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Exploring Secondary School Pupils' ICT Engagement: A Validation Study

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Abstract

This paper regards a validation study aiming to explore secondary school pupils' ICT engagement. A 36-item questionnaire was administered to 246 adolescents (12 - 15 years old) of an experimental school, in Greece. Four factors were extracted: "ICT self-concept", "social exposure to ICT", "interest in computers" and "interest in mobile devices". The factorial structure of the "ICT engagement" questionnaire was revealed. The majority of the pupils expressed strong interest towards both computers and mobile devices. Over 90% of the adolescents believe that the internet is very useful to find practical information, that they can handle mobile phones confidently, and that they know how to download new applications for a mobile phone. Gender was statistically significant correlated to "ICT self-concept" and "social exposure to ICT", where the boys had higher mean values in comparison to girls. The frequency of computer use had positive correlations with the factors "ICT self-concept", "social exposure to ICT" and "interest in computers". It is suggested to describe adolescents' ICT engagement with respect to discrete dimensions. In particular, the dimensions-factors "interest in computers" and "interest in mobile devices" should be distinct when defining concepts related to ICT engagement. The questionnaire is suggested to be used with other adolescent populations of different countries, in order to reveal possible similarities and differences.

Keywords

ICT Engagement, Computers, Mobile Phones, Secondary/High School

1. Introduction

In today's digital knowledge societies, ICT literacy is required in nearly all areas of work and ICT-related com-

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petencies are an essential component of employability (e.g., Drigas et al., 2014). Staying engaged in ICT is essential for ICT literate life-long learners in the digital age. The newly developed construct of "ICT engagement" comprises at least three related dimensions: ICT-related interest, self-concept related to the use of ICT and social exposure to ICT (see Zylka et al., 2015). These three dimensions are briefly explained here. ICT-related interest is conceived as a disposition with feeling-related and value-related components. Feeling-related components refer to feelings such as enjoyment and involvement, whereas value-related components actually advert to the subject's personal development, competence or understanding of problems. Engaged ICT users are therefore assumed to have well-developed long-term interests in the area of ICT as well as favorite ICT topics or types of ICT activities. Interest in ICT is not seen in a purely technology-driven way, it is instead understood as enjoying the use of specific ICT-based products, such as mobile devices, games, or social networks, and acknowledging related benefit. The self-concept related to the use of ICT points toward personal notions about ICT-related abilities facilitating intrinsically motivated behavior. It refers to individual ICT experiences, attitudes and beliefs and as such is a crucial determinant of ICT-related behavior (Janneck et al., 2013). Social exposure to ICT indicates the extent to which students make ICT a subject of interpersonal communication and interaction, for instance, to talk about the latest smartphone features or about problems with their computers at home. Zylka's et al. (2015) recent study with pupils aged 14-17 years old, found that ICT engagement integrates the above three distinct dimensions. This paper is a validation study aiming to explore secondary school pupils' ICT engagement, using a different sample of adolescent pupils in another country.

2. Objectives of the Study

The research objectives were:

- To reveal the factorial structure of the "ICT engagement" questionnaire (see Zylka et al., 2015) and the relationships among factors regarding pupils' views.
- To investigate the impact of pupils' individual characteristics (gender, age, frequency of computer use) on the "ICT engagement" factors.

3. Methodology

3.1. Sample

The sample consisted of 246 adolescent pupils of an experimental secondary/high school in Piraeus, in Greece. Demographic and individual characteristics of the sample (grade and age group, gender, frequency of computer use at home) are shown in **Table 1**. All pupils have access to a computer at home. The age of pupils ranged from 12 to 15 years old. Regarding computer use at home, 53.7% of the pupils reported they make computer use "daily", while around 33% use the computer "2 - 4 times per week". There were no gender differences regarding the frequency of computer use at home. The questionnaire was administered during the academic year 2015-2016. The responses were anonymous and the pupils were assured that there was not right or wrong answer.

3.2. The Research Instrument

Data were collected by the use of a questionnaire, which consisted of two sections. Section A involved statements regarding pupils' demographic and individual characteristics (gender, year of study, age, access to com-

Table 1. Demographic and individual characteristics of the sample (246 pupils).

