Proposal of a Framework for the Assessment of ICT Literacy and Examining the Structure of High School Students' ICT Literacy: A Case of Turkey

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Abstract: Development levels of societies are highly correlated with the efficiency in usage of information and communication technologies between people belonging to those particular societies. For this reason, this study aims to investigate ICT literacy levels of high school students, to find out the general profile in terms of literacy levels and to reveal the students' internet usage purposes according to their ICT literacy levels. So as to achieve this goal a questionnaire developed by the researchers was conducted among the students at their 9th, 10th, 11th and 12th levels of study. Sample of the study encompassed different types of high schools in the Sakarya province of Turkey including Anatolian High School, Science High School, Vocational & Technical High School, Private Anatolian High School and Sports School. Students were questioned so as to determine their ICT literacy levels and to find out reasons behind their internet usage by means of variables representing school type, gender, level of study (9, 10, 11, 12), average success score and frequency of usage. As a result, even though the purpose of internet usage demonstrated a common trend among groups having different levels of ICT literacy, priorities for the usage of internet changed among different levels.

1 INTRODUCTION

Information & communication technologies (ICT) literacy is the individuals' possession of minimum level of technology and communication usability skills that makes their daily and business lives easier. ICT literacy has been increasingly gaining importance and it has even become a compromising context for all other fields of science. Depending on the fact that there is not any field that information technologies are not used, people of this age have to own sufficient levels of ICT literacy so as to handle their activities easily and complete them in a short time. Thus, it is necessary to determine the common criteria and to establish standards for measuring the ICT literacy. Nowadays, rapid changes in the development of information technologies have remarkably affected all sectors. In terms of producing qualified work force for business world importance of using IT in the field of education is getting more and more important. Students of today which can be classified as "digital locals" meet technology at earlier ages compared to older generations and they inevitably develop different abilities and thoughts (Prensky, 2001). Education supported with IT improves students' ICT literacy skills as well. Today's students are capable of doing multiple activities by using a single technological tool (Yildiz, 2012), they are skilful in terms of handling new technologies and they are eager to use them. Such a student profile forces educational institutions or any other decision makers to adapt state of the art educational models (Arabaci and Polat, 2013).

2 LITERATURE REVIEW

Based on the Alexandria Proclamation of 2005 and UNESCO's Information for All Programme (IFAP), information literacy is basically defined as the ability of people to know their information requirements and to assess information quality. Moreover, it means holding, revealing information, using it effectively and in an ethical manner and implementing it in order to develop and disseminate knowledge (Catts and Lau, 2008). Bruce (2002) as cited by Virkus (2003)

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expressed information literacy as a context that arrived with the emergence of information technologies in 1970s. In addition to this, it is the underlying and required literacy for our century as technology is continuously evolving, becoming more complex and new technologies are emerging. Thus, information literacy constitutes the basis of learning in this complex and dynamic environment (Bruce, 2002). Moreover, according to Owusu and Ansah (2003) as cited by Anunobi and Ukwoma (2016) providing education by solely giving structured knowledge to the students is not acceptable anymore. Their processes of acquisition and production of new knowledge should be maintained and espousal of lifelong learning should be provided. In order to achieve this, equipping students with experiences and capabilities for investigating new knowledge, conducting research and navigating properly are remarkably important (Anunobi and Ukwoma, 2016).

All over the world, in the field of education there is an increasing trend on getting maximum benefit from information and communication mechanisms by means of integrating them into learning processes. Enhancement in the level of ICT skills through practices and experiences is aimed which contributes to transfer these skills to any other fields of life as well (Bruce, 2002).

