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School engagement, information technology use, and educational development: An empirical investigation of adolescents

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ABSTRACT

This study focuses on three objectives. First, it investigates distinctive profiles of adolescents based on combinations of their levels of behavioral, cognitive, and emotional engagement with school. Second, it examines whether adolescents' educational development outcomes (GPA) and extent of use of utilitarian (school-oriented) and hedonic (social media and videogames) information technologies (IT) vary as a function of their school engagement profiles. Third, it probes the mediation effects of adolescents' extent of use of utilitarian and hedonic IT on the relation between the different school engagement dimensions and educational development outcomes. The sample (n = 6885) was drawn from a large nationally representative dataset that is part of a series of annual surveys of American adolescents. Latent profile analysis identified five distinctive profiles of adolescents based on the combinations of their levels of three school engagement dimensions. The results of ANCOVA analyses indicated that these profiles differ in the use of utilitarian and hedonic IT as well as GPAs. Moreover, results of structural equation modeling showed that while the extent of use of hedonic IT partially mediated the effect of school engagement dimensions on GPA, the extent of use of utilitarian IT did not. Considering the importance of adolescents' school engagement for their development and the essential role of IT in adolescents' lives, our findings make important contributions to the literature and shed light on promising avenues for future research.

1. Introduction

School engagement is an important antecedent of students' psychological and educational development (Fredricks, Blumenfeld, & Paris, 2004). Several prototypical types of school engagement profiles may exist, including Highly Engaged, Moderately Engaged, Minimally Engaged, Emotionally Disengaged, and Cognitively Disengaged, each of which can drive

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different behaviors, psychological states, and educational development outcomes (M.-T. Wang & Peck, 2013). Nonetheless, the mediating mechanisms through which different engagement profiles result in different educational development outcomes are still largely unknown. It is important to focus on such mechanisms, because interventions targeting them may improve the relationship between school engagement dimensions and educational development outcomes.

One arguably important set of such mediating mechanisms includes the use of information technologies (IT), both for school (i.e., utilitarian) and pleasure (i.e., hedonic) purposes. IT has become an increasingly important part of life in modern societies, especially among adolescents, who are commonly referred to as "digital natives" (e.g., Thompson, 2013). Discussing IT use as a mediating mechanism is particularly important because IT can *dualistically* facilitate both adolescents' engagement with school work (e.g., asking for help with homework, searching for relevant information, Ensor, 2012; Jacobs, 2012), and their disengagement from school (e.g., through playing non-educational videogames or using social media for socialization and fun, Christakis, Ebee, Rivara, & Zimmerman, 2004; Ong et al., 2011). In essence, IT is a double-edged sword; it is a readily available means for engaging with the school work (e.g., Gross, 2004; Jackson et al., 2006; Madell & Muncer, 2004; Willoughby, 2008), but also for escaping and disengaging from school (e.g., Junco, 2012a; Karpinski, Kirschner, Ozer, Mellott, & Ochwo, 2013; Kirschner & Karpinski, 2010; Turel, 2015; Turel & Bechara, 2016; Turel, Mouttapa, & Donato, 2015; Turel, Romashkin, & Morrison, 2016; Xu, Turel, & Yuan, 2012). For example, some studies have raised concerns regarding the negative effects of hedonic and excessive patterns of IT use, such as the problematic use of videogames and/or social media, on adolescents' performance at school (e.g., Turel, 2015; Turel & Serenko, 2012; Turel, Serenko, & Giles, 2011). In contrast, other studies have argued that IT can help adolescents; they use IT predominantly for accessing information, mostly for educational purposes, which can have positive impacts on adolescents' educational development (e.g., Gross, 2004; Jackson et al., 2006; Madell & Muncer, 2004; Willoughby, 2008).

Considering this wide spectrum of potential impacts of different patterns of IT use on adolescents' educational development, it is important to better comprehend (a) how the patterns of IT use vary among adolescents as a function of their school engagement, and (b) how these patterns can affect adolescents' educational development outcomes. This study makes one of the first strides towards addressing these gaps; it examines how IT use patterns can help translating common school engagement profiles into educational outcomes.

1.1. School engagement

School engagement refers to "energized, directed, and continued action, or the discernible qualities of students' interactions with learning activities or environments" (M.-T. Wang & Peck, 2013, p. 1266). It is a trichotomy of behavioral, cognitive, and emotional engagement dimensions (e.g., Fredricks, et al., 2004; M.-T.; Wang & Peck, 2013; Watton, 2014). Behavioral engagement with school refers to the notion of participation in learning activities and physical presence in class and school (Fredricks et al., 2004; M.-T.; Wang & Peck, 2013). Cognitive engagement with school captures preference for hard work, investment in and use of self-regulated approaches to learning, as well as being strategic in planning, monitoring, and evaluating short-term and long-term learning outcomes (Fredricks et al., 2004; Zimmerman, 1989). Emotional engagement with school encompasses affective reactions to the school environment and to the school activities (e.g., Fredricks, et al., 2004; Skinner & Belmont, 1993; Voelkl, 1997). The multidimensional conceptualization of school engagement provides a rich lens for understanding how students act, feel, and think toward the school, which can directly and indirectly affect their educational development outcomes (Fredricks et al., 2004; M.-T.; Wang & Peck, 2013).

Students who demonstrate high behavioral engagement with school are more likely to absorb the delivered content, feel they belong, participate in the class, and ultimately succeed academically. In contrast, students who adapt disengaging behaviors, such as truancy, are at a greater risk for educational failure (Appleton, Christenson, Kim, & Reschly, 2006; Simons-Morton & Chen, 2009; M.-T.; Wang, 2009; M. T.; Wang, Selman, Dishion, & Stormshak, 2010). Similarly, cognitive engagement with school is positively associated with educational development; students who are willing to exert the necessary cognitive effort toward studying and learning and develop and use self-regulated strategies for learning, manage to better comprehend and master complex concepts (Miller & Byrnes, 2001; Zimmerman, 1989). Finally, high emotional engagement with school (i.e., having positive feelings and attitude toward the school and enjoying being at school) can foster educational development (Fredricks et al., 2004; M.-T.; Wang & Peck, 2013). In contrast, low emotional engagement with school can lead to a number of developmental problems, such as substance abuse and depression (e.g., Hawkins, Guo, Hill, Battin-Pearson, & Abbott, 2001; Li & Lerner, 2011; Maddox & Prinz, 2003; M.-T.; Wang & Peck, 2013).