Age group	Gender
12 - 13 years old (or year 7) (41.9%) 13 - 14 years old (or year 8) (32.1%) 14 - 15 years old (or year 9) (26%)	Male (55.7%) Female (44.3%)
Frequency of computer use at home	
Less than once per month (4.9%) Monthly (2 - 4 times per month) (8.5%) Weekly (2 - 4 times per week) (32.9%) Every day (53.7%)	

puter at home, frequency of computer use at home). Section B involved 36 statements/items aiming to investigate pupils' ICT engagement. All statements were taken from the recent study of Zylka et al. (2015). Their study separated the 36 items into five groups/ factors, as follows: their first group/factor involved eight items (S1, S2, S3, S4, S5, S6, S7, S8) related to positive ICT self-concept, the second group/ factor involved three statements (S9, S10, S11) related to negative ICT self-concept, the third group involved twelve items (S12 to S23) related to social exposure to ICT, the fourth group involved six items (S24 to S29) related to interest in computers, and the fifth group involved seven items (S30 to S36) related to interest in mobile devices. The reliability of the questionnaire used was satisfactory. More specifically, the Cronbach's a was 0.88, 0.87, 0.77, 0.73 for the factors positive ICT self-concept, social exposure to ICT, interest in mobile devices and interest in computers respectively (only the negative ICT self-concept had a moderate internal consistency of 0.61). In the questionnaire, the 36 items were presented in mixed order, and the pupils were asked to rate their beliefs on a 4-point Likert-type scale (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree). The items S9, S10, and S11 were reversed from negative to positive wording.

3.3. Data Analysis

The statistical software SPSS version 20.0 (2011) was used for managing the data and conducting the statistical analyses (descriptive statistics, factor analysis, correlation analysis). Monte Carlo PCA for Parallel analysis (Watkins, 2000) was used to conduct Parallel analysis.

4. Results

4.1. Descriptive Measures for Pupils' Views and Factorial Structure of the Questionnaire

To explore pupils' views on ICT engagement, a descriptive analysis was performed. **Table 2** shows pupils' response rates (%) on the 36 items of the questionnaire (n = 246 pupils). The last column of the table has added together the percentages of those who "agree" and "strongly agree". The majority of the pupils showed strong interest towards both computers and mobile devices. Indicatively, over 90% of the sample, believe that "the internet is very useful to find practical information" (for S29: 97.6%), that they "know how to download new applications for a mobile phone from the internet" (for S34: 94.7%), they think they can handle mobile phones confidently (for S35: 92.7%), and they also believe they get on easily with their home computer (for S4: 91.1%).

An exploratory factor analysis was performed, using Principal Axis Factoring method accompanied by the Oblimin Factor rotation method, in order to investigate the factorial validity of the 36 item questionnaire. KMO coefficient of sampling adequacy, 0.86, was satisfactory. Seven factors show an eigen-value greater than one (Kaiser, 1960), while the screen plot and the parallel analysis results support a four factor solution which we retain for interpretation. The first factor (F1) was labeled "ICT self-concept", the second factor (F2) was labeled "Social exposure to ICT", the third factor (F3) was labeled "Interest in computers" and the fourth factor (F4) was labeled "Interest in mobile devices". **Table 3** displays the loadings and the Chronbach-a coefficient for internal consistency for each factor (F1 to F4). All factors show an acceptable internal consistency: Chronbach-a coefficient ranged from 0.7 to 0.85. Loadings with an absolute value > 0.4 appear in **Table 3**. Ten items, show loadings with absolute value > 0.4 on the first factor labeled as "ICT self-concept". Only the item S4 ("With my computer at home, I get on easily") had a loading <0.4, but its meaning confirms the relation with the first factor. For the second and the third factor labeled "Social exposure to ICT" and "Interest in computers" respectively, six items show loadings over the cut-off 0.4. The fourth factor labeled "Interest in mobile devices" was loaded by 7 items. Seven of the 36 items show loadings under 0.4 and did not load on any factor. None of the 36 items was complex. Correlations among the "ICT engagement" factors were positive, as expected; we found small to mediocre significant correlation coefficients among factors ($p < 0.05$) (**Table 4**).

4.2. Impact of Pupils' Individual Characteristics (Gender, Age, Frequency of Computer Use) on the "ICT Engagement" Factors

In order to investigate the impact of specific individual characteristics (gender, age, frequency of computer use) on the "ICT engagement" factors extracted above (F1, F2, F3 and F4), an estimation of correlation coefficients was conducted (see **Table 4**). **Table 4** displays the correlations among ICT-engagement factors and the frequency of computer use. Positive correlations were found between the frequency of computer use and each of

Table 2. Pupils' response rates (%) on the 36 items (n = 246 pupils).

