High school pupils' attitudes and self-efficacy of using mobile devices

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Abstract. This paper regards a study aiming to investigate junior high school pupils' attitudes and self-efficacy of using mobile devices. A 25-item questionnaire was administered to 260 pupils aged 12-15 years old, in Greece. Pupils' attitudes were positive, and four factors were extracted, "perceived usefulness", "affection", "perceived control" and "behaviour". Regarding pupils' self-efficacy, one factor was revealed and this was significantly correlated with all attitude factors. Most of the pupils (over 87%) expressed high self-efficacy in using mobile devices. Higher self-efficacy was linked to positive perspectives and feelings, to greater willingness to use mobile devices, and to favorable perceptions towards their independent control. It is suggested to describe pupils' attitudes of using mobile devices with respect to discrete dimensions. Gender or age differences in attitudes were very small. The mobile devices attitudes and self-efficacy questionnaire is suggested to be used with other adolescent populations of different countries, in order to reveal possible similarities and differences.

Keywords: mobile devices, attitudes, self-efficacy, high school students

Introduction

Mobile technologies, such as mobile phones, smart-phones, tablets (tablet PCs), laptops and personal digital assistants (PDAs) have attracted the attention of the educators and researchers (e.g., Motiwalla, 2007; Chang, Chen & Hsu, 2011; Wu et al., 2012; Jones, Scanlon & Clough, 2013; Tay, 2016; Heflin, Shewmaker & Nguyen, 2017) to consider its pedagogical implications. Mobile or portable devices connect their users to a mobile web with multiple applications, are light enough, and might influence how learners learn. Examples of their uses include communication, casual entertainment (watching and sharing short movies, photo albums), navigation, capturing objects and events (usually as still images) and accessing web-based information as need arises. In the 2010s, most handheld devices are also equipped with Wi-Fi, Bluetooth, near field communication capabilities, as well as Global Positioning System (GPS) capabilities. Evidence reports on the high penetration rate of mobile devices and their high popularity among the school-age population, particularly in the teenage years (Rau, Gao & Wu, 2008; Merchant, 2012).

The educational use of the mobile devices (MD) is often referred to as mobile learning, with the focus on facilitating and extending the reach of the teaching and learning (Attewell, 2005; Vavoula et al., 2009; Merchant, 2012; Wu et al., 2012; Jones et al., 2013) such as knowledge construction, information collection and exchange, collaborative learning (Hine, Rentoul, & Specht, 2004), independent learning (Bull & Reid, 2004) and lifelong learning (Attewell & Savill-Smith, 2004). For example, in Vavoula's et al. (2009) study, pupils used mobile phones for inquiry-based learning to allow learners to gather information during school visits to museums, while in Jones' et al. (2013) study 14-15 years old pupils used web-based software to support science inquiry learning in a semiformal context.

Learners' attitudes (e.g. Oral, 2008; Tsai, Lin & Tsai, 2001) and self-efficacy (e.g. Chu & Tsai, 2009; Tsai & Tsai, 2003; 2010; Wang & Wang, 2008) towards computers, internet and mobile devices influence their usage. Various factors may influence the usage and the effectiveness of mobile learning (Judd, Kennedy & Cropper, 2010; Tsai, Tsai & Hwang, 2010; Yang, 2012; Briz-Ponce et al., 2017). Pupils' computer self-efficacy and attitudes were basic factors which determined the success of pupils' participation in mobile learning. For example, Tsai and Tsai (2003) found that pupils with higher internet self-efficacy may accomplish their tasks in a better way than pupils with lower internet self-efficacy in an internet-based learning task.

Pupils' attitudes, perceptions and self-efficacy towards using mobile devices are issues to be investigated by researchers. Such an investigation is important because the attitudes and self-efficacy towards using mobile devices are factors that are expected to affect pupils' motivation, interests and performance in mobile based environments. Pupils' attitudes towards using mobile devices may influence the motivation and the interest that pupils apply to using mobile devices, and this, in turn, may affect their performance in mobile-based learning environments. The purpose of this study was to investigate junior high school pupils' attitudes and perceived self-efficacy of using mobile devices.

Literature review

This section initially discusses the theoretical framework regarding pupils' attitudes and self-efficacy (their psychological definitions, their evolution and their significance for the educational research), since these concepts are of interest in this study.