Despite the importance of viewing school engagement as a multidimensional phenomenon, most studies thus far have either focused on a sole dimension of school engagement, usually behavioral engagement, or combined various dimensions of school engagement into a single composite factor (Marks, 2000). Both of these approaches impede the examination of distinctive and simultaneous effects on dimensions of engagement on developmental outcomes (Jimerson, Campos, & Greif, 2003; M.-T.; Wang & Peck, 2013). Accordingly, a recent study has shown that the three dimensions of school engagement can configure differently in adolescents, creating distinct profiles of individuals, who significantly vary in their educational and psychological functioning (M.-T. Wang & Peck, 2013). Following this path, we first attempt to investigate the following question:

> ***Research Question 1***: *Are there meaningful distinctive clusters of adolescents based on the configurations of different levels of their behavioral, cognitive, and emotional engagement with school?*

1.2. Adolescents' use of IT

IT may be broadly classified into two types: productivity-oriented or "utilitarian" systems and pleasure-oriented or "hedonic" systems (Massey, Khatri, & Montoya-Weiss, 2007; Van der Heijden, 2004; Wu & Lu, 2013). While the prime objective of utilitarian IT is to improve users' productivity in school/job related tasks, the principal objective of a hedonic IT is to create pleasurable and entertaining experiences for users (Massey et al., 2007; Van der Heijden, 2004). Using self-determination theory (Ryan & Deci, 2000) terminology, utilitarian IT (e.g., Microsoft Excel) are aimed at primarily generating extrinsic rewards, whereas hedonic IT (e.g., videogames, social media) are aimed at yielding intrinsic rewards. Hence, utilitarian IT serves a specific goal external to the interaction between the user and the system, such as doing school work (Massey et al., 2007). In contrast, interacting with hedonic IT is typically an end in itself.

Extrapolating these notions to the context of this study, we can categorize adolescents' use of IT into two types: (1) use of IT for utilitarian purposes, which represents the use of IT, such as word processors or online learning systems, in support of school work (hereafter, use of utilitarian IT); and (2) use of IT for hedonic purposes, which refers to the use of IT for pleasure, socialization, and entertainment purposes (hereafter, use of hedonic IT). It is noteworthy that the boundaries between utilitarian and hedonic IT may not always be as palpable as their names suggest (Sun & Zhang, 2006; Wu & Lu, 2013) because hedonic IT can still occasionally provide utilitarian value and utilitarian IT can elicit intrinsic rewards. Nonetheless, we follow the logic that "a system is classified as utilitarian if it is used in a work or education environment to improve job or school performance more than 80 percent of the time, or as hedonic if it is employed in the home for fun and relaxation more than 80 percent of the time" (Wu & Lu, 2013, p. 155).

Studies on the impacts of use of IT on students' educational development have implicitly associated the use of utilitarian IT with positive impacts and the use of hedonic IT with negative impacts (e.g., Jackson, et al., 2006; Junco, 2012b, 2012c; Willoughby, 2008). Nonetheless, how these IT use choices may be influenced by one's school engagement is largely unknown. While we know that different school engagement profiles may lead to different levels of educational functioning (M.-T. Wang & Peck, 2013), our search revealed no study that examined the relationships between adolescents' engagement with school and their patterns of use of utilitarian and hedonic IT. Hence, we address this issue by examining how the extent of use of utilitarian and hedonic IT as well as educational development outcomes vary between adolescents with different school engagement profiles.

> ***Research Question 2:*** *How are distinctive clusters of adolescents, based on combinations of their different levels of behavioral, cognitive, and emotional engagement with school, associated with adolescents' extent of use of utilitarian and hedonic IT as well as their educational development outcomes (GPA)?*

1.3. Mediation effect of adolescents' use of IT on their educational development

Behavioral, cognitive, and emotional engagement dimensions can drive students' educational development (e.g., Fredricks, et al., 2004; Li & Lerner, 2011; M.-T.; Wang & Peck, 2013). Moreover, it is also expected that different school engagement profiles determine, in part, the extent of use of utilitarian and hedonic IT employed by students. Furthermore, research has generally indicated positive impacts of the use of utilitarian IT and negative impacts of the use of hedonic IT on students' educational development outcomes (e.g., Jackson, et al., 2006; Junco, 2012b, 2012c; Kirschner & Karpinski, 2010; Paul, Baker, & Cochran, 2012; Willoughby, 2008). On this basis, we can expect that adolescents' use of utilitarian and hedonic IT partially mediates the effects of adolescents' behavioral, cognitive, and emotional engagement with schools on their educational development outcomes (See Fig. 1). Considering that no study has empirically investigated such a partial-mediation model, we pose the following research question:

> ***Research Question 3:*** *Does adolescents' use of utilitarian and hedonic IT partially mediate the relation between their behavioral, cognitive, and emotional engagement with school and their educational development outcomes (GPA)?*

2. Material and methods

2.1. Sample and procedure

The sample was drawn from an anonymous, nationally representative dataset of 8th and 10th grade high school students across the United States (U.S.), which was put together by the University of Michigan's Institute for Social Research, Survey Research Center in 2013 (Johnston, Bachman, O'Malley, & Schulenberg, 2013). This dataset is part of a series of annual surveys that explore changes in important values, behaviors, and lifestyle orientations of American adolescents. After removing the missing values for the key variables in this study, a clean sample of 6885 ethnically diverse (10% Black, 56% White, 17% Hispanic, and 18% others) adolescents (52.6% female; 47.4% male) from across the U.S. (17% Northeast Region, 24% North Central Region, 35% South Region, and 25% West Region) was obtained and used for investigating the three research questions.

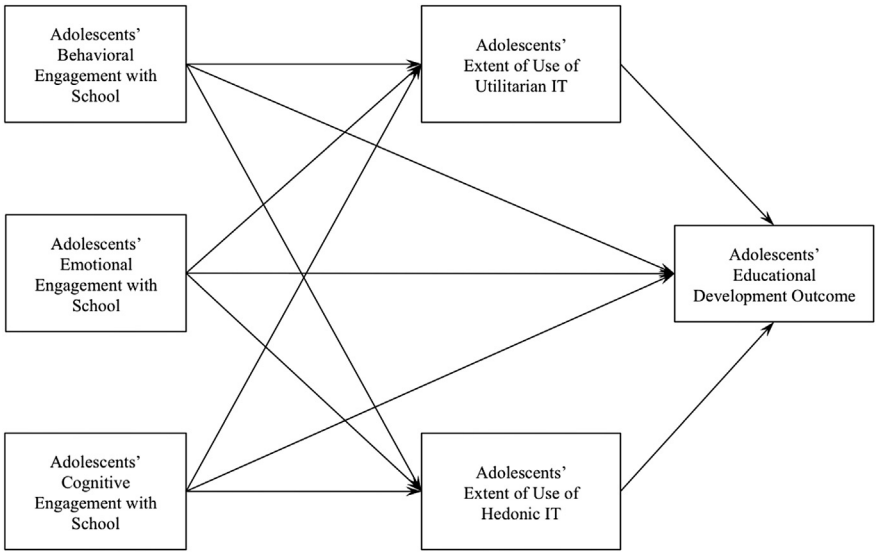


Fig. 1. Proposed research model in support of research question 3.

