Type III SS	df	MS	F	p
#Items	79.36	10	7.936	6.120	p<0.001
#Groups	197.62	2	98.81	76.197	p<0.001
Interaction	24.60	20	1.230	0.949	0.524
Error	984.23	759	1.297		
Total	1285.82	791			

Also, we performed multiple-comparisons using Scheffe's test. From all pairwise comparisons, three pairs of items were identified as having significant differences ($F_{M1, M9}$ = 3.80, $p < 0.01$; $F_{M2, M9}$ = 3.22, $p < 0.01$; $F_{M3, M9}$ = 2.59, $p < 0.01$).

Next, Table 9 shows the result of the Scheffe's multiple comparison tests for each item. Similarly to the analysis of communication competence in Section 4.1, we detected many significant differences between the TE group and the other two student groups.

Comparing the CT and RE groups, students in the CT group returned relatively higher score in M10 than scores of other groups (Table 9). The mean M10 values were 0.768 (CT), -0.057 (RE), and -0.159 (TE), revealing differences in the groups'

understanding of the danger of communicating with strangers. Next, we performed Dunnett's multiple comparison tests for the groups vs. a control group.

By this approach, we found that CT > TE, RE > TE, and CT > RE (Table 10). Similarly to Section 4.1, there was a significant difference between CT and RE (compare Tables 9 and 10).

Table 9. Comparison of items of monitoring competency by multiple comparisons (Scheffe's test)

	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11
CT vs RE	.968	.279	.265	.132	.692	.908	.970	.647	.724	*	.290
CT vs TE	**	**	**	**	.074	*	*	**	**	*	.**
RE vs TE	**	**	.072	**	**	*	*	**	*	.953	.256

*: $p < 0.05$, **$p < 0.01$

Table 10. A group versus control groups comparison by multiple comparisons (Dunnett's test)

Comparison	Difference	SE	Observed q'	p
TE < CT	-1.182	0.0933	-10.966	.**
TE < RE	-0.864	0.0933	-8.932	.**
CT > RE	0.318	0.0991	3.207	.**

**$p < 0.01$

4.3 Participation Competency

Sheffe's Paired Comparisons. The importance of performance criteria items in participation competency was assessed. For the statistic-based sensory evaluation, Scheffe's analysis of variance for paired comparison was used. By this approach, we detected significant difference in the performance criteria items across all groups (Table 11–13).

By this approach, we detected a significant interaction only in the CT group (Table 11). Figures 4 show the mean values of performance criteria items (dots) for each group, as well as their 95% confidence intervals (yardsticks above). A similar tendency was observed for all groups: "risk" scored highest, and "tool" scored lowest. In addition, the 95% confidence intervals demonstrated the existence of significant differences for "risk" in CT and TE. It should also be noted that the mean value of "risk" in the CT group was larger than that of the TE group. Based on these findings, we propose that students from cities better recognize the importance of risk awareness.

Because the scores for the paired comparisons use the same scale, the groups' mean values have important implications. The scores of "interact" were similar to the scores of "involve" and were larger in the RE group than the CT and TE groups. In fact, this set of items explained the core drive to lead them to join socio-cultural communication in SNS.

CT and TE had similar mean values, especially their highest scores for "risk" affected to decrease socres of other performance criteria items, whereas RE had a more limited range of mean values with rather murkily expressed importance.

In all groups, the "tool" component of the technical skills was valued as being of the least importance.

Saaty's Paired Comparison. Next, we calculated of weights by Saaty's paired comparison. Table 14 shows the results of both the weights of importance from the holistic approach (Saaty's paired comparison) and their relative ranking by analytic approach (Sheffe's paired comparison) (Table 14).

Similarly, as reported in a previous study [9], no incongruities were observed when comparing the results of the two methods. Scheffe's method identified "risk" is a remarkable item in all groups, and this item was statistically significant as highest ranked item in the student groups. However, Saaty's method implied a more holistic view. Also, we were able to confirm that "risk" was not the only dominant item. The recognition of "risk" in CT (58.4%) was larger than in RE (39.1%), and this difference would be related to differences in the second-ranked item in each group, namely "involve" in CT and "interact" in RE and TE.

Table 11. Paired comparisons for the CT group (Scheffe's test).

Source	SS	df	MS	F	p
Main effect	183.6823	3	61.2274	106.2262	P < 0.001
Individual effect in Main effect	90.8999	69	1.3174	2.2856	P < 0.001
Interaction effect	7.3482	3	2.4494	4.2496	0.0082
Error	39.7707	69	0.5764		
Total	321.7011	144			

Table 12. Result of Paired Comparison for RE Group (Scheffe)

Source	SS	df	MS	F	p
Main effect	37.5614	3	12.5205	13.2581	P < 0.001
Individual effect in Main effect	119.7201	69	1.7351	1.8373	0.0062
Interaction effect	2.9706	3	0.9902	1.0486	0.3767
Error	65.1610	69	0.9444		
Total	225.4132	144			

