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Antecedents of Students' Self-Regulatory Strength in Technology-Rich School Environments

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Abstract. The internet activity of adolescents has increased to a considerable extent over the past few years. A key question is how students are able to regulate their study efforts in technology-rich classrooms. With the introduction of internet access in the classroom, a conflict of motivations may ensue between short-term rewards of playing games, interacting on social media or surfing the net and the long-term rewards of academic achievement. The purpose of this article is to explore the antecedents of students' self-regulatory strength. The antecedents are students' school motivation and school-related factors (use of internet as a learning resource at school, as well as distinct quality aspects of the teaching: teacher expectations, explanatory skills and classroom management). Regression analysis and structural equation modelling (SEM) were carried out based on 3400 student (15-17 year olds) answers to a questionnaire administered in 60 secondary schools. First, the regression analysis shows significant associations between the regressors and students' regulatory strength. Second, the SEM analysis shows that any positive effect of the teaching on students' self-regulation depends to a significant extent on the attitudes of the students towards the school as an institution. Third, our results show that the provision of the internet as a teaching resource induces a motivational conflict between recreational internet activity and school-related academic work. This conflict has a clear negative effect on students' regulatory strength in academic work. The conclusion must therefore be that it is difficult to make use of the many internet affordances for school learning within schools without a critical

awareness of the potential negative side effects on students' self-regulatory strength.

Keywords: ICT and education; technology-rich classrooms; self-regulation; motivational conflict.

Introduction

The internet activity of adolescents in and out of school has increased to a considerable extent over the past few years. The use of the internet in the context of school has long fascinated educational researchers, politicians, educational bureaucrats, teachers and students. Some see the arrival of information and communication technology (ICT) in schools as part of schools' necessary adaptation and modernisation (Søby, 2013). ICT has contributed to efficiencies in many careers, so why not in school? Others regard the internet as a potential tool for strengthening learners' creative work with information sources (Willett, Robinson & Marsh, 2009). Searching for information and synthesizing information from multiple sources is an important skill in a society in which access to information increases significantly year on year (European Commission, 2013). On the basis of such reasoning, Nordic educational authorities claim that digital skills are an important competency (Finnish National Board of Education, 2014; Skolverket, 2013; Utdanningsdirektoratet, 2012). School should prepare an individual for life after schooling, so why not use ICT as a writing tool, for simulations, for the gathering of information and for communication? Students are currently expected to make academic use of the internet. However, the technology also affords the possibility to off-task behaviours in the classroom: chat, browse websites and play games.

A significant professional controversy is found in the question of what effect different varieties of ICT use in school can have on academic achievement. One argument is that the conscious use of ICT tools can contribute to more effective learning (Rutten, van Joolingen, & van der Veen, 2012). ICT can, for instance, help visualise explanations of dynamic processes, which traditional textbooks struggle to do in a similar manner (Clarke & Mayer, 2011). An example is a physical explanation of what happens inside a pump when a person uses the pump to blow air into a bicycle tyre. The possibility of visualising the dynamic mechanisms involved means that educational computer programmes are better able to explain the physical processes than a textbook's step-by-step images of certain stages of the process combined with textual explanations (Mayer & Moreno, 2002). Another example is that educational computer programmes make it possible to simulate processes which otherwise are difficult to experiment with, such as simulating blood flow in the body, macroeconomic mechanisms, physical processes in zero gravity, cell division and so on. In short, it is argued that ICT can contribute to unique opportunities for learning complex

academic material in an effective manner (Smetana & Bell, 2012). Others believe that learning activities in school will offer an amputated experience if learners cannot use the information tools that actually exist in the world outside school (Greeno, 2006). An example of this is the argument that traditional school examinations without the help of external aids promote an artificial control of knowledge (Ludvigsen, 2012). Yet others propose a socio-cultural view that knowledge is built into the apparatus that we use. From this theoretical perspective, thinking is no longer regarded as something that takes place exclusively in a person's head, but rather it occurs in the interaction between the person, the object and the tools that are employed (Säljö, 2001, p. 83).