An attitude refers to one's positive or negative judgment about a concrete subject. Ajzen (1988) described an attitude as a predisposition to respond favorably or unfavorably to an object, person, or event. As implied in this definition, attitudes possess cognitive (beliefs, knowledge, and expectations), affective (motivational and emotional), and performance (behaviour or actions) components. Attitudes towards ICT usage have been defined as a person's general evaluation or feeling towards ICT and specific computer and internet related activities (Smith, Caputi & Rawstone, 2000). The learner attitude toward computer measures a person's capabilities in effective learning. Garland and Noyes (2005) indicated that in the educational context, confidence should lead to more positive attitudes toward computers and the internet, and this will enhance learning and associated activities. Attitude, consists of various dimensions, such as perceived usefulness, computer confidence, anxiety and liking. Previous models, like TPB and TRA (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), presented the participants' attitudes towards various aspects of computer usage (affective, perceived usefulness, perceived control and behavioural intention).

Social cognitive theory provided a theoretical foundation for the concept of self-efficacy. Self-efficacy refers to an individual's belief in his/her capability to successfully perform tasks of a particular domain (Bandura, 1977) and this belief influences his/her choice of activities, how much effort he/she will expend, and how long he/she will sustain effort in dealing with stressful situations (Bandura, 1993). The stronger the pupils' beliefs in their efficacy, the more occupational options they consider possible, the greater the interests they show in them, the better they prepare themselves educationally for different career pursuits, and the greater their persistence and success in their academic coursework (Lent, Brown & Hackett, 1994). A concept developed in the field of social psychology, self-efficacy, has been adapted to many different fields and employed in various disciplines: perceived computer self-efficacy and perceived internet self-efficacy are examples of these fields (Kaya & Durmuş, 2010). Computer self-efficacy (Murphy, Coover & Owen, 1989) refers to

individual's self-efficacy specifically toward using the computers. Similarly, internet self-efficacy has been defined as individuals' perceptions about their own abilities toward using the internet (Tsai & Tsai, 2003; 2010).

Learners' attitudes and self-efficacy regarding information technology influence their usage, and as a consequence might influence how they learn and their learning performance (Tsai & Tsai, 2003; Susskind, 2008; Wu & Tsai, 2006). Previous studies revealed that the attitude towards a new technology plays an important role in its acceptance and usage (Peng, Tsai, & Wu, 2006). For example, pupils' attitudes may influence their motivation to learn in a mobile learning environment. In turn, the motivational orientation of pupils (e.g., when using mobile communication) has a significant impact on their learning performance (Rau et al., 2008). Students' and pupils' perceived self-efficacy in utilizing technology-related (such as computer, the internet, mobile devices) tasks has received growing attention among educational researchers (Tsai & Tsai, 2003, 2010; Wang & Wu, 2008; Wang & Wang, 2008; Tsai et al., 2010). For example, it was been reported that higher levels of computer self-efficacy leads to higher levels of behavioural intention and information technology usage (Cheon et al., 2012). Both attitudes and self-efficacy are important variables in educational research.

Pupils' attitudes and self-efficacy of using mobile devices have not been sufficiently investigated to date, but relevant research is gradually growing. Wang and Wang (2008) developed a mobile computing self-efficacy instrument to explore learners' self-efficacy regarding mobile computers, such as PDAs and handheld computers, and found that learners with higher self-efficacy in terms of mobile computers have favorable perspectives towards using them.

Tsai et al. (2010) investigated elementary school pupils' attitudes and self-efficacy of using PDAs. They found that, in general, pupils had positive attitudes and adequate self-efficacy, while gender differences existed only in pupils' self-efficacy of using PDAs for internet related functions (the boys were significantly more confident than the girls).

Poll (2014) examined elementary and high school pupils' attitudes towards mobile devices. Across all grade levels, about one third of the sample reported they were "early adopters", among the first to try a new electronic device or gadget, while over 50% of the sample would like to use mobile devices more often in the classroom. Pupils at all grade levels felt that tablets make learning more fun, help them to do better in class, and to learn in a way that is best for them. Three quarters of high school pupils said they know more about technology than their teachers, and also boys and girls shared similar attitudes.

A popular and attractive for adolescents mobile devices feature/function is the wireless and instant access to the internet: pupils engage in a range of online activities such as internet surfing, managing e-mail, playing games and communicating via social network sites (Joyce-Gibbons et al., 2017). Thus, internet self-efficacy of using mobile devices is an issue under investigation when exploring attitudes and self-efficacy of using mobile devices. Wu and Tsai (2006) found that pupils' attitudes toward the internet were correlated highly with their internet self-efficacy: learners with higher information technology self-efficacy may have more positive attitudes toward information technology.

Cheung and Hew (2009), in their review study, indicated that mobile handheld devices were most commonly used by students as communication and multimedia access tools. Students had positive attitudes and reported satisfaction towards using mobile devices (in particular, PDAs and mobile phones).