Regarding the computer literacy, researchers have studied the concept from different aspects and defined various types of skills to portray a computer literate individual. Simon et al. (1987) as cited by Oliver and Tomei (2000) defined computer literacy as having insight into computer characteristics, abilities, practices, implementations and owning capability of transferring this knowledge in terms of efficient usage of computer implementations. However, the last decade has experienced significant advancements in communication technologies era which caused the evolution of computer literacy concept. Gilster (1997) as cited in Oliver and Tomei (2000) expressed that changes in technology diversified notions of computer literacy and many concepts associated with computer literacy occurred such as information technology literacy, digital literacy, online literacy or net literacy. In the matter of information and communication technology (ICT) literacy, the term represents a wider framework stemmed from the requirement of technology usage for obtaining information and using it in a productive manner. Using internet, world-wide-web and e-mail for searching of information, sharing and communicating are parts of ICT literacy (Oliver and Tomei, 2000). Lau and Yuen (2014) stated that although there are various terminologies for digital literacy it is basically concerned with internet and computer literacy. Markauskaite (2007) examined the level of ICT literacy of trainee teachers based on information literacy and digital literacy. Researcher determined the main components of assessment to be the cognitive capabilities and technical capabilities. Cognitive capabilities involved problem solving and communication and meta-cognition whereas technical capabilities involve basic computer and internet related capabilities. Educational Testing Service (2007) developed a tool compromising technical and cognitive sites of ICT literacy for assessing ICT literacy levels. Taking into consideration these arguments ICT literacy can be considered as a generic term that includes information literacy, computer literacy and internet literacy (Lau and Yuen, 2014).

Many researchers have investigated ICT literacy in education field and comprehensive tools assessing both information and technology aspects have been used. For instance, by means of ETS's iSkills tool ICT literacy levels of junior students were evaluated and necessary precautions were taken in terms of course contents (Somerville, Smith and Macklin, 2008). Again the same tool was used by Katz and Mackin (2007) in 30 universities in U.S. to validate the measurement tool and to improve ICT literacy. "IEA International Computer and Literacy Study (ICILS)", "Programme for International Student Assessment (PISA) Digital Reading Assessment" and "Assessment and Teaching of 21st Century Skills (AT21CS)" are other broad ICT literacy evaluation mechanisms (Global Education Monitoring Report, 2016). Oliver and Towers (2000) studied on ICT literacy of students depending on computer, software-application, internet and www skills and developed a measurement tool. Moreover, Dijk and Deursen (2014) evaluated ICT literacy merely focusing on internet skills.

This research developed a measurement tool on ICT literacy of high school students in the wider context of ICT literacy which integrates information, computer and internet skills for evaluation.

3 METHODOLOGY

This study aims to measure ICT literacy of high school students and to analyze differences among students based on variables such as school type, gender, level of study, average school success and frequency of computer and internet usage. In the way of accomplishment research questions of this study were as follows:

What are the ICT literacy levels of students?

Is there a meaningful difference in ICT literacy levels according to school type?

Is there a meaningful difference in ICT literacy levels according to gender?

Is there a meaningful difference in ICT literacy levels according to level of study?

Is there a meaningful difference in ICT literacy levels according to average school success?

Is there a meaningful difference in ICT literacy levels according to frequency of internet usage?

Is there a meaningful difference in purposes for internet usage according to ICT literacy levels?

Under the quantitative research paradigm a questionnaire was conducted in order to explore necessary information.

Regarding the sample of the study, students in the 9th, 10th, 11th and 12th classes of four different types of high schools were chosen. Three dimensions compromising basic skills, office skills and internet skills were identified to assess the ICT literacy levels of students.

Measurement tool constructed by the researchers was at first used for a pilot study in order to readjust the scale. After examination of results it was accepted for implementation. Participants were compromised of 1000 students and 477 responses were obtained representing a response rate of 47.7%.

The questionnaire encompassed questions about demographic information of students (6 questions), IT ownership (smart phone, tablet, laptop, desktop computer and internet), frequency of internet usage, most preferred tools for connecting to internet (5 questions), computer and internet usability skills (10 questions), purposes for internet usage (17 questions) and attitudes in internet usage (28 questions).

According the reliability analyses, Cronbach alpha values measuring the purposes for internet usage (14th section) and attitudes in internet usage (15th section) were 0,825 and 0,916, respectively. Depending on the fact that Kaiser-Meyer-Olkin Measure of Sampling Adequacy value (0,917) represented the applicability of factor analysis, for the 15th section factor analysis was implemented and six factors were obtained.