On the basis of the above descriptions, there are scholarly arguments for the use of ICT in schools. Following this reasoning, the educational authorities in some countries (such as Norway) have put significant resources into purchasing personal computers with internet access for almost all students in upper-secondary education. Further, similar purchases of computers for many students in primary and lower secondary school are expected to occur. Norway, Sweden and Finland come top in Europe with regard to ICT access at 11th grade (European Commission, 2013:, p. 12), but the intensity of ICT use in lessons by teachers is much lower in Finland compared to Sweden and Norway (European Commission, 2013, p. 56). Investments have also been made in learning platforms as communication tools between teachers and students, as administrative tools for school management and as a teaching resource (for instance, electronic textbooks and educational programmes that are incorporated in the learning platforms). A great deal of research has been carried out into how students use computers in an educational context for academic work (e.g. Smets & Mooji, 2001) and the impact on learning (Angrist & Lavy, 2002; Fried, 2008; Vavik et al., 2010), and research also indicates the darker sides of student use of computers in school (Elstad, 2006, 2008), such as tendencies to multitask and to carry out non-academic activities during lessons (Fried, 2008; Brante, 2009).

Self-regulation is a crucial component if students are to mindfully apply effort at school (Salomon, 1983). Self-regulation or self-discipline "outdoes IQ" in predicting academic performance of adolescents, and "A major reason for students falling short of their intellectual potential [is] their failure to exercise self-discipline" (Duckworth & Seligman, 2005, pp. 939, 944). Regulatory skills are important because "grades depend heavily on the ability to sustain effort and concentration despite boredom, fatigue, and innumerable distractions over the course of an academic year" (Duckworth & Seligman 2006, p. 199). Regulatory strength requires (1) "the ability to suppress prepotent responses in the service of a higher goal and … such a choice is not automatic but rather requires conscious effort" (Duckworth & Seligman, 2005, p. 944) and/or (2) that teachers influence students' regulatory strength by means of their teaching. The

purpose of this article is to explore the antecedents of students' regulatory strength in technology-rich school environments.

Theoretical framework

Mindful engagement is crucial for achieving deep learning in academic tasks (i.e. the answers students are required to produce). Intellectual demands are inherent in students' academic work at school: the products students are to formulate, the operations that are to be used to generate the product and the learning resources available to students in technology-filled classrooms while they are generating a product (Doyle, 2006). Students may find school boring, and at the same time, they need regulatory strength to overcome the temptation of off-task behaviours while they are doing academic tasks when they have access to the internet and games. A motivational conflict then arises, and this motivational conflict may influence the students' regulatory strength. School motivation to learn the material in question is here regarded as a precursor of regulatory strength. Regulatory strength expresses sincerity, self-exertion, endurance of hardship and concentration. To simplify matters, it is assumed here that the student has two types of decision alternatives: either (1) to concentrate on an activity that is on the academic agenda for that lesson, with or without use of technology; (2) to engage with non-academic activities, which gives the student an immediate euphoric experience; or (3) a mix between 1 and 2. Students in technology-filled classrooms have their own techniques for switching from window to window so that the teacher does not notice that they are writing e-mails, chatting or browsing some of the time (Blikstad-Balas, 2012). There may be periodic variations in the prevalence of non-academic activities in response to contextual factors, such as the subject matter or the quality of the teaching. To some extent, students manage to switch from academic activities, in accordance with the school programme of action, to non-academic activities, and vice versa, but multitasking takes up so much of the students' information processing capacity that attention is diverted from the learning task on the academic agenda (Opher et al., 2009).

The non-academic activity may be conducted surreptitiously or openly. The teacher may or may not constrain students' off-task behaviours and/or influence the students' school motivation. This study integrates three strands of theories that have their focal points in students' regulatory strength in academic work: (1) a theory on school motivation and self-regulation, (2) Didaktik theory and (3) a theory on affordances of ICT in technology-rich school environments.