2.2. Measures

We used conceptually established measures in the dataset (see appendix A for details). *Behavioral engagement with school* was measured using the following questions: (1) during the last four weeks, how many whole days of school have you missed because you skipped or cut? (2) During the last four weeks, how often have you gone to school, but skipped a class when you weren't supposed to? *Cognitive engagement with school* was assessed by a principal component of: (1) the number of hours in an average week that the student had spent on his/her school work, and (2) the student's educational aspiration (Fredricks et al., 2004; M.-T.; Wang & Peck, 2013), which was measured as a principal component of: (1) the student's self-reported likelihood of going to college after high school, and (2) the student's self-reported likelihood of graduation from college in the future. *Emotional engagement with school* was measured using the principal component of: (1) during the last year at school, how often did you enjoy being at school? And the reverse-coded values of (2) during the last year at school, how often did you hate being at school? *Extent of use of utilitarian (school-oriented) IT* was assessed with a single question: "About how many hours a week do you spend using a computer to do school work?" *Extent of use of hedonic (pleasure-oriented) IT* was assessed based on the self-reported number of hours a week each participant had spent playing videogames and/or visiting social media websites. The e*ducational development outcome* was captured by adolescents' self-reported GPAs. *Socio-demographic characteristics* of adolescents, namely gender, ethnicity, and high school region in the U.S. were also extracted from the dataset for descriptive and control purposes. Considering the restricted age range in the sample (i.e., 8th and 10th grade students), age was not included as a control factor.

2.3. Data analysis

Each research question was tested with a different technique as deemed appropriate. We examined the first research question using Latent Profile Analysis (LPA) (Melas, Zampetakis, Dimopoulou, & Moustakis, 2014), using the "mclust" package version 5.0.2 in R version 3.2.2 (Fraley, Raftery, Murphy, & Scrucca, 2012). LPA was employed iteratively with different numbers of possible latent clusters (1–9, which is the maximum number of clusters that converged) to identify distinct latent clusters of adolescents based on the three dimensions of school engagement. LPA model fit was compared across different number of clusters using the Bayesian Information Criterion (BIC) (Fraley et al., 2012) in order to find the optimal number of clusters. Larger values of BIC indicated better fit to the data (Fraley et al., 2012). Obtained solutions were examined for interpretability. The second research question was examined using analysis of covariance (ANCOVA) in SPSS version 23. The third research question was addressed using structural equation modeling (SEM) analysis for estimating the model in Fig. 1, using AMOS version 23 (More details are provided in Appendix B).

3. Results

Descriptive statistics and correlations for key variables are provided in Table 1.

Table 1
Descriptive statistics and correlations.

Variable		Mean (SD)	Skew (Kurt)	1	2	3	4	5	6	7
1	Behavioral engagement	3.65 (0.82)	−2.27 (3.87)	1.00						
2	Cognitive engagement	0.00 (1.00)	−0.3 (1.09)	0.20***	1.00					
3	Emotional engagement	0.00 (1.00)	−0.29 (−0.33)	0.21***	0.24***	1.00				
4	GPA	6.41 (2.15)	−0.65 (−0.42)	0.27***	0.42***	0.29***	1.00			
5	Extent of use of utilitarian IT	3.15 (1.52)	1.02 (1.91)	0.04**	0.36***	0.08***	0.15***	1.00		
6	Extent of social media use	3.99 (2.40)	0.7 (−0.47)	-0.14***	-0.02	-0.13***	-0.14***	0.07***	1.00	
7	Extent of use of videogames	4.47 (2.28)	0.5 (−0.56)	-0.05***	-0.08***	-0.12***	-0.11***	0.03**	0.31***	1.00

SD: Standard Deviation; Skew: Skewness; Kurt: Kurtosis.
** < 0.01; *** < 0.001.

3.1. Investigating research question 1: LPA results

Results of the LPA (BIC values for different number of clusters) revealed that a five-cluster solution was the best fit for the data. Mean differences were evident across the five clusters on behavioral engagement ($F_{(4,\ 6880)} = 37825.81$, $p < 0.001$), cognitive engagement ($F_{(4,\ 6880)} = 959.36$, $p < 0.001$), and emotional engagement ($F_{(4,\ 6880)} = 216.49$, $p < 0.001$). The interpretation of these five clusters was mainly consistent with (M.-T. Wang & Peck, 2013)'s findings.

As depicted in Fig. 2, relatively low levels of behavioral, cognitive, and emotional school engagement dimensions characterized the first cluster (labeled "Highly Disengaged"). This cluster is consistent with M.-T. Wang and Peck (2013)'s "Minimally Engaged" group and accounted for almost 12% (n = 810) of the sample. The second cluster exhibited moderate-to-low levels of behavioral, cognitive, and emotional engagement with school (labeled "Moderately Disengaged") and constituted 6% (n = 421) of the sample. The third cluster comprised of adolescents with relatively low levels of cognitive and emotional engagement, but a relatively high level of behavioral engagement with school (labeled "Emotionally and Cognitively Disengaged"). This cluster constituted slightly more than 2% (n = 147) of the sample and is conceptually consistent with the "Emotionally Disengaged" and "Cognitively Disengaged" groups in (M.-T. Wang & Peck, 2013). The fourth cluster exhibited moderate-to-high levels of behavioral, cognitive, and emotional engagements with school (labeled "Moderately Engaged") and constituted 66% (n = 4552) of the sample. The "Moderately Disengaged" and "Moderately Engaged" clusters presented a more granular heterogeneity among adolescents, as compared to M.-T. Wang and Peck (2013)'s findings that grouped them together in one cluster called "Moderately Engaged". Finally, the fifth