4 FINDINGS & RESULTS

Depending on the descriptive analysis on the data of questionnaire results findings about the ownership of information technology are represented in Table 1.

Table 1: Information technologies ownership.

	Ratio		Total	
	N	%	N	%
Ownerships				
Desktop computer	268	56,2	477	
Laptop	316	66,2		
Tablet	304	63,7		
Smart phone	452	94,8		
Internet-yes-limited	53	11,3	471	100
Internet-yes-limitless	324	68,7		
Internet-no	94	20		
Tools mostly used for internet connection				
Smart phone	369	78,30	471	
Tablet	20	4,20		
Laptop	49	10,30		
Desktop computer	33	6,90		
Frequency of Internet Usage				
Less than 2 hours/per day	215	45,90	468	100
2-8 hours every day	189	40,40		
8-12 hours every day	31	6,60		
One day/per week	33	7,10		

As seen in the table percentage of smart phone owners represents an extremely high number (94.8%). Percentages of desktop computer owners, laptop owners and tablet owners are 56.2%, 66.2% and 63.7%, respectively. With regard to internet owners total percentage is 80%. The highest percentage in terms of internet usage frequency is observed among the group using the internet less than 2 hours per day by 45.5%.

4.1 Calculation of the ICT Literacy Score of Students

In the case of calculation of information literacy the methodology is as follows:

The dimensions of “Basic skills”, “office skills” and “internet skills” were used to measure the ICT literacy and scores were calculated accordingly.

For the office skills and internet skills 5-point Likert-type scales were used whereas in the case of basic skills a dichotomous scale was used and respondents were asked to choose between 1:no, 2:yes for answering the questions. About internet skills participants were asked about their level of agreement to each item on a Likert scale (1:strongly disagree, 2:disagree, 3:neither agree nor disagree, 4:agree, 5:strongly agree). As a result for basic skills minimum score was expected to be 6 while maximum score was expected to be 12. For office skills scores were supposed to be (min= 4, max=20) and for internet skills (min=11, max=55). For an explicit rating both basic and office skills were calculated over 55 points. Formulation is represented below:

SOIL: Score of ICT literacy: T
BSS: Score of basic skills: x
OSS: Score of office skills: y
ISS: Score of internet skills: z

$$T = \frac{55}{12}.x + \frac{55}{20}.y + z$$

$$\text{minT} = \frac{55}{12}.6 + \frac{55}{20}.4 + 11 = 49.5$$

Maximum score maxT=55.3=165
MaxT-MinT=165-49.5=115.5
Difference among degrees=115.5:5=23.10
49.50-72.60: Very Low
72.61-95.71: Low
95.72-118.82: Moderate
118.83-141.93: High
141.94-165.00: Very High

Using these formulations ICT literacy levels of schools are demonstrated in Table 2

Table 2: ICT literacy score according to high schools.

	High Schools	**ICT Literacy Score (SOIL)**
4	Özel Şahin Private Anatolian H.S.	138.5538
2	Sakarya S&T H.S.	131.6231
1	Sakarya Anatolian H.S.	130.0032
5	Sakarya Sports H.S.	124.1667
3	Serdivan-F. Mesleki ve Teknik A.L.	122.0019
Mean		129.1759
Max. score		165
Min. score		49.5

***1:** Sakarya Anatolian High School, **2:** Sakarya Science High School,* **3**: *Serdivan Farabi Vocational & Technical High School, **4:** Ozel Sahin Private Anatolian High School **5:** Sakarya Sports High School*

Examination of the data in the table reveals that although order of schools did not change in terms of office skills, internet skills and ICT literacy skills of students, for the assessment of basic skills ranks of school 4 and school 1 changes place based on their scores. In order to get if there is a meaningful difference between schools in terms of information literacy scores One-way Anova analysis was conducted and Test of Homogeneity of Variance showed that variances were homogeneous (p=0,129>0.05). As p=0.000<0.05 for the Anova Test it was accepted that there were differences. Tamhane's T2 test results exhibited that there were meaningful differences among (school 1 and 4), (school 2 and 3), (school 3 and 4), (school 4 and 5).

Table 3 demonstrates ICT literacy scores based on gender.