Theory on school motivation and self-regulation

One antecedent mental state that causes self-regulatory strength in academic work is school motivation (Zimmerman & Schunk, 2011). Therefore, we expect

positive associations between students' school motivation and their self-regulatory strength in academic work. This is hypothesis 1. Research on motivation gives empirical support, however, for the claim that students exhibit a decline in their intrinsic motivation for school learning as they enter and move through secondary education (Eccles, 2014; Eccles et al., 1993; Eccles & Wigfield, 2002). There is a systematic grade-related change from an orientation of intrinsic to more extrinsic motivation. These psychological shifts of orientation are associated with a general mismatch between the needs of developing students and the opportunities provided by schools. In schools, computers are primarily used as tools for writing, for collecting information and for communication, and students are expected to use the internet only for academic purposes. Yet, a motivational conflict—and thus a self-regulatory challenge—may arise with easy online access in the classroom, with students drawn to undemanding off-task behaviours while trying to engage in demanding academic work.

Our basic model of the self-regulation process is Mischel and Ayduk's cognitive-affective processing model (2011), which relies on discounting theory (Ainslie, 2001). Discounting refers to a method of comparing immediate and delayed rewards, and it is an important attribute in our decision making in that our decisions demand that we weigh temporally distributed consequences. Practically all of us are faced with 'choice situations' that require us to choose between present and future rewards. In these situations, when we have a choice between rewards at different points in time, the relative value we assign to the choices is discounted in accordance with anticipated delays until they are realised. Hence, our subjective valuation of a delayed reward is inversely related to the length of the postponement (Ainslie, 2001). Extensive research on human decision making has identified this type of hyperbolic pattern and our proclivity to attach more importance to immediate rather than delayed rewards. In such cases, our behaviour can be described as dynamically inconsistent—the very modus operandi of weakness of will (Elster, 1979). The existence of competing motivations is called motivational conflict in this article.

Students may have academic ambitions and clear objectives for what they want to achieve in their education, for which consistent diligent effort at school in required. Yet, at the same time, they may be found lacking in the regulatory strength needed to work strategically in the present. The qualitative mechanisms of this paradigmatic case of self-regulatory ability can be explained by a model of hyperbolic discounting. However, we do not believe that students discount the future by a precise quantitative function. Curves I and II in Figure 1 represent the current value of reward A (mindful effort in academic work) and reward B (off-task behaviour), respectively. We assume that the student has A and B as possible future options at a given point in time, represented by t1 in Figure 1 (well ahead of the time of choice). At that particular point in time (t1),

the student values academic work over off-task behaviour because of its contribution to the achievement of a future educational objective at time-point t3. In other words, at t1, the student prefers the greater but delayed academic reward at t3. However, as the time to the short-term reward draws close (t*), the subjective value of short-term reward B catches up and equals the subjective value of long-term reward A, which is illustrated by an intersection of curves I and II in Figure 1. Thus, between t* and the time of the short-term reward at t2, the attractions of off-task digital behaviour loom larger than those of mindful effort in academic work. In other words, between t* and t2, the current subjective value of the smaller reward is higher, and consequently, at t2 the student takes the smaller reward.