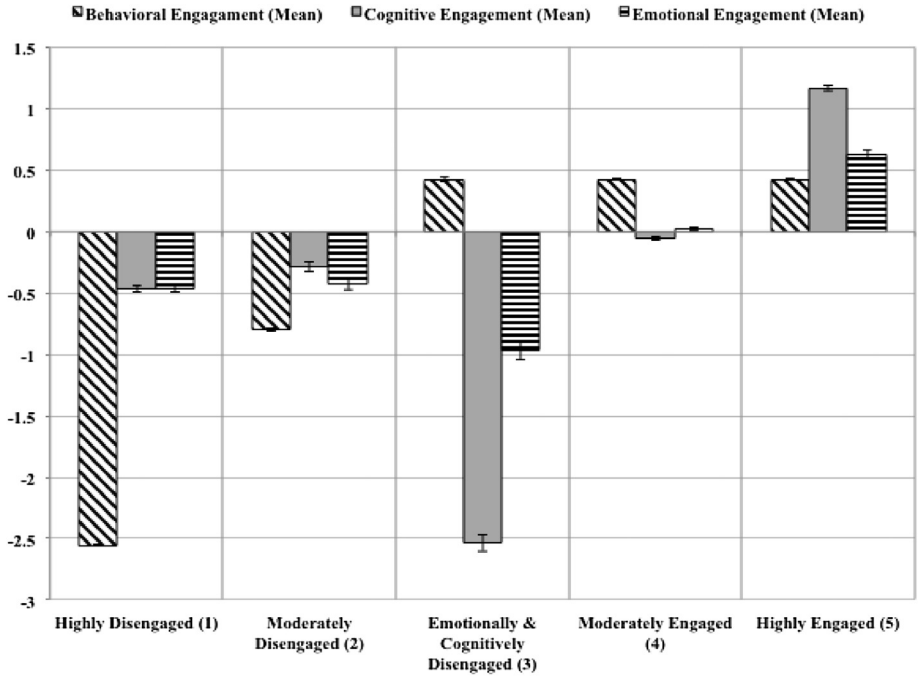


Fig. 2. Clusters of adolescents in 8th and 10th grades, based on their standardized scores of behavioral, cognitive, and emotional school engagement dimensions.

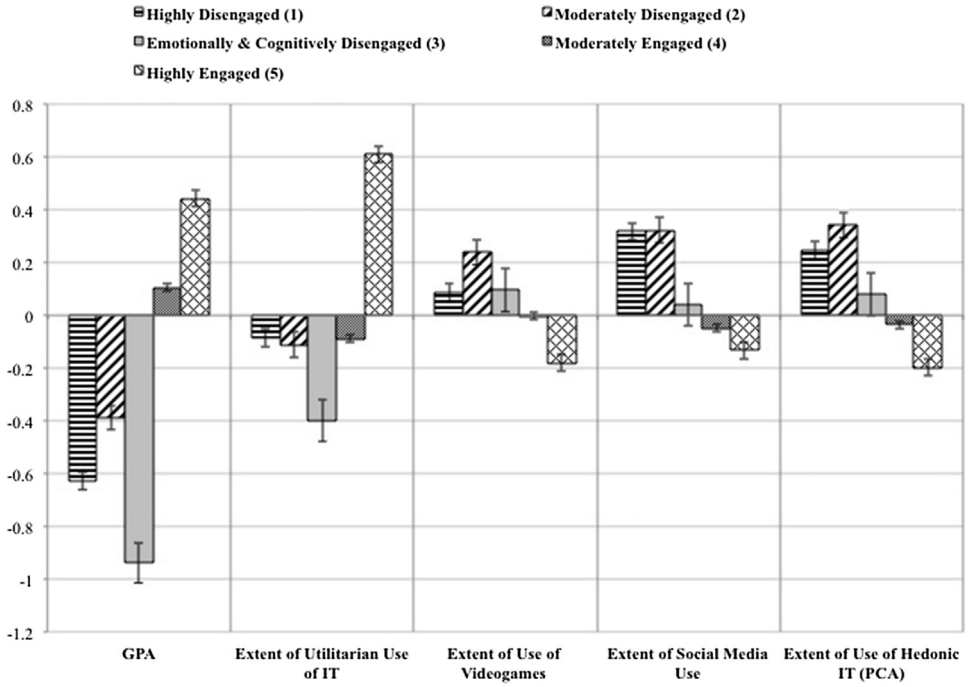


Fig. 3. Means and standard errors of adolescents' extent of use of utilitarian and hedonic IT as well as their GPAs based on their school engagement cluster.

cluster exhibited relatively high levels of behavioral, cognitive, and emotional school engagement dimensions (labeled "Highly Engaged"). This cluster is similar to M.-T. Wang and Peck (2013)'s "Highly Engaged" group and comprised almost 14% (n = 955) of the sample.

3.2. Investigating research question 2: ANCOVA results

Results of ANCOVA tests suggested that the five aforementioned clusters are associated with students' extent of use of utilitarian and hedonic IT, as well as their GPAs. Fig. 3 shows the mean and the standard error for each of the five clusters. Tables 2–6 outline the ANCOVA results in form of pairwise comparisons between the five clusters.

GPA. The pairwise comparisons identified significant differences among clusters. Specifically, as depicted in Fig. 3 and Table 2, the Highly Engaged cluster of adolescents had significantly higher self-reported GPA than the other clusters had, followed by the Moderately Engaged, Moderately Disengaged, Highly Disengaged, and Emotionally & Cognitively Disengaged clusters, in a descending order.

Extent of Use of Utilitarian IT. As depicted in Fig. 3 and Table 3, adolescents in the Highly Disengaged, Moderately Engaged, and Moderately Disengaged clusters had fairly similar extent of use of utilitarian IT. Nonetheless, their extent of use of utilitarian IT was significantly lower than that of students in the Highly Engaged, and significantly higher than that of students in the Emotionally and Cognitively Disengaged clusters. In other words, adolescents in the Highly Engaged cluster spent more time using utilitarian IT in support of their school work, while their counterparts in the Emotionally and Cognitively Disengaged cluster spent the least amount of time using utilitarian IT. The extent of use of utilitarian IT was similar in the Highly Disengaged, Moderately Engaged, and Moderately Disengaged clusters.

Extent of Use of Hedonic IT. We considered three operationalization of this construct: (1) extent of use of social media, (2) extent of use of videogames, and (3) the composite (i.e., principal component) score of the extent of use of social media and videogames (labeled "extent of use of hedonic IT").

As demonstrated in Fig. 3 and Table 4, adolescents in the Highly Disengaged and Moderately Disengaged clusters had quite similar levels of use of social media. Likewise, adolescents in the Moderately Engaged and Emotionally and Cognitively Disengaged clusters had relatively similar levels of use of social media, although their levels of use were significantly lower than those of the students in the Highly Disengaged and Moderately Disengaged clusters. Lastly, adolescents in the Highly Engaged cluster spent significantly less time on social media as compared to adolescents in the other four clusters.