Yang (2012) investigated the attitudes and self-efficacy of using mobile learning devices for college students in a language class by employing task-based instruction and found that most students had positive attitudes towards mobile learning. Cheon et al. (2012) investigated college students' mobile learning readiness. Students' confidence with mobile devices, usefulness, and ease of use were found to affect their attitudes for adopting mobile learning. Students' beliefs influence their intention to adopt mobile devices in their coursework. Hsu (2012) studied the effectiveness of portable devices for university students studying English. His results indicated that students had better academic performance in learning English vocabulary, as well as positive attitudes towards learning English. Kim et al. (2013) investigated University students' perceptions towards the use of mobile devices to create personalized learning experiences outside the classroom. The participants had generally positive attitudes (views and feelings) towards the use of MD for learning, they demonstrated ability and willingness to use their MD in projects, but they also identified some barriers (e.g. small screen size, keyboard complexity).

A recent research synthesis regarding the effects of integrating mobile devices into education on students' learning performance (Sung, Chang & Liu, 2016), indicated that researchers mostly studied students in higher education, while most research has used mobile devices primarily as a reinforcement tool to stimulate motivation and strengthen engagement. The effect size was larger for using MD in the outdoors and informal locations (rather than in classrooms). As each student has his/her own mobile device, the MD "individuality" combined with wireless communication enabled more accessible self-paced and self-directed study.

Hur et al. (2015) investigated how student teachers perceive mobile device integration in classrooms. The results showed that 72% of variances in students' intention to use mobile devices were explained by perceived usefulness and self-efficacy for technology integration jointly, while perceived usefulness was the strongest predictor. Baek, Zhang and Yun (2017) investigated teachers' attitudes towards mobile learning and indicated that female teachers had more positive attitudes than males.

Research questions of the study

The study asked the following research questions:

- What are the pupils' attitudes of using mobile devices?
- What is the pupils' self-efficacy of using mobile devices?
- Is there any significant relationship between pupils' MD attitudes and their MD self-efficacy?
- Is there any significant difference in pupils' MD attitudes and MD self-efficacy with regard to their individual characteristics (gender, age group, and frequency of computer use)?

Methodology

Sample

The sample consisted of 260 junior high school 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.

Table 1. Demographic and individual characteristics of the sample (260 pupils)

Age group	Gender
12 – 13 years old (or year 7) (38.1%)	Male (51.2%)
13 – 14 years old (or year 8) (36.5%)	Female (48.8%)
14 – 15 years old (or year 9) (25.4%)	
Frequency of computer use at home	
Less than once per month (6.2%)	
Monthly (2-4 times per month) (13.5%)	
Weekly (2-4 times per week) (26.5%)	
Every day (daily) (53.8%)	

All pupils have access to a computer at home and a mobile phone, while 71.5% of the sample has also a tablet. The age of pupils ranged from 12 to 15 years old. Regarding the frequency of computer use at home, 53.8% of the pupils reported "daily" computer use, while around 26.5% reported computer use "2-4 times per week". There were no gender differences regarding the frequency of computer use at home. However, there was a significant difference in relation to the age group, for the category "daily": the chi-square test (χ^2(df=6, N=260)=28.26, $p<0.01$) showed that 13-14 year old pupils reported significantly more frequent use of mobile devises in comparison to the other age groups (39.4%, 72.6% and 48.5% for age groups 12-13, 13-14 and 14-15, respectively). The questionnaire was administered at the beginning of the academic year 2016-2017. The responses were anonymous and the pupils were assured that there was not right or wrong answer.

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, access to a computer and a tablet at home, frequency of computer use at home). Section B involved 25 statements/items aiming to investigate pupils' attitudes and self-efficacy of using mobile devices. All statements were taken and slightly adapted from the study of Tsai et al. (2010), who developed two instruments to assess pupils' attitudes and their self-efficacy of using PDAs: the PDA attitudes survey and the PDA self-efficacy survey (these two instruments were developed with satisfactory validity and reliability measures). In this study, the authors used the same items, rewriting the term "PDA" as "mobile device (MD)". For example, the item "a PDA can help me to attain more ideas" was rewritten as "a mobile device can help me to attain more ideas".

Pupils' attitudes towards using mobile devices were assessed by 16 items (S1-S16) separated into four scales/ factors as follows: the first factor involved six items (S1, S2, S3, S4, S5, S6) related to "perceived usefulness", the second factor involved four statements (S7, S8, S9, S10) related to "affection", the third factor involved three items (S11, S12, S13) related to "behaviour", and the fourth factor involved three items (S14, S15, S16) related to "perceived control". The items stated in reverse (S7, S8, S9, S10, S14 and S15) were scored in a reverse way. That is, pupils with higher average scores on the scales were more likely to hold more positive attitudes towards using mobile devices; on the contrary, those with lower average scores, may express more negative attitudes towards using mobile devices. The reliability of the first 16 items of the questionnaire was satisfactory (in Tsai's et al. study, overall Cronbach-a = 0.83).