	Strongly disagree	Disagree	Agree	Strongly agree	Agree & strongly agree
S29. The internet is very useful to find practical information	2.0	0.4	26.0	71.5	97.6
S34. I know how to download new apps for a mobile phone from the internet	1.6	3.7	16.7	78.0	94.7
S35. I think that I can handle mobile phones confidently	3.7	3.7	19.9	72.8	92.7
S4. With my computer at home, I get on easily	2.8	6.1	35.8	55.3	91.1
S27. It is important for me to be able to work with a computer (e.g. to find information on the internet)	2.8	8.1	42.7	46.3	89.0
S36. I think that I can handle tablet computers (e.g. iPad) confidently	2.0	8.9	30.5	58.5	89.0
S30. I am interested in tablet computers (e.g. iPad)	2.0	11.0	35.4	51.6	87.0
S1. I have the notion that I can handle computers confidently	1.6	13.4	43.1	41.9	85.0
S26. The computer helps me a lot, e.g., when doing my homework	6.1	8.9	37.4	47.6	85.0
S32. I am interested in the latest mobile phones and smartphones	6.1	10.6	30.1	53.3	83.3
S5. I get on with computers that I normally never use	6.1	13.4	47.6	32.9	80.5
S6. It's easy for me to get familiar with new computer programs	7.3	16.3	38.2	38.2	76.4
S8. I can handle the majority of my computer programs confidently	6.1	17.9	41.9	34.1	76.0
S28. Working with computers brings me a lot of fun	4.9	20.7	44.3	30.1	74.4
S31. I am always curious when new smartphones are released	7.3	18.3	32.5	41.9	74.4
S33. I easily forget about the time, when I am dealing with a computer	4.9	20.7	29.7	44.7	74.4
S7. I am able to install new programs on my computer without help	7.7	20.7	34.1	37.4	71.5
S25. I would like it, if I had to do more things on a computer	7.7	20.7	32.5	39.0	71.5
S14. I discuss with friends when I have a question about my computer or my mobile phone	8.1	24.0	52.0	15.9	67.9
S3. I think that most of the computer programs are easy to understand	5.7	26.8	43.9	23.6	67.5
S13. I am very interested when friends show me new things on the computer	10.2	22.8	45.1	22.0	67.1
S24. I prefer doing my homework on a computer	11.8	21.1	38.2	28.9	67.1
S16. On internet platforms, I exchange views with others on computers, videogames or mobile phones	10.6	27.2	36.2	26.0	62.2
S15. To learn news about computer or videogames, I like to talk with my friends	15.0	28.5	41.1	15.4	56.5
S22. I like dealing with computer topics	13.8	30.5	31.7	24.0	55.7
S2. Given appropriate time, I can solve computer problems on my own	14.6	30.5	41.1	13.8	54.9
S12. I like to talk to my friends about recent developments in computers	12.2	35.8	43.1	8.9	52.0
S23. I am interested in new features of new program versions	20.3	30.9	32.1	16.7	48.8
S17. I discuss with others in internet platforms, how to solve computer problems	28.0	38.2	28.0	5.7	33.7
S11. If I am faced with a computer problem, I often don't know what to do	23.6	43.9	24.0	8.5	32.5
S10. If I have problems operating my mobile phone, I can't solve them	28.9	43.5	22.4	5.3	27.6
S9. If my computer doesn't work, I soon get tired of dealing with the computer	35.0	43.9	15.9	5.3	21.1
S20. I am or I was participating with schoolmates in a computer project group	55.7	27.2	4.9	12.2	17.1
S18. Sometimes I go to LAN-parties	59.3	25.2	10.2	5.3	15.4
S19. I go to computer fairs with friends	52.4	33.7	11.8	2.0	13.8
S21. I am or was a member in a union of computer players	65.4	21.5	8.5	4.5	13.0

Table 3. Factor loadings per item (36 items: S1 - S36).