Fig. 3 and Table 5 show that adolescents in the Moderately Disengaged cluster spent significantly more time playing videogames as compared to adolescents in other clusters. The extent of use of videogames in the remaining clusters in a

Table 2
ANCOVA results of adolescents' educational development outcome (GPA) in different school engagement clusters, after controlling for gender, ethnicity, and school region.

Cluster (I)	Cluster (J)	Mean difference (I-J)	Std. error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
1	2	−0.24	0.06	0.00	−0.35	−0.13
1	3	0.31	0.08	0.00	0.15	0.47
1	4	−0.73	0.04	0.00	−0.80	−0.67
1	5	−1.07	0.04	0.00	−1.16	−0.98
2	1	0.24	0.06	0.00	0.13	0.35
2	3	0.55	0.09	0.00	0.38	0.73
2	4	−0.49	0.05	0.00	−0.59	−0.40
2	5	−0.83	0.05	0.00	−0.94	−0.72
3	1	−0.31	0.08	0.00	−0.47	−0.15
3	2	−0.55	0.09	0.00	−0.73	−0.38
3	4	−1.04	0.08	0.00	−1.20	−0.89
3	5	−1.38	0.08	0.00	−1.54	−1.22
4	1	0.73	0.04	0.00	0.67	0.80
4	2	0.49	0.05	0.00	0.40	0.59
4	3	1.04	0.08	0.00	0.89	1.20
4	5	−0.34	0.03	0.00	−0.40	−0.27
5	1	1.07	0.04	0.00	0.98	1.16
5	2	0.83	0.05	0.00	0.72	0.94
5	3	1.38	0.08	0.00	1.22	1.54
5	4	0.34	0.03	0.00	0.27	0.40

Table 3
ANCOVA results of adolescents' extent of use of utilitarian IT in different school engagement clusters, after controlling for gender, ethnicity, and school region.

Cluster (I)	Cluster (J)	Mean difference (I-J)	Std. error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
1	2	0.03	0.06	0.65	−0.09	0.14
1	3	0.31	0.09	0.00	0.14	0.48
1	4	0.00	0.04	0.93	−0.07	0.08
1	5	−0.70	0.05	0.00	−0.79	−0.61
2	1	−0.03	0.06	0.65	−0.14	0.09
2	3	0.29	0.09	0.00	0.10	0.47
2	4	−0.02	0.05	0.64	−0.12	0.07
2	5	−0.72	0.06	0.00	−0.83	−0.61
3	1	−0.31	0.09	0.00	−0.48	−0.14
3	2	−0.29	0.09	0.00	−0.47	−0.10
3	4	−0.31	0.08	0.00	−0.47	−0.15
3	5	−1.01	0.09	0.00	−1.18	−0.84
4	1	0.00	0.04	0.93	−0.08	0.07
4	2	0.02	0.05	0.64	−0.07	0.12
4	3	0.31	0.08	0.00	0.15	0.47
4	5	−0.70	0.04	0.00	−0.77	−0.63
5	1	0.70	0.05	0.00	0.61	0.79
5	2	0.72	0.06	0.00	0.61	0.83
5	3	1.01	0.09	0.00	0.84	1.18
5	4	0.70	0.04	0.00	0.63	0.77

descending order was as follows: Emotionally & Cognitively Disengaged, Highly Disengaged, Moderately Engaged, and Highly Engaged. Almost all differences in cluster means were statistically significant; the only exception was the Emotionally & Cognitively Disengaged cluster, the mean of which was only significantly different from the mean of the Highly Engaged cluster.[2]

As shown in Fig. 3 and Table 6, adolescents in the Highly Disengaged and Moderately Disengaged clusters had fairly similar extent of use of hedonic IT. Furthermore, there was no statistically significant difference in terms of the extent of use of

[2] This can be attributed to the larger standard error in the Emotionally & Cognitively Disengaged cluster, which can be an artifact of its smaller cluster size.

Table 4
ANCOVA results of adolescents' extent of social media use in different school engagement clusters, after controlling for gender, ethnicity, and school region.

Cluster (I)	Cluster (J)	Mean difference (I-J)	Std. error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
1	2	0.00	0.06	0.95	−0.12	0.11
1	3	0.28	0.09	0.00	0.11	0.45
1	4	0.37	0.04	0.00	0.30	0.44
1	5	0.45	0.05	0.00	0.36	0.54
2	1	0.00	0.06	0.95	−0.11	0.12
2	3	0.28	0.09	0.00	0.10	0.47
2	4	0.37	0.05	0.00	0.27	0.47
2	5	0.46	0.06	0.00	0.34	0.57
3	1	−0.28	0.09	0.00	−0.45	−0.11
3	2	−0.28	0.09	0.00	−0.47	−0.10
3	4	0.09	0.08	0.27	−0.07	0.25
3	5	0.17	0.09	0.05	0.00	0.34
4	1	−0.37	0.04	0.00	−0.44	−0.30
4	2	−0.37	0.05	0.00	−0.47	−0.27
4	3	−0.09	0.08	0.27	−0.25	0.07
4	5	0.08	0.04	0.02	0.02	0.15
5	1	−0.45	0.05	0.00	−0.54	−0.36
5	2	−0.46	0.06	0.00	−0.57	−0.34
5	3	−0.17	0.09	0.05	−0.34	0.00
5	4	−0.08	0.04	0.02	−0.15	−0.02

Table 5
ANCOVA results of adolescents' extent of use of videogames in different school engagement clusters, after controlling for gender, ethnicity, and school region.

Cluster (I)	Cluster (J)	Mean difference (I-J)	Std. error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
1	2	−0.16	0.06	0.01	−0.27	−0.04
1	3	−0.01	0.09	0.89	−0.19	0.16
1	4	0.09	0.04	0.02	0.01	0.16
1	5	0.26	0.05	0.00	0.17	0.36
2	1	0.16	0.06	0.01	0.04	0.27
2	3	0.14	0.10	0.13	−0.04	0.33
2	4	0.24	0.05	0.00	0.14	0.34
2	5	0.42	0.06	0.00	0.31	0.53
3	1	0.01	0.09	0.89	−0.16	0.19
3	2	−0.14	0.10	0.13	−0.33	0.04
3	4	0.10	0.08	0.24	−0.07	0.26
3	5	0.28	0.09	0.00	0.10	0.45
4	1	−0.09	0.04	0.02	−0.16	−0.01
4	2	−0.24	0.05	0.00	−0.34	−0.14
4	3	−0.10	0.08	0.24	−0.26	0.07
4	5	0.18	0.04	0.00	0.11	0.25
5	1	−0.26	0.05	0.00	−0.36	−0.17
5	2	−0.42	0.06	0.00	−0.53	−0.31
5	3	−0.28	0.09	0.00	−0.45	−0.10
5	4	−0.18	0.04	0.00	−0.25	−0.11

hedonic IT among adolescents in the Moderately Engaged and Emotionally and Cognitively Disengaged clusters. Nonetheless, adolescents in the Highly Disengaged and Moderately Disengaged clusters showed significantly larger extent of use of hedonic IT than did adolescents in the Moderately Engaged and Emotionally and Cognitively Disengaged clusters. Adolescents in the Highly Engaged cluster spent the shortest time with hedonic IT.