Pupils' self-efficacy of using mobile devices was assessed by 9 items (S17-S25) separated into two scales/ groups as follows: the first group involved five items (S17, S18, S19, S20, S21)

related to internet self-efficacy of using mobile devices, while the second group involved four statements (S22, S23, S24, S25) related to general mobile devices self-efficacy. The reliability of the self-efficacy items of the questionnaire was satisfactory (in Tsai's et al. study, overall Cronbach-a = 0.89). In the attitudes and self-efficacy questionnaire, the 25 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).

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.

Results

Descriptive measures for pupils' attitudes, self-efficacy and factorial structure of the questionnaire

To explore pupils' attitudes and self-efficacy of using mobile devices, a descriptive analysis was performed. Table 2 shows pupils' response rates (%) on the 25 items of the questionnaire (n=260 pupils). The last column of the Table has added together the percentages of those who "agree" and "strongly agree". The items indicating pupils' mobile devices (MD) self-efficacy had the highest percentages of agreement. The majority of the pupils expressed high self-efficacy of using mobile devices. More specifically, over 87.3% of the sample, "agree and strongly agree" with all nine items (S17-S25) which correspond to MD self-efficacy. For example, they reported they "can copy content from the internet and paste it into a document using a mobile device" (for S18: 96.5%), they "can key in a website address to enter the website using a mobile device" (for S19: 94.6%).

Pupils' MD attitudes were also positive. For example, items with high percentage of agreement were: "If I have the opportunity to use a mobile device, I am willing to take it" (for S12: 88.8%), "A mobile device can allows me to do more interesting and imaginative work" (for S6: 85%), and "A mobile device is helpful for my learning" (for S2: 85%). The items S15, S10, S14, S7, S9 and S8 (which appear at the bottom of Table 2) are those stated in reverse: this means, that positive attitudes are expressed via the "strongly disagree" and "disagree".

An exploratory factor analysis was performed, using Principal Axis Factoring method accompanied by the Oblimin factor method, in order to investigate the factorial validity of the 16-item attitudes questionnaire. In this analysis, the negative worded items (S15, S10, S14, S7, S9 and S8) were scored in a reverse way, in order to maintain the correspondence between high values and positive attitudes. KMO coefficient of sampling adequacy, 0.83, was satisfactory. The scree plot (Figure 1) and the parallel analysis results support a four factor solution which we retain for interpretation. The first factor (F1) was labeled "perceived usefulness", the second factor (F2) was labeled "affection", the third factor (F3) was labelled "perceived control" and the fourth factor (F4) was labelled "behaviour". Table 3 displays the loadings and the Cronbach-α coefficient for internal consistency for each factor (F1 to F4). The loading of the item S6 does not appear in the Table because it was lower than 0.4 (it was .27). All factors show an acceptable internal consistency: Cronbach-α coefficient ranged from 0.69 to 0.79.

Table 2. Pupils' response rates (%) on the 25 items (n=260 pupils)

Items	strongly disagree	disagree	agree	strongly agree	agree & strongly agree
S18. I think I can copy content from the internet and paste it into a document using a mobile device	1.2	2.3	18.5	78.1	96.5
S19. I think I can key in a website address to enter the website using a mobile device	1.2	4.2	21.9	72.7	94.6
S23. I think I can click the link or button to enter a new step using a mobile device	1.5	4.6	22.3	71.5	93.8
S21. I think I know how to use a Web homepage like 'Google' using a mobile device	2.3	5.8	14.2	77.7	91.9
S22. I think I can read the content on the screen using a mobile device	3.1	6.2	16.2	74.6	90.8
S24. I think I can know where I am using a mobile device	2.7	7.3	28.5	61.5	90.0
S17. I think I can download a figure from the internet using a mobile device	4.6	5.4	23.8	66.2	90.0
S12. If I have the opportunity to use a mobile device, I am willing to take it	5.0	6.2	38.1	50.8	88.8
S25. I think I can enter words into a document using a mobile device	3.8	7.3	20.0	68.8	88.8
S20. I think I can check a hyperlink to enter another website using a mobile device	3.1	9.6	23.8	63.5	87.3
S6. A mobile device can allows me to do more interesting and imaginative work	6.2	8.8	41.5	43.5	85.0
S2. A mobile device is helpful for my learning	5.4	9.6	54.2	30.8	85.0
S11. I hope to have regular time to use a mobile device at school	6.5	9.6	29.6	54.2	83.8
S16. I can use a mobile device independently, without the assistance of others	8.5	9.2	28.5	53.8	82.3
S1. A mobile device can help me to attain more ideas	6.9	11.2	56.2	25.8	81.9
S13. I hope to apply a mobile device in various learning activities	5.0	14.2	43.1	37.7	80.8
S5. A mobile device provides me with another way to learn	5.0	16.2	45.8	33.1	78.8
S3. The materials are clarified when using a mobile device	6.9	26.5	49.2	17.3	66.5
S4. A mobile device can enhance my desire to learn	10.8	25.9	37.1	26.3	63.3
S15. I need someone to tell me the best way to use a mobile device	36.5	29.2	23.1	11.2	34.2
S10. I am not good at talking about the experiences of using a mobile device	36.2	37.7	16.9	9.2	26.2
S14. I need an experienced person nearby when I use a mobile device	42.7	37.7	12.7	6.9	19.6
S7. I hesitate to use a mobile device because of my fear of making mistakes I can't correct	51.9	31.2	10.8	6.2	16.9
S9. I feel bored using a mobile device	57.7	26.2	11.9	4.2	16.2
S8. A mobile device makes me feel uncomfortable	65.8	22.7	7.3	4.2	11.5