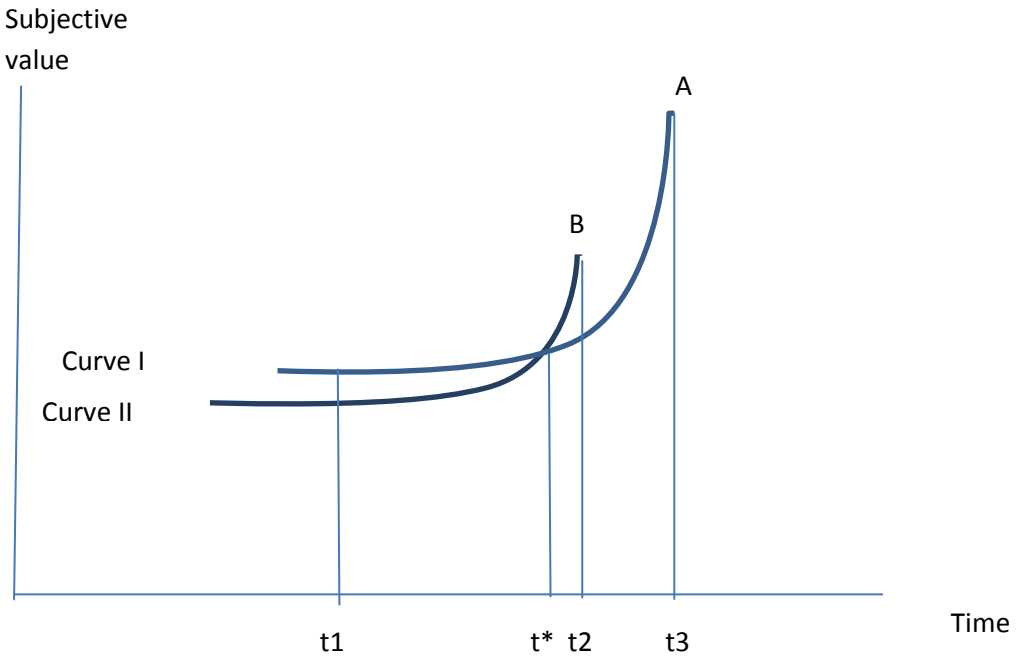

Figure 1: The motivational conflict arises between t* and t2 when a non-academic activity (curve II) provides a quick gain and it looms larger than the academic work illustrated by curve I (figure adjusted after Ainslie, 2001).

To sum up, the current subjective value of reward A is greater than the current subjective value of reward B before the point in time t*. However, after t* and until making the decision to cash in the smaller reward of the imminent alternative B at t2, the subjective value of the delayed alternative A is smaller than B. In the absence of an effective application of self-discipline or external contextual restrictions, e.g. constraints enforced by a teacher, the realisation of alternative B can be said to provide higher utility than alternative A in the prospect of an imminent reward. A clear-cut hypothesis is not defendable because several mechanisms are possible, but we explore the associations between a motivational conflict (between leisure and school-based activities) on the one hand, and students' self-regulatory strength in academic work on the other. This is our exploratory hypothesis 2. Further, we explore the associations

between school motivation and motivational conflict. This is our exploratory hypothesis 3.

Didaktik theory

Hopmann (2007) characterises the common core of the German concept Didaktik as "restrained teaching". A number of studies show that teaching quality impacts student achievement. These effects are quite large (Aaronson, Barrow, & Sander, 2007; Goldhaber & Hansen, 2010; Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004). In this article, we limit ourselves to focusing on three different aspects of restrained teaching: teachers' exposed expectations about student achievement (Braun, 1976; Cooper & Tom, 1984), teachers' classroom management (Doyle, 2006; Emmer & Stough, 2001) and teachers' instructional explanatory skills (Duffy et al., 1986; Penno et al., 2002). Students' choices are possibly subject to constraints imposed by the teacher.

'Classroom management' is understood as a method of facilitating positive student behaviour and achievement. Sugai and Horner (2002) maintain that the central components of classroom management are the maximised allocation of time for instruction and the arrangement of instructional activities to optimise academic engagement and achievement. Hence, classroom management is by definition a factor that is supposed to help students attend to the academic tasks at hand, thereby increasing the amount of engaged time. It is therefore hypothesised that classroom management is associated with students' regulatory strength (hypothesis 4). Successful classroom management and building good relationships may nurture students' school motivation (hypothesis 5). However, opposite mechanisms are also possible.

A common feature among effective teachers is that they have high expectations on behalf of their students' academic behaviour, learning and achievement, a phenomenon often referred to as the "Pygmalion effect" (Rosenthal & Jacobson, 1968; Rubie-Davies, Peterson, Sibley, & Rosenthal, 2014). Drawing on the theoretical framework, this increase in achievement is the result of an increase in the duration and/or quality of students' active engagement in trying to learn specific academic content. Based on this assumption, we hypothesise that teacher expectation is associated with students' regulatory strength (hypothesis 6) and their school motivation (hypothesis 7). Further, we expect that teachers' instructional explanatory skills are associated with students' regulatory strength (hypothesis 8) and their school motivation (hypothesis 9).