Table 3: ICT literacy score according to gender.

Gender	Mean	N	Standard dev.	Min	Max
Male	130.334	189	21.140	60.08	165
Female	127.833	163	17.387	65.5	160
Total	129.176	352	19.506	60.08	165

Although ICT literacy score (SOIL) was found higher for males, Independent Samples Test results exhibited that variances were not homogeneous (p=0.22<0.05). Moreover, Sig.(2-tailed) result showed that there was no meaningful difference in SOIL according to gender.

Table 4: ICT literacy score according to levels of study.

Level	Mean	N	Standard dev.	Min.	Max.
9	126.30	127	21.227	60.08	165
10	131.38	106	19.413	65.50	165
11	131.17	66	18.689	75.08	165
12	129.25	50	15.773	99.00	160.25
Mean	129.19	349	19.555	60.08	165

One Way Anova analysis displayed that there was not a significant relationship among SOIL and the level of study. Although, Test of Homogeneity of Variance showed that variances were homogeneous (p=0.154>0.05), there were not meaningful differences among levels of study (p=0.188>0.05) according to Anova test. Analysis results of SOIL according to TEOG Score are summarized in Table 5. TEOG is a central exam for entrance to high schools in Turkey. For the students that are at the 9th level of study Table 5 presents the analysis results which examines the relationship between TEOG score and SOIL

Table 5: ICT literacy score according to TEOG score.

	Mean	N	Standard dev.	Min.	Max.
1	112.69	16	24.546	60.08	165
2	121.82	32	20.109	74.5	151.75
3	131.38	9	10.188	115.25	144.25
4	130.96	72	20.283	86.25	165
M.	126.45	129	21.105	60.08	165

***1:** TEOG score between (100-200), **2:** TEOG score between (201-300), **3:** TEOG score between (301-400), **4:** TEOG score between (401-500)*

Table 5 proves that SOIL values of students increased based on TEOG scores. However, the group having TEOG score between (301-400) demonstrated a higher SOIL compared to the group having TEOG score between (401-500). One Way Anova test results

showed that variances were homogeneous (p=0.073>0.05) and depending on the the Anova test (p=0.006<0.05) it was accepted that there were meaningful differences.

Table 6 below shows the statistical analysis` results of students in their 10th, 11th and 12th levels of study, their average scores on school success and the ICT literacy scores of students.

Table 6: ICT literacy score according to average school success score.

	Mean	N	Standard dev.	Minimum	Maximum
1	105.19	3	24.741	79.75	129.17
2	119.84	27	18.430	70.83	154
3	132.77	12	10.805	107.25	148.42
4	129.83	32	21.604	75.08	165
5	132.19	80	18.314	65.5	165
6	134.37	63	15.463	103.75	162.25
mean	130.60	217	18.429	65.5	165

***1:** (0-49.99), **2:** (50-59.99), **3:** (60-69.99**), 4: (**70-79.99), **5:** (80-89.99), **6**: (90-100) (Intervals represent average success score of students)*

Average school success increased with SOIL with the exception of students having success scores among 70-79.99. As One-Way Anova test results exhibited homogeneity of variances (p=0.184>0.05), Tukey test was performed. SOIL differed according to average success score of students based on Anova results (p=0.002<0.005).

Table 7: ICT literacy score according to frequency of internet usage.

	Mean	N	Std.dev.	Min.	Max.
1	129.63	160	18.666	74.5	165
2	128.95	144	19.778	60.08	165
3	136.85	21	18.046	97.83	165
4	125.03	22	19.599	70.83	157
mean	129.49	347	19.199	60.08	165

***1:** Less than 2 hrs, **2:** (2-8) hrs everyday, **3:** (8-12) hrs everyday **4:** Once/week (Categorization for frequency of internet/computer usage)*

Analysis results above demonstrates that SOIL of students using internet/computer only once a week had lower SOIL than the ones using the internet for (8-12) hours every day. It is meaningful that (8-12) hours of internet usage results in higher SOIL. When the data was analysed for a meaningful difference, (p=0.783>0.05) showed that variances were homogeneous and Anova test represented that SOIL did not showed difference based on the frequency of internet usage.