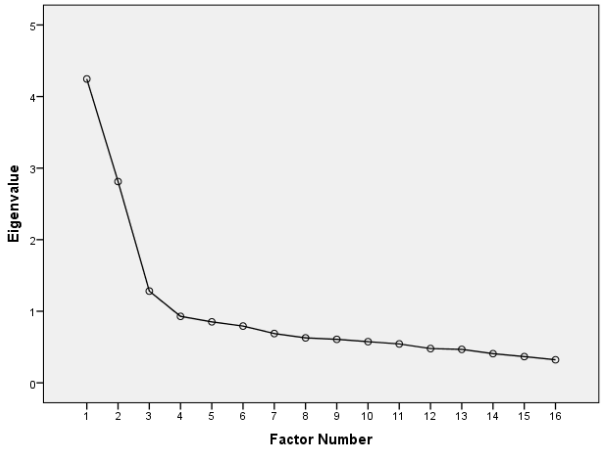

Figure 1. Scree plot of eigenvalues extracted by factor analysis on the 16 attitudes items

Table 3. Factor loadings per item, for the scales of attitudes (16 items: S1-S16)

Items	Factors			
	F1	**F2**	**F3**	**F4**
S2. A mobile device is helpful for my learning	.716			
S5. A mobile device provides me with another way to learn	.690			
S1. A mobile device can help me to attain more ideas	.674			
S4. A mobile device can enhance my desire to learn	.641			
S3. The materials are clarified when using a mobile device	.489			
S6. A mobile device can allows me to do more interesting and imaginative work				
S8. A mobile device makes me feel uncomfortable *		.764		
S9. I feel bored using a mobile device *		.686		
S7. I hesitate to use a mobile device because of my fear of making mistakes I can't correct *		.497		
S10. I am not good at talking about the experiences of using a mobile device *		.470		
S14. I need an experienced person nearby when I use a mobile device *			.723	
S15. I need someone to tell me the best way to use a mobile device *			.631	
S16. I can use a mobile device independently, without the assistance of others			.570	
S11. I hope to have regular time to use a mobile device at school				.768
S12. If I have the opportunity to use a mobile device, I am willing to take it				.611
S13. I hope to apply a mobile device in various learning activities				.421
Total variance explained is 57%				
Cronbach-a	0.79	0.73	0.69	0.69

All responses ranged from 1 (strongly disagree) to 4 (strongly agree)
Factor 1 (F1): "perceived usefulness", Factor 2 (F2): "affection", Factor 3 (F3): "perceived control", Factor 4 (F4): "behaviour"
Extraction Method: Principal Axis Factoring. Rotation Method: Oblimin with Kaiser Normalization
* items scored in a reverse way

A second factor analysis (of the same type as the former) was performed, in order to explore the factorial validity of the 9-item questionnaire regarding pupils' self-efficacy of using mobile devices. A one-factor solution was accepted using scree-plot (Figure 2) and the parallel analysis results. Both, factor loadings (ranged from 0.61 to 0.82) and the high value

of Chronbach-a coefficient (a=0.9) support satisfactory properties of the self-efficacy part of the questionnaire (Table 4).