Table 13. Result of Paired Comparison for TE Group (Scheffe)

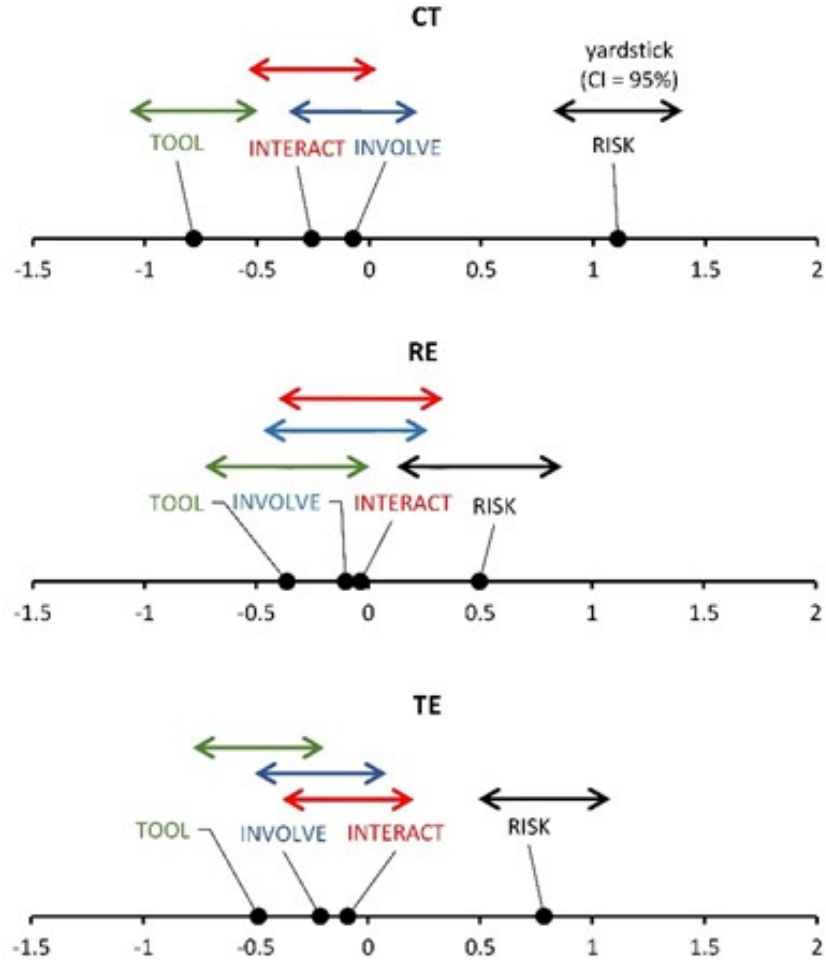| Source	SS	df	MS	F	p
Main effect	87.0607	3	29.0202	48.4326	P < 0.001
Individual effect in Main effect	153.6006	69	2.2261	3.7152	P < 0.001
Interaction effect	3.2989	3	1.0996	1.8352	0.1489
Error	41.3440	69	0.5992		
Total	285.3042	144			

Fig. 4. Means of importance in items of participation competency (CT, RE and TE).

Table 14. The perceived importance of performance criteria items in each group.

	CT		RE		TE	
Items	*Importance*	*Rank*	*Importance*	*Rank*	*Importance*	*Rank*
Involve	17.9 %	2	21.5%	3	17.9%	3
Risk	58.4%	1*	39.1%	1*	48.4%	1
Interact	14.9%	3	23.0%	2	20.2%	2
Tool	8.8%	4	16.5%	4	13.6%	4

*: $p < 0.05$

5 Discussion

Here, for overall performance criteria items, we detected higher mean values of students' self-evaluation than teachers' evaluation. Also, by group comparisons, we found that the mean values of urban students were statistically higher than regional students in both communication competency and monitoring competency. In both competencies, the items asked about their knowledge, skills, experiences, and awareness. The mean value the risk awareness item was higher than the technical skills item (C8 vs. C2), and an item of risk awareness also scored higher than the socio-cultural skills item (C8 vs. C9). Similarly, we detected relatively low mean values for socio-cultural skills in monitoring competency (M8 and M9).

By paired comparisons, we found that both students and teachers gave higher importance to risk awareness than socio-cultural or technical skills. To our surprise, for the importance of risk awareness, urban students (58.4%) scored this higher than their teachers (48.4%).

In a previous study, those students more aware of the risks associated with SNSs were more likely to protect themselves within these spaces [10]. Thus, we can conclude that students' counter risk skills are proficient.

5.1 Communication in SNSs

Social media is designed by using scalable ICT to spread information via social interaction. SNSs are a part of social media, and its characteristics are defined as services that enhance communication among members [11]. Therefore, SNSs allow people to join, own, and edit personal pages, as well as to connect with other users [12]. Here, we introduced an analysis based on the following classification of SNSs, as proposed by Thelwall et al. [13].