	Factors			
	F1	F2	F3	F4
S11. If I am faced with a computer problem, I often don't know what to do	−0.579			
S2. Given appropriate time, I can solve computer problems on my own	0.572			
S8. I can handle the majority of my computer programs confidently	0.554			
S7. I am able to install new programs on my computer without help	0.540			
S6. It's easy for me to get familiar with new computer programs	0.538			
S1. I have the notion that I can handle computers confidently	0.513			
S5. I get on with computers that I normally never use	0.489			
S3. I think that most of the computer programs are easy to understand	0.472			
S9. If my computer doesn't work, I soon get tired of dealing with the computer	−0.433			
S10. If I have problems operating my mobile phone, I can't solve them	−0.414			
S4. With my computer at home, I get on easily				
S19. I go to computer fairs with friends		0.726		
S18. Sometimes I go to LAN-parties		0.721		
S12. I like to talk to my friends about recent developments in computers		0.605		
S22. I like dealing with computer topics		0.531		
S21. I member or was a member in a union of computer players		0.517		
S17. I discuss with others in internet platforms, how to solve computer problems		0.477		
S15. To learn news about computer or videogames, I like to talk with my friends				
S23. I am interested in new features of new program versions				
S20. I am or was participating with schoolmates in a computer project group				
S28. Working with computers brings me a lot of fun			0.566	
S27. It is important for me to be able to work with a computer (e.g. to find information on the internet)			0.548	
S26. The computer helps me a lot, e.g., when doing my homework			0.520	
S25. I would like it, if I had to do more things on a computer			0.477	
S13. I am very interested when friends show me new things on the computer			0.419	
S24. I prefer doing my homework on a computer			0.412	
S33. I easily forget about the time, when I am dealing with a computer				
S14. I discuss with friends when I have a question about my computer or my mobile phone				
S29. The internet is very useful to find practical information				
S32. I am interested in the latest mobile phones and smartphones				0.794
S36. I think that I can handle tablet computers (e.g. iPad) confidently				0.699
S35. I think that I can handle mobile phones confidently				0.643
S30. I am interested in tablet computers (e.g. iPad)				0.586
S31. I am always curious when new smartphones are released				0.572
S34. I know how to download new apps for a mobile phone from the internet				0.534
S16. On internet platforms, I exchange views with others on computers, videogames or mobile phones				0.429
Cronbach-a	0.85	0.81	0.7	0.81

All responses ranged from 1 (strongly disagree) to 4 (strongly agree). Factor 1 (F1): "ICT self-concept", Factor 2 (F2): "Social exposure to ICT", Factor 3 (F3): "Interest in computers", Factor 4 (F4): "Interest in mobile devices". Extraction Method: Principal Axis Factoring. Rotation Method: Oblimin with Kaiser Normalization. a. Rotation converged in 16 iterations.

Table 4. Correlations among ICT-engagement factors and the frequency of computer use.

	Frequency of computer use	ICT self-concept	Social exposure to ICT	Interest in computers
ICT self-concept	0.293**			
Social exposure to ICT	0.156*	0.333**		
Interest in computers	0.141*	0.255**	0.329**	
Interest in mobile devices	0.069	0.294**	0.126*	0.355**

**Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed).

the factors "ICT self-concept", "social exposure to ICT" and "interest in computers". The factor "interest in mobile devices" was not correlated to the frequency of computer use.

A series of two-way analyses of variances were performed, each of which had as dependent variable the factors (F1 to F4) expressed by factor scores produced from factor analysis, and as independent variables the gender, the grade (i.e., pupils' age group) (see **Table 5**). There was no interaction effect between gender and grade. It was found that gender was statistically significant correlated to "ICT self-concept" ($F(1,240) = 6.1$, $p = 0.014$) and "social exposure to ICT" ($F(1,240) = 33.3$, $p < 0.001$), where the boys had higher mean values in comparison to girls (see **Table 5**). There were no statistical significant correlations among pupils' grade (or age-group) and the factors; there was only a small increase of mean value by grade in factors F1 and F2, but with no statistical significance (**Table 5**).