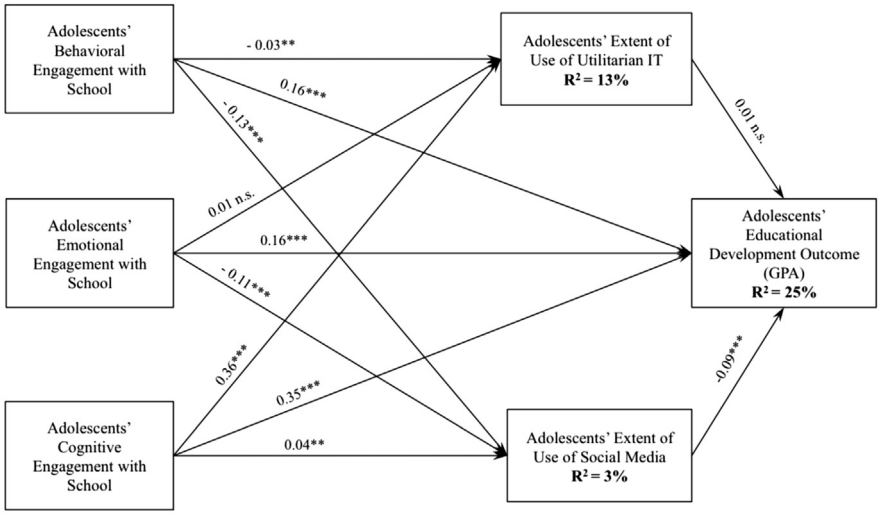
3.3. Testing research question 3: SEM results

Figs. 4 to 6 depict the results of SEM analyses, each employing a different operationalization of extent of use of hedonic IT: (1) social media, (2) videogames, and (3) a composite score. The goodness of fit indices for the three models were within acceptable thresholds (Hu & Bentler, 1999), which indicated acceptable fit of data to the models.

The results were generally similar across the three models. All three models showed that the extent of use of hedonic IT partially and negatively mediates the effects of the three dimensions of school engagement on GPA. These results were consistent with prior findings, which demonstrated that the extent of use of hedonic IT negatively affected students' GPAs (e.g., Junco, 2012b, 2012c; Karpinski et al., 2013; Kirschner & Karpinski, 2010; Paul et al., 2012). In contrast to our expectation,

Table 6
ANCOVA results of adolescents' extent of use of hedonic IT (principal components) in different school engagement clusters, after controlling for gender, ethnicity, and school region.

Cluster (I)	Cluster (J)	Mean difference (I-J)	Std. error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
1	2	−0.10	0.06	0.10	−0.22	0.02
1	3	0.16	0.09	0.07	−0.01	0.34
1	4	0.28	0.04	0.00	0.21	0.35
1	5	0.44	0.05	0.00	0.35	0.53
2	1	0.10	0.06	0.10	−0.02	0.22
2	3	0.26	0.10	0.01	0.08	0.45
2	4	0.38	0.05	0.00	0.28	0.48
2	5	0.54	0.06	0.00	0.43	0.65
3	1	−0.16	0.09	0.07	−0.34	0.01
3	2	−0.26	0.10	0.01	−0.45	−0.08
3	4	0.12	0.08	0.16	−0.05	0.28
3	5	0.28	0.09	0.00	0.11	0.45
4	1	−0.28	0.04	0.00	−0.35	−0.21
4	2	−0.38	0.05	0.00	−0.48	−0.28
4	3	−0.12	0.08	0.16	−0.28	0.05
4	5	0.16	0.04	0.00	0.09	0.23
5	1	−0.44	0.05	0.00	−0.53	−0.35
5	2	−0.54	0.06	0.00	−0.65	−0.43
5	3	−0.28	0.09	0.00	−0.45	−0.11
5	4	−0.16	0.04	0.00	−0.23	−0.09

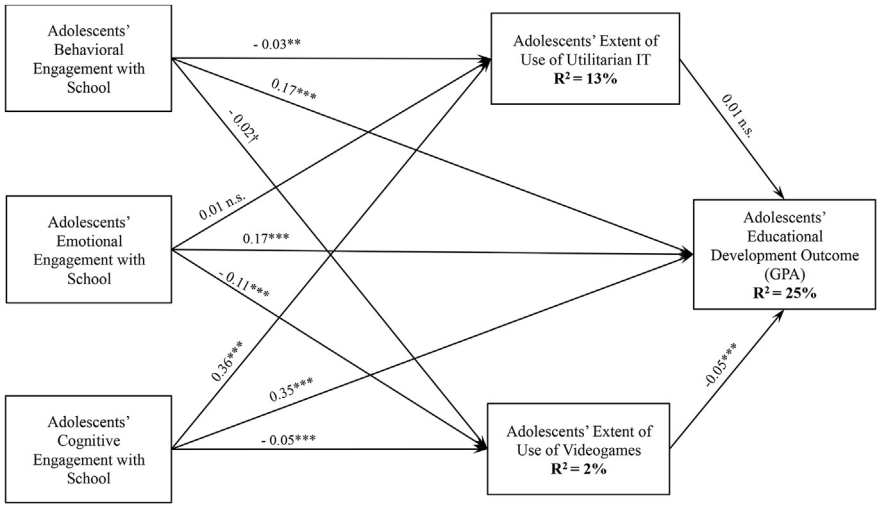


***: < 0.001; **: < 0.01; *: < 0.05; n.s.: Non Significant.
N = 6885;
Chi-Square = 39.486; DF = 1; GFI = 0.998; AGFI = 0.960; CFI = 0.991; IFI = 0.991; NFI = 0.990; SRMR = 0.0152; RMSEA = 0.075 (0.056, 0.096).

Fig. 4. Result of SEM analysis of the proposed model with adolescents' extent of use of utilitarian IT and adolescents' extent of social media use as partial mediators.

the results showed that the use of utilitarian IT in support of school work did not have a significant direct effect on students' GPA. It hence did not partially mediate the effects of adolescents' engagement with school on their GPA.