Table 8: ICT literacy levels.

		N	%
Very low	1	1	0.3
Low	2	35	10.0
Moderate	3	162	46.2
High	4	148	42.2
Very high	5	5	1.4
Total		351	100

Greatest number of students fell under the moderate and high level of ICT literacy categories by constituting 46.2% and 42.2% of entire students.

The next step of analyzes was to assess ICT literacy levels according to school types and Table 9 portrays these findings.

Table 9: ICT literacy levels according to schools.

		ICT Literacy Levels				T
		2	**3**	**4**	**5**	
1	N	12	48	43	1	104
	%	34.30	29.60	29.10	20.00	29.60
2	N	5	41	40	2	88
	%	14.30	25.30	27.00	40.00	25.10
3	N	15	42	28	1	87
	%	42.90	25.90	18.90	20.00	24.80
4	N	0	17	30	1	48
	%	0.00	10.50	20.30	20.00	13.70
5	N	3	14	7	0	24
	%	8.60	8.60	4.70	0.00	6.80
T	N	35	162	148	5	351
	%	100	100	100	100	100

***1:** Sakarya Anatolian High School, **2:** Sakarya Science High School, **3**: Serdivan Farabi Vocational & Technical High School, **4:** Ozel Sahin Private Anatolian High School **5:** Sakarya Sports High School*

Serdivan Farabi Vocational & Technical High School (42.9%) had the highest number of students belonging to “Very Low” category in terms of ICT literacy. Ozel Sahin Private Anatolian High School did not have any students having “Very Low” and “Low” levels of ICT literacy. In the case of Sakarya Anatolian High School the highest number of students had “Moderate” level of ICT literacy. Moreover, in Sakarya Anatolian High School percentage of students having “High” level of ICT literacy was more than other schools’ percentages of the same category (29.1%).

Table 10 displays ICT literacy levels based on TEOG score.

Table 10: ICT literacy levels according to TEOG score.

		ICT literacy levels				T
		2	**3**	**4**	**5**	
1	N	5	9	2	0	16
	%	33.3	14.5	4.0	0.0	12.4
2	N	3	19	10	0	32
	%	20.0	30.6	20.0	0.0	24.8
3	N	1	6	2	0	9
	%	6.7	9.7	4.0	0.0	7.0
4	N	6	28	36	2	72
	%	40.0	45.2	72.0	100	55.8
T	N	15	62	50	2	129
	%	100	100	100	100	100

***1:** TEOG score between (100-200), **2:** TEOG score between (201-300), **3:** TEOG score between (301-400), **4:** TEOG score between (401-500)*

Table 11: ICT literacy levels according to average success score at school.

		ICT literacy levels				T
		2	**3**	**4**	**5**	
1	N	1	2	0	0	3
	%	5.0	2.0	0.0	0.0	1.4
2	N	5	13	7	1	26
	%	25.0	13.1	7.5	33.3	12.0
3	N	1	7	4	0	12
	%	5.0	7.1	4.3	0.0	5.6
4	N	5	12	14	0	32
	%	25.0	12.1	15.1	0.0	14.8
5	N	7	34	39	0	80
	%	35.0	34.3	41.9	0.0	37.0
6	N	1	31	29	2	63
	%	5.0	31.3	31.2	66.7	29.2
T	N	20	99	93	3	216
	%	100	100	100	100	100

***1:** (0-49.99), **2:** (50-59.99), **3:** (60-69.99)**, 4: (**70-79.99), **5:** (80-89.99), **6**: (90-100) (Intervals represent average success score of students)*

Findings of the Table 11 display ICT literacy levels of students based on their average success scores at school. Students having average success scores between 80-89.99 achieved the highest percentage in the category of "High Level" ICT literacy by 41.9% and the same pattern was observed among other groups as well. Since, it can be concluded that ICT literacy levels increased by average success grades of students.

Table 12 shows internet usage` purposes of students which belong to each particular level of ICT literacy.

Table 12: Reasons for using the internet.