– Socializing SNS: Supporting informal social interaction between members (e.g., Facebook).
– Networking SNS: Supporting non-social interpersonal communication, people-finding SNS (e.g., LinkedIn).
– Navigation SNS: Supporting finding resources via interpersonal connections (e.g., Tumblr).

Figure 5 shows the typology of SNS types. Based on a previous Japanese SNS study, the author mapped nine of the top SNS sites for Japanese high school students into the framework [14]. The mean values of related performance criteria items were also mapped onto the framework. Unfortunately, there was no site around Networking SNS, so LinkedIn was arranged for reference. The students' confidence levels were included in the framework.
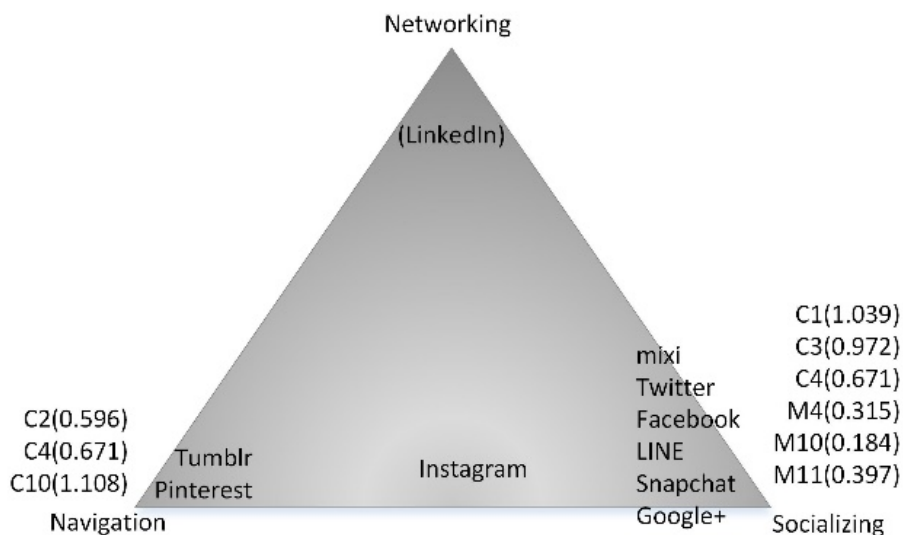
Fig. 5. The relationships between performance criteria and the typology triangle (C = communication; M = monitoring).

The "interact" and "involve" items, which were required in societal-public activities skills, were valued as relatively low importance. This finding supports the data we collected about students' familiar sites and explains the range of mean values in the topology. This implies that students are SNS savvy about their personal communication or identifying resources, but that they are not proficient at participating in active civil society, as indicated by the mean values of item M10. Mass self-communication spaces, such as Twitter and Facebook, are still subject to power relations and self-interest. However, government, corporate interests, and the media are all influencing and affecting these online public spheres in ways that challenge the democratic and deliberative nature of the Internet [15]. In this context, the results of this study have important implications for how best to address the skill gap for societal-public activities from the enhancement of UNESCO's criteria.

5.2 Technical Skills in SNS

The survey data of Ministry of Internal Affairs and Communication reported that only 0.4% of students used SNSs for learning activities. However, those students that scored higher in this evaluation better felt the effects of using the Internet in learning [2]. Also, an earlier study found that technology brings learning outside of the classroom and into students' everyday lives [16].

Therefore, there is an emerging view of competencies for knowledge-based society to develop in SNS that has more focus on increasing connections under the context-contingent situation, while students enjoy natural affinity of individuals.

This raises the question, can learning be improved through the use of SNSs. Enhancing students' communication skills through active citizenship training will not directly fall in line with the proficiency for learning, and it needs an additional view of actuation to find online connections as an element to enhance learning. SNSs have opened up new opportunities for collaborative learning and networking.

Chatti was an initiator of the 'Learning as a Network' (LaaN) theory, which advocates the importance of extending the network connections of learners [17]. Chatti explains that the result of learning is a restructuring of one's personal knowledge network, that is, an extension of one's external network with new knowledge nodes (external level) and a reframing of one's theories-in-use (conceptual/internal level). Therefore, within SNSs, connections of the context-contingent position should be fostered by similar objectives, shared changes, and common tasks. Advanced technical skills are also required to identify and connect with a new community, and to adapt to the environment of SNSs. Thus, communication in those activities is unlike those detected in Section 5.1, which is influenced by personal interests and feelings.

5.3 Conclusion

The findings reported here have important implications for future educational policy and practice in Japan. The lack of impact and confidence in communication skills to expand connections and usage of advanced technical skills are worrying. Then, it is necessary to address the skill gap of SNS usage for learning and societal-public activities.

Risk awareness and cyber safety are important student concerns and, even more so, in the context of their private use of SNSs. Equipping students with an adequate understanding of risk and educational potential of SNS is imperative for schools. We propose that schools must include SNS skill set development into the curriculum in order to widen ICT and social opportunity for students. This inclusion should not only focus on high school education but should span across all levels of education, including adult education.

6 Acknowledgments

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