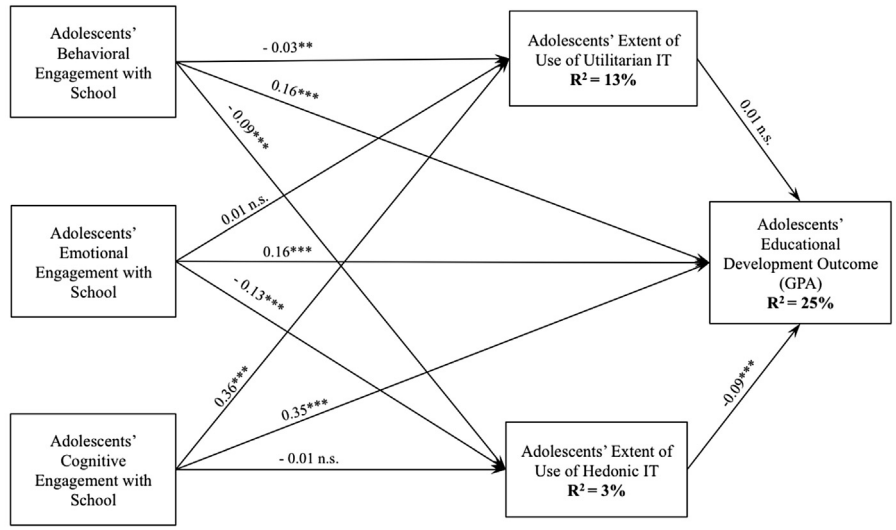
The results also showed that behavioral engagement with school negatively affected adolescents' extent of use of both utilitarian and hedonic IT. Emotional engagement with school negatively affected adolescents' extent of use of hedonic IT, but had no significant effect on the extent of use of utilitarian IT. Cognitive engagement with school positively affected the extent of use of utilitarian IT, while its effect on the extent of use of hedonic IT varied based on the type of hedonic IT. Specifically, cognitive engagement with school positively affected the extent of social media use, but negatively affected the extent of use of videogames. This relationship was not significant for the composite score.



***: < 0.001; **: < 0.01; *: < 0.05; †: < 0.1; n.s.: Non Significant.

N = 6885;
Chi-Square = 28.950; DF = 1; GFI = 0.999; AGFI = 0.971; CFI = 0.993; IFI = 0.993; NFI = 0.993; SRMR = 0.0131; RMSEA = 0.064 (0.045, 0.085).

Fig. 5. Result of SEM analysis of the proposed model with adolescents' extent of use of utilitarian IT and adolescents' extent of use of videogames as partial mediators.



***: < 0.001; **: < 0.01; *: < 0.05; n.s.: Non Significant.
N = 6885;
Chi-Square = 52.332; DF = 1; GFI = 0.997; AGFI = 0.947; CFI = 0.987; IFI = 0.987; NFI = 0.987; SRMR = 0.0175; RMSEA = 0.086 (0.067, 0.10).

Fig. 6. Result of SEM analysis of the proposed model with adolescents' extent of use of utilitarian and hedonic IT as partial mediators.

3.4. Post-hoc mediation tests

In order to better examine the proposed partial mediation effects of IT use, post-hoc mediation tests were performed with 500 re-samples (Preacher, Rucker, & Hayes, 2007). The direct, indirect and total effects (Montazemi & Qahri-Saremi, 2013; Montazemi & Qahri-Saremi, 2015), as well as their levels of two-tailed significance are given in Table 7, where each column represents a different operationalization of hedonic IT use. In all cases, the total and direct effects of school engagement

Table 7
Direct, indirect and total effects (two-tailed significance in parentheses) for the relationship between school engagement dimensions and school performance.

School engagement dimensions	Standardized effects on GPA	IT use: Utilitarian and social media	IT use: Utilitarian and videogames	IT use: Utilitarian and hedonic
Behavioral engagement	Direct effect	0.158 *(p < 0.003)*	0.168 *(p < 0.004)*	0.161 *(p < 0.004)*
	Indirect effect	0.011 *(p < 0.003)*	0.001 *(p < 0.166)*	0.008 *(p < 0.003)*
	Total effect	0.169 *(p < 0.003)*	0.169 *(p < 0.003)*	0.169 *(p < 0.003)*
Cognitive engagement	Direct effect	0.350 *(p < 0.004)*	0.347 *(p < 0.004)*	0.347 *(p < 0.004)*
	Indirect effect	−0.001 *(p < 0.833)*	0.004 *(p < 0.359)*	0.003 *(p < 0.411)*
	Total effect	0.351 *(p < 0.006)*	0.350 *(p < 0.006)*	0.350 *(p < 0.006)*
Emotional engagement	Direct effect	0.161 *(p < 0.004)*	0.165 *(p < 0.004)*	0.159 *(p < 0.004)*
	Indirect effect	0.010 *(p < 0.04)*	0.005 *(p < 0.002)*	0.011 *(p < 0.004)*
	Total effect	0.171 *(p < 0.004)*	0.171 *(p < 0.004)*	0.171 *(p < 0.004)*

dimensions on GPA were positive and significant. In almost all cases, the direct, indirect and total effects of emotional and behavioral engagement on GPA were statistically significant (except for the indirect effect of behavioral engagement, in the case of videogame use). In the case of cognitive engagement, the indirect effects were not significant across the operationalizations of use of hedonic IT. This implies that extent of use of IT (hedonic and utilitarian) partially mediated the effects of emotional and behavioral engagement dimensions on GPA. It did not mediate the effect of cognitive engagement on GPA.

4. Discussion and conclusions

This study contributes to research in education and developmental psychology by addressing three important research questions. The first research question focused on school engagement as a multidimensional construct and inquired about the distinctive and meaningful clusters of adolescents based on the combinations of different levels of behavioral, cognitive, and emotional engagement with school. Our findings lent support to the existence of distinctive profiles of adolescents, based on combinations of different levels of behavioral, cognitive, and emotional engagement with school. Specifically, five profiles of engagement with school were identified: Highly Disengaged, Moderately Disengaged, Emotionally & Cognitively Disengaged, Moderately Engaged, and Highly Engaged. These profiles differed in terms of their extent of utilitarian and hedonic IT use as well as GPA. Consistent with M.-T. Wang and Peck (2013), our findings illustrate that heterogeneity among adolescents in terms of engagement with school and its consequences can be more meaningfully explained based on multidimensional school engagement profiles, rather than through using a single composite school engagement score (Jimerson et al., 2003).