	ICT literacy levels				
		2	**3**	**4**	**5**
Social media	**N**	21	107	111	4
	%	60	66.9	75	80
	T	35	160	148	5
Checking the e-mail account	**N**	7	37	42	1
	%	21.2	23	28.6	20
	T	33	161	147	5
Chatting	**N**			0	3
	%	47.1	63.1	72.3	60
	T	34	160	148	5
Playing online games	**N**	12	44	51	1
	%	34.3	27.5	35.2	20
	T	35	160	145	5
Searching for course related activities	**N**	13	64	66	4
	%	37.1	39.8	44.6	80
	T	35	161	148	5
Listening to music	**N**	23	123	115	4
	%	67.6	76.4	77.7	80
	T	34	161	148	5
Watching film/video	**N**	15	107	102	3
	%	42.9	66.5	70.3	60
	T	35	161	145	5
Shopping	**N**	7	35	30	0
	%	20	21.9	20.5	0
	T	35	160	146	6
Research	**N**	18	61	66	2
	%	52.9	37.9	45.2	40
	T	34	161	146	5
Following the news	**N**	12	63	61	3
	%	34.3	39.6	41.2	60
	T	35	159	148	5
Entering to e-learning system of the school	**N**	14	64	58	3
	%	41.2	39.8	39.2	60
	T	34	161	148	5
Entering to e-governent system	**N**	4	12	10	1
	%	11.8	7.5	6.8	20
	T	34	161	146	5
Entering to e-health system	**N**	5	20	20	1
	%	14.3	12.4	13.6	20
	T	35	161	147	5
Joining to chat rooms/live forums	**N**	4	21	19	2
	%	11.8	13.1	12.8	40
	T	34	160	148	5

Based on the data in Table 12, most widely indicated purposes were summarized and a short table showing the priority of internet usage` purposes among different ICT literacy levels was constructed.

Table 13: Major reasons for using the internet.

	ICT literacy levels			
	2	**3**	**4**	**5**
Listening to music	1	1	1	3
Social media	2	2	2	1
Research	3	9	6	3
Chatting	5	4	3	4
Watching film/video	6	3	4	5
Entering to e-learning system of the school	7	7	9	9
Searching for course related activities	8	6	7	2
Playing online games	9		10	
Following the news	10	8	8	6

The first reason for using the internet was "listening to music" for students having low, moderate and high levels of ICT literacy whereas the third reason was "doing research" for students having low and very high level of literacy. However, "doing research for my courses" was identified to be the second reason for students in the fifth group. This data pattern showed that all students used the internet nearly for the same purposes although the priorities of each group altered.

5 CONCLUSIONS

Nowadays based on the fact that ICT literacy level of individuals has been gradually increasing, today's high school students as well as the others have to achieve very high levels of ICT literacy to adapt the dynamic environment and rapidly changing circumstances. This study's findings demonstrate that percentage of owners of smart phones which is 94.8% is extremely high and the smart phone is the most prevalent tool for connecting to the internet. The percentage of internet ownership among households is 80% which also demonstrates a high number. In the matter of ICT literacy, SOIL differs according to school type and the highest scores are achieved by students of the Private High School and Science & Technology High School. Concerning the gender there is no difference between males and females, and also for different levels of study (9^{th}, 10^{th}, and 11^{th}, 12^{th}) ICT literacy score does not express meaningful differences. Nevertheless, ICT literacy score changes according to TEOG score and average success score of students. Another criterion that ICT literacy score does not exhibit difference is the frequency of internet usage. Finally, there is a trend among students for using the internet for similar reasons although the priorities change based on literacy levels.

ICT literacy is the combination of technical literacy skills and information literacy skills. Availability of information, speed of access to the information, information sources and types have changed significantly which changed the way people search, learn and work. In order to be successful it is not enough having only technical capabilities, it is also necessary to have skills of transferring them and using in information society. This is undoubtedly true for students and educators as well.

According to the findings of our study it is observed that there are significant differences in terms of ICT literacy of students among different school types which may be considered as the reflection of poor integration of IT in learning activities and curriculum. For this reason, integrating information and communication technologies and associated mechanisms to the learning processes, supporting research and projects that require usage of these technologies are critically important.

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