Correlations among the factors were positive, as expected; we found small to mediocre correlation coefficients among factors (Table 5). The factor "MD self-efficacy" was statistically significant ($p<0.01$) correlated with all attitudes factors (i.e., "perceived usefulness", "affection", "behaviour" and "perceived control"). "MD self-efficacy" counts for variability for each one of the attitudes scales. "Behaviour" was significantly correlated to "perceived usefulness" and "affection", while it had a small correlation (<0.2) to "perceived control". "Perceived control" was also significantly correlated with "affection".

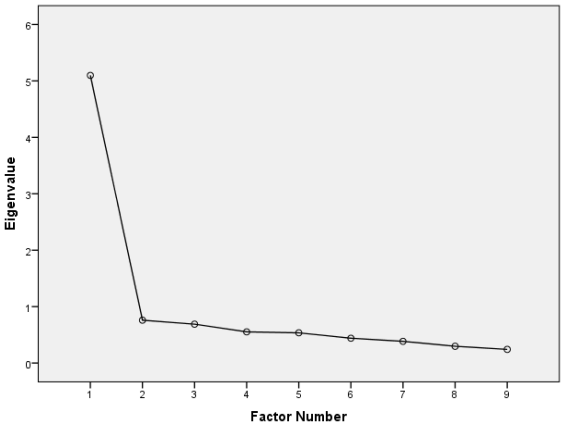

Figure 2. Scree plot of eigenvalues extracted by factor analysis on the 9 self-efficacy items

Table 4. Factor loadings per item, for the mobile devices self-efficacy (9 items: S17-S25)

Items	1
S23. I think I can click the link or button to enter a new step using a mobile device	.824
S19. I think I can key in a website address to enter the website using a mobile device	.809
S25. I think I can enter words into a document using a mobile device	.808
S22. I think I can read the content on the screen using a mobile device	.786
S21. I think I know how to use a Web homepage like 'Google' using a mobile device	.776
S20. I think I can check a hyperlink to enter another website using a mobile device	.768
S24. I think I can know where I am using a mobile device	.723
S18. I think I can copy content from the Internet and paste it into a document using a mobile device	.641
S17. I think I can download a figure from the Internet using a mobile device	.607
Cronbach-a	0.90

Extraction Method: Principal Component Analysis
a. 1 components extracted

Table 5. Correlations among (a) attitudes and mobile devices (MD) self-efficacy factors, and (b) the frequency of computer use and all factors

	Frequency of computer use	Perceived usefulness	Affection	Behaviour	Perceived control
Perceived usefulness	.120				
Affection	.030	.121			
Behaviour	.039	.560**	.307**		
Perceived control	.097	.051	.465**	.146*	
MD self-efficacy	.059	.370**	.384**	.505**	.412**

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

Differences in pupils' attitudes and self-efficacy with regard to gender, age, and frequency of computer use

In order to investigate possible significant differences in pupils' MD attitudes and MD self-efficacy with regard to their individual characteristics (gender, age group, and frequency of computer use), an estimation of correlation coefficients was conducted (see Table 5). None of the attitudes and self-efficacy factors (five factors in total) was significantly correlated to the frequency of computer use (correlations were very close to zero).

Analyses of variance were performed, each of which had as dependent variable the factors, and as independent variables the gender and the grade (i.e., pupils' age group) (see Table 6). Pupil's factor score corresponds to pupil's mean score of his/her responses on the factor items. Before proceeding to the analysis, we investigated assumptions underline parametric ANOVA.

Sapiro-Wilks normality tests show significant deviation (with few exceptions) from normal distribution for all six groups (gender by age) and all five factors. Additionally box-plots reveal the existence of extreme low values in some groups. Negative skewness was present except for boys aged 12-13 and their scores of "perceived usefulness". Homogeneity of variance was explored by a series of levene's tests: these showed significance only in the case of "affection" and "MD self-efficacy". However, the ratio of the largest group variance to the smallest group variance was 2.09 and 3 respectively, clearly lower than 4. Hence, homogeneity of variance is not a problem in this analysis (Tabacknick & Fidell, 1996). Although parametric anova is robust towards departures from normality when sample sizes exceeds 20 (Tabacknick & Fidell, 1996), we conducted a non-parametric two-way anova (kruskal-Wallis extension) using Scheirer-Ray-Hare test (Scheirer et al., 1976), in order to minimize the effects of the severe skewness and the presence of extreme values. At the first step we performed one parametric two-way anova using the ranks of the row scores. At the second step, for each effect of the model we calculated H statistic (the ratio of Sum of Squares to the mean of Total Sum of squares obtaining at the first step), and the corresponding p value (see Table 7). There was no significant interaction between gender and grade. Gender effect was significant only in the case of "perceived usefulness" (H(df =1)=6.48, p=0.011). Boys showed significant higher "mean" perceived usefulness than girls. Age differences were significant only on "behavior" scale (H(df =2)=6.18, p=0.045). The pupils' mean score of "behaviour" was significantly lower for the ages 14-15 than the mean scores in the other two age groups.