The clusters we identified were largely consistent with M.-T. Wang and Peck (2013)'s findings. This study therefore adds to the thus far very limited body of works on distinctive school engagement profiles. Future studies can examine the stability of the clusters identified. Furthermore, using larger samples sizes can result a more nuanced distinction of school engagement profiles. For example, our large sample size (n = 6885) as compared to M.-T. Wang and Peck (2013)'s sample size (n = 1025) resulted in more nuanced partitioning of the "Moderately Engaged" cluster into two clusters: "Moderately Disengaged" and "Moderately Engaged". Such differences in our findings as compared to M.-T. Wang and Peck (2013)'s, as well as the possibility of having new, more nuanced clusters that can better explain adolescents' heterogeneity in terms of school engagement dimensions are important avenues for future research.

Building on the first research question, our second research question investigated how adolescents' school engagement profiles are associated with their patterns of IT use, a question that had been left unexplored in the prior studies. In general, our findings depict a negative relation between school engagement and extent of use of hedonic IT (videogames and social media) and a positive relation between school engagement and extent of use of utilitarian IT. Adolescents who are more disengaged from school have higher extent of use of social media and videogames, while they typically use utilitarian IT less often. Specifically, students in the Highly Engaged cluster spent, on average, the largest number of hours using school-oriented (utilitarian) IT, while they spent, on average, fewer hours on using hedonic IT, as compared to adolescents in other clusters.

In contrast, it was found that adolescents in Cognitively & Emotionally Disengaged cluster spent the least amount of time working with utilitarian IT. This finding is important, considering that these adolescents' academic failure can potentially be overlooked by teachers, essentially because they are *behaviorally* engaged with school (i.e., they are not causing disciplinary problems) (M.-T. Wang & Peck, 2013). Furthermore, it is noteworthy that behavioral disengagement can result from emotional and cognitive disengagement: "dropping out of school for many students is not an instantaneous event; rather, it is a cumulative process within which the student becomes emotionally and cognitively disengaged from school" (M.-T. Wang & Peck, 2013, p. 1272). Therefore, just focusing on behavioral engagement indicators (e.g., attending school and classes) may not be adequate for capturing school engagement. Moreover, our findings show that this cluster of students does not heavily use utilitarian IT, nor hedonic IT, as compared to other clusters. Therefore, future research should shed light on how this group of students spends time. Our findings suggest that early identification and intervention, for example based on observing students' extent of use of educational (utilitarian) and hedonic IT, can help devise more effective interventions to prevent behavioral problems, such as school dropout. Future research should examine such interventions.

Our results also showed that students in the Highly Disengaged and Moderately Disengaged clusters spent, on average, significantly more time on hedonic IT, as compared to other clusters. These groups are also among the ones with relatively lower GPAs, as compared to other clusters. Therefore, we can argue that these findings, consistent with the extension of escape theory (Kiraly et al., 2015; Kwon, Chung, & Lee, 2011), show that the extent of use of hedonic IT, such as videogames and social media, can help adolescents who are disengaged from school to escape from the stress of not performing at school. This can point to a serious problem, because hedonic IT can *further* isolate these adolescents from school and friends, which can exacerbate their school engagement and performance problems (Hall-Lande, Eisenberg, Christenson, & Neumark-Sztainer, 2007; Sanders, Field, Miguel, & Kaplan, 2000).

Consistent with this view, we contend that spending a significant amount of time per week on using hedonic IT by adolescents, who are largely disengaged from school, may reinforce and perhaps worsen their situation. This is an important avenue for future research. Furthermore, future research can also investigate how educators can leverage adolescents' interest in hedonic IT, for instance, by developing educational systems that include more hedonic features (e.g., "gamification" (Abrams & Walsh, 2014)). While this study focused on the effects of school engagement profiles on the extent of use of utilitarian and hedonic IT and GPA, future studies can focus on the *antecedents* of school engagement profiles and leverage their findings to devise effective interventions for improving adolescents' engagement with school.

The results of analysis in response to the third research question shed light on the mediating mechanisms through which different school engagement dimensions influence the educational development outcome, a question that had remained a black box in the extant literature. This study tried to partially open this black box by investigating the mediation effects of adolescents' extent of use of utilitarian and hedonic IT between the three dimensions of school engagement and their GPA. The results of SEM analyses showed that extent of use of hedonic IT negatively and partially mediate the effects of two dimensions of school engagement, namely behavioral and emotional engagement, on students' educational development outcome. This was not the case for the use of school-oriented (utilitarian) systems.

The across-the-board negative partial mediation effects of extent of hedonic IT use on GPA illuminate the importance of controlling the use of these systems among adolescents. This is particularly important given the frenziedly increasing popularity of hedonic IT, such as social media and videogames, among adolescents (Turel 2016; Turel, He, Xue, Xiao, & Bechara, 2014; Turel et al., 2015; Turel et al., 2016). A recent survey (Lenhart, 2015, p. 47) suggests that more than 70% of adolescents in the US use Facebook, many of which also use other social media sites such as Instagram and Snapchat; and 73% of adolescents have access to videogames on their smartphones. Furthermore, recent studies have pointed to the potentially addictive characteristics of hedonic IT, including social media (e.g., Vernon, Barber, & Modecki, 2015) and videogames (e.g., Festl, Scharkow, & Quandt, 2013). This may result in adverse developmental and psychological outcomes, including subpar educational performance. Hence, our results call for finding effective interventions for controlling the extent of use of hedonic IT among adolescents.

The non-significance effect of extent of use of utilitarian IT on adolescents' GPA is another important finding of this study. It points to possible lack of effective school-oriented and educational systems and applications for adolescents. While IT has been used effectively to promote the use of hedonic applications (Eyal & Hoover, 2014), it may not have been used as effectively in developing educational systems, specifically for adolescents. Considering the importance of IT in adolescents' lives, such issues call for not only a better investment in IT-enabled educational systems and applications for adolescents, but also more studies to identify the important functionalities and approaches, such as "digital game-based learning" (Papastergiou, 2009), that can make IT-enabled educational systems more effective in terms of promoting students' knowledge and motivation for learning.

Finally, it is noteworthy that while our data are from 8th and 10th grade students in the U.S., we contend that the findings may generalize to other grades and other countries. An important feature of hedonic IT, such as social media and videogames, is their accessibility for different age groups and around the World. This makes it likely that the patterns we observed in this study generalize to other adolescent groups and in other countries with similar Internet connectivity and availability. Nevertheless, such extensions should be studied in future research.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.compedu.2016.07.004.

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