5. Discussion and Conclusions

This was a validation study aiming to explore secondary school pupils' ICT engagement. This study adds to the body of empirical evidence regarding the construct of "ICT engagement". With regard to the first objective (to reveal the factorial structure of the ICT engagement questionnaire and the relationships among factors regarding pupils' views), the analysis demonstrated that there were four factors in the 36-item questionnaire: "ICT self-concept" (Factor 1 or F1), "social exposure to ICT" (Factor 2 or F2), "interest in computers" (Factor 3 or F3) and "interest in mobile devices" (Factor 4 or F4) (**Table 3**). This reveals the factorial structure of the questionnaire and indicates that literature-originated constructs of "ICT engagement" do not differ between adolescent populations of different countries (e.g., adolescents aged 14-17 years old in Germany versus 12-15 years old in Greece). There was a strong agreement with the factors proposed by Zylka et al. (2015)—whose questionnaire was used in this study. In particular, the first factor of this study (F1: "ICT self-concept") was exactly the same (i.e., the same items) with two factors in Zylka's et al. (2015) study, those related to positive and negative ICT self-concept; the difference was that in this study the items emerged as only one factor. The other factors which have emerged from this study (F2, F3 and F4) included to a great extent the same items as those proposed by Zylka et al. (2015); corresponding to the factors "social exposure to ICT", "interest in computers" and "interest in mobile devices", respectively. As revealed in this study and as suggested by Zylka et al. (2015), the factors "interest in computers" and "interest in mobile devices" should be distinct, when defining concepts related to ICT. The factors extracted in our study had small to medium/ mediocre correlations, suggesting that the factors were distinct in the current sample. The descriptive analysis revealed that there is similarity of pupils' beliefs-views across cultures. Regarding pupils' views, the majority of them expressed strong interest towards both computers and mobile devices. Over 90% of the pupils believe that the internet is very useful to find practical information, that they can handle mobile phones confidently, and that they know how to download new applications for a mobile phone (from the internet).

With regard to the second objective, to investigate the impact of pupils' individual characteristics (gender, age, frequency of computer use) on the ICT engagement factors, we found that: (a) gender was statistically significant correlated to "ICT self-concept" (Factor F1) and to "social exposure to ICT" (Factor F2), where the boys had higher mean values in comparison to girls, (b) there was no impact of pupils' grade (or age group) on the ICT engagement factors, and (c) the frequency of computer use had positive correlations with the factors "ICT self-concept", "social exposure to ICT" and "interest in computers" (but not with the "interest in mobile devices"). Finding (a) above, is in agreement with earlier studies which showed that adolescent boys report higher confidence (or self-efficacy) with ICT/computers, in comparison to adolescent girls (Nikolopoulou, 2009) and

Table 5. "ICT engagement" factor scores by gender and grade.

	grade (age group)						gender			
	12 - 13		13 - 14		14 - 15		Male		Female	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
ICT self-concept	−0.132a	0.956	0.090a	0.928	0.101a	0.831	0.150a	0.908	−0.189b	0.903
social exposure to ICT	−0.052a	0.864	−0.015a	0.875	0.102a	1.057	0.278a	0.910	−0.349b	0.809
Interest in computers	0.084a	0.797	−0.155a	0.993	0.055a	0.905	−0.005a	0.906	0.006a	0.883
Interest in mobile devices	0.078a	0.837	−0.192a	1.123	0.111a	0.774	−0.026a	0.946	0.033a	0.912

Note: Values in the same row and subtable not sharing the same subscript are significantly different at $p < 0.05$ in the two-sided test of equality for column means. Cells with no subscript are not included in the test. Tests assume equal variances. Tests are adjusted for all pairwise comparisons within a row of each innermost subtable using the Bonferroni correction.

they discuss with their friends things about computers. The finding that there was no impact of pupils' grade (or age group) on the ICT engagement factors was probably due to the small range of ages (i.e., 12 to 15 years old). In case we compared adolescents with young University students the findings might be different. Finding (c) above, was expected as the higher the frequency of computer use (i.e., experience with computers) results in higher confidence with computers and higher interest towards computers as well. The fact that the frequency of computer use was not significant correlated to the "interest in mobile devices", makes stronger the argument/ suggestion that the dimensions-factors "interest in computers" and "interest in mobile devices" should be distinct when defining concepts related to ICT.

The findings of this study have implications for secondary school teachers and researchers. Teachers, for example, need to be aware of pupils' views on ICT engagement. In particular, information technology teachers should be aware and apply appropriate methods/ activities in order to increase girls' confidence regarding computer use. Limitations of this study include the narrow age-range of pupils and the origin of the sample (from only one city). Pupils' constructs and their related views can be further explored with larger and more diverse populations. Investigating pupils' views regarding ICT engagement is not an end by itself. Initially, it is considered as appropriate to describe adolescents' ICT engagement with respect to discrete dimensions, as those revealed by the questionnaire. We suggest for the questionnaire to be used with different adolescent and other target populations (e.g., young University students), in other countries, in order to reveal possible similarities and differences. Further new technology/ICT developments, which cannot easily be foreseen, will appear in the future. Because of the rapidly changing digital media and technology, the construct of "ICT engagement" will need to be measured and defined throughout the time.

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