Table 6. "Mobile devices attitudes and self-efficacy" factor scores by gender and grade

Factors	Grade (age group)						Gender				Total	
	12 -13		13-14		14-15		Male		Female			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Perceived usefulness	2.98	.50	3.07	.65	2.91	.62	3.06	.61	2.92	.55	2.99	.59
Affection	3.34	.57	3.25	.72	3.28	.67	3.30	.68	3.29	.62	3.29	.65
Perceived control	3.05	.74	3.14	.77	3.19	.74	3.15	.73	3.08	.77	3.11	.75
Behaviour	3.33	.63	3.31	.69	3.11	.67	3.30	.71	3.23	.62	3.27	.67
MD self-efficacy	3.59	.52	3.60	.50	3.60	.60	3.54	.61	3.65	.43	3.59	.53

Table 7. Scheirer-Ray-Hare test results (H statistic, p values) for the main and interaction effects of a two-way non-parametric ANOVA

	Omnibus		grade		gender		Grade x gender	
Factor	**H**	**p**	**H**	**p**	**H**	**p**	**H**	**p**
Perceived usefulness	11.61	0.041	4.14	0.126	6.48	0.011	0.69	0.709
Affection	4.46	0.486	0.12	0.944	0.56	0.456	3.88	0.144
Perceived control	6.91	0.228	1.78	0.411	0.35	0.557	4.97	0.083
Behaviour	9.33	0.097	6.18	0.045	2.29	0.130	0.63	0.730
MD self-efficacy	2.38	0.795	1.24	0.539	0.67	0.415	0.49	0.784

Discussion and Conclusions

This was a study aiming to explore junior high school pupils' attitudes and self-efficacy of using mobile devices. This study adds to the body of empirical evidence regarding pupils'/ adolescents' attitudes and self-efficacy of using mobile devices.

With regard to the first research question (What are the pupils' attitudes of using mobile devices?), pupils expressed positive attitudes towards using mobile devices. More specifically, they expressed high willingness to use MD, positive feelings, and favorable perceptions towards independent control of mobile devices. The analysis revealed four factors for the 16-item questionnaire regarding pupils' attitudes. More specifically, the attitudes factors were "perceived usefulness" (Factor 1 or F1), "affection" (Factor 2 or F2), "perceived control" (Factor 3 or F3) and "behaviour" (Factor 4 or F4) (Table 3). This reveals the factorial structure of the questionnaire and indicates that literature originated scales regarding pupils' attitudes towards using mobile devices do not differ much between young populations of different countries (e.g., 9-12 year olds in Taiwan versus 12-15 years old in Greece). There was a strong agreement with the factors proposed by Tsai et al. (2010), whose questionnaire was slightly adapted for this study. In particular, all attitude factors of this study (F1 to F4) were exactly the same (i.e., consisted of the same identical items) with the factors in Tsai's et al. study. Although the two studies (this study and Tsai's et al. study) had different pupils' age ranges and different range in scales, a comparison is attempted. Comparing the Cronbach-a values for each factor, the scale "perceived control" was more reliable in this study while all other three scales were more reliable in Tsai's et al. study. Greek pupils expressed strong perceptions towards independent control of mobile devices, and this finding could be attributed to adolescence. Additionally, the most widely used mobile devices by Greek adolescents seem to be the mobile phones followed by the tablets, and this may also be linked to their perceptions. As revealed in this study and as suggested by Tsai et al. (2010), the attitude factors "perceived usefulness", "affection", "perceived control" and "behaviour" should be distinct (discrete aspects), when investigating pupils' attitudes of using mobile devices. This is a note-worthy finding, because there was lack of strong significant correlations among the attitude factors (Table 5). The above mentioned four scales were found to be sufficiently reliable for measuring pupils' attitudes in using mobile devices. The descriptive analysis revealed a similarity of pupils' attitudes-perceptions across cultures and age groups; participants hold positive perceptions of the usefulness of mobile devices, express willingness to use a mobile device, and feel confident in their independent control of a mobile device.

With regard to the second research question (What is the pupils' self-efficacy of using mobile devices?), the majority of the sample in this study expressed strong confidence in using mobile devices; over 87% of the sample reported high levels of self-efficacy when using mobile devices. The analysis revealed one factor for the 9-item questionnaire

regarding pupils' MD self-efficacy (Table 4). This was a difference between this study and Tsai's et al. (2010) study, in which these items constituted two factors ("internet self-efficacy of using MD" and "general MD self-efficacy"). We interpret this difference as follows. Due to the convergence of technology applications and the new MD features, internet-related functions are embedded within diverse mobile applications, and as a result, various MD tasks/ activities involve internet usage; as a consequence, such functions may be indistinguishable in pupils' minds. Also, the internet-based tools/ functions of mobile devices may be the ones predominantly used by Greek pupils.

There is an agreement with earlier studies which indicated positive attitudes and self-efficacy among elementary school pupils (Tsai et al., 2010), high school pupils (Wang & Wang, 2008; Poll, 2014), as well as among college students (Yang, 2012; Mnaathr et al., 2013, Sung et al., 2016). There is also an agreement with these studies with regard to the significant relationship between pupils' attitudes and their self-efficacy in using mobile devices. In this study, the MD self-efficacy factor was significantly correlated with all attitude factors/ scales. This finding corresponds to the third research question (Is there a significant relationship between pupils' MD attitudes and their MD self-efficacy?). This means that higher self-efficacy was linked to positive perspectives and feelings, to greater willingness to use mobile devices, and to favorable perspectives towards independent control of mobile devices.

With regard to the fourth research question (Is there a significant difference in pupils' MD attitudes and MD self-efficacy with regard to their gender, age group, and frequency of computer use?), we found that: (a) Gender or age differences in attitudes were isolated and very small, while there were no differences in self-efficacy, and (b) none of the attitudes and self-efficacy factors was significantly correlated to the frequency of computer use (correlations were very close to zero). Boys showed significant higher "mean" perceived usefulness than girls, but this finding was isolated and very small. Both boys and girls expressed positive MD attitudes and were equally confident in using mobile devices, thus the traditional gender gap was not existent. Gender differences may be narrowing or disappearing by the years, since both males and females are acquiring experiences with technology from an early age, and, in the current sample, there was no significant difference regarding the frequency of computer use. There is a partial agreement with earlier studies (Tsai & Tsai, 2010) which indicated that the gender gap may no longer exist in high school pupils' confidence in using the internet. Similarly, there were no statistically significant gender differences among young University students (Mnaathr et al., 2013). However, the data gathered from this study was limited and further research is needed to examine the gender gap across generations and across different populations. Finding (b) above (the frequency of computer use was not significant correlated to any factor), makes stronger the argument/suggestion that the factors "perceived usefulness", "affection", "perceived control", "behaviour" and "MD self-efficacy" should be distinct (i.e., discrete aspects - dimensions) when investigating pupils' attitudes and self-efficacy towards using mobile devices.

The findings of this study have implications for high school teachers and researchers. Teachers, for example, need to be aware of pupils' attitudes and self-efficacy of using mobile devices. Teachers of various subjects should embrace pupils' perceptions and recognize them as essential when designing effective mobile learning environments. This can potentially empower pupils by engaging them in personalized learning experiences with mobile devices. Information technology teachers, for example, could apply appropriate methods/ activities to the design of mobile based learning environments, in order to improve pupils' independent control of such devices. As the use of mobile devices becomes

more pervasive, these devises will have more potential to provide, for example, greater connectivity and communication. When applying to learning activities, the mobile communication services may increase pupils' motivation to participate in learning (which may lead to positive learning outcomes). Researchers need to further explore the practical and pedagogical considerations in designing positive mobile learning environments that cultivate, for example, confidence in MD use. Besides, professional teacher development programmes for mobile-supported learning could be strengthened.

Limitations of this study relate to the origin of the sample from only one city, in Greece: lack of random and unbiased sampling. In future studies, interviews or observations could be combined with questionnaires in order to have more robust evidence. Pupils' constructs and their related views can be further explored with larger and more diverse populations. Investigating pupils' attitudes is not an end by itself. Initially, it is considered appropriate to describe adolescents' attitudes with respect to discrete dimensions, such as "perceived usefulness", "affection" and "perceived control". We suggest for the questionnaire to be used with different adolescent and other target populations, in other countries, in order to reveal possible similarities and differences. Pupils' attitudes and self-efficacy towards using mobile devices are factors that are expected to affect their motivation and performance (learning outcomes) in mobile based learning environments. Investigating pupils' attitudes and self-efficacy is a first step, since research related to mobile learning and the literacies involved, as well as the implications of the use of mobile technology in schools is gradually growing. Future research could investigate pupils' competence in using mobile technologies, as well as the purposes for their use. Further new mobile technologies/ICT developments, which cannot be easily foreseen, will appear in the future. Because of the rapidly changing digital media and technology, the attitudes and self-efficacy constructs/aspects will need to be defined and measured throughout the time.

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