Theory on affordances of ICT

Affordances of ICT refer to the perceived and actual properties of digital resources (computers and mobile phones), primarily those functional properties

that determine just how the thing could possibly be used in school (Salomon, 1997). Wikis, blogs and WebQuest and other web-based communication tools might have the potential to allow teachers and students to increase student engagement by enhancing the experiential type of learning (Blessinger & Wankel, 2012), depending on how the actual properties are perceived and put to use. The combination of actual and perceived utility thus determines their affordance. Similarly, the use of social media in school can have a positive impact on some students' motivation for school work (Luckin et al., 2009). Students can be motivated by social media (Luckin et al., 2009), and online tools facilitate conversation and interaction online among youth (Kaplan & Haenlein, 2010; Selwyn, 2011; Vasbø et al., 2012), and this motivation may nurture school motivation or not. Our exploratory research question is as follows: How are affordances of ICT in school associated with school motivation (exploratory hypothesis 10), motivational conflict (exploratory hypothesis 11) and students' regulatory strength (exploratory hypothesis 12)? Based on these hypotheses, we create this theoretical model:

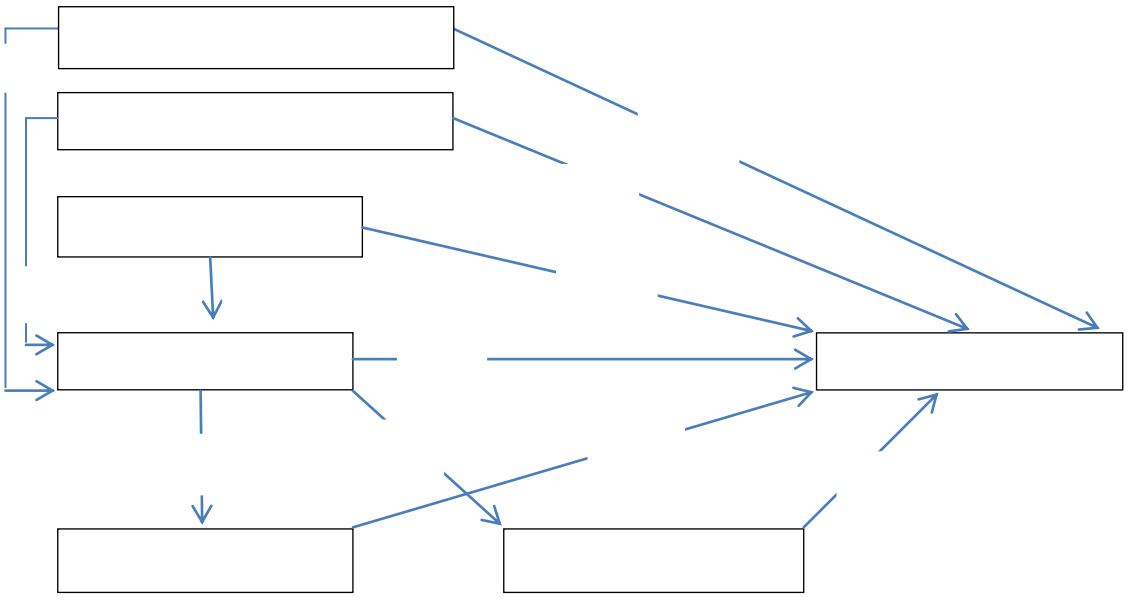

Figure 2: The hypothesised research model (hypothesis is abbreviated as H).

Methods

Sample

The empirical study that forms the basis for the analysis was completed with 60 secondary and upper secondary schools between February and March 2013. We chose schools located in, or close to, main city areas in the Nordic countries,

since city teens are most likely to have full broadband access and thus have had the opportunity to engage in the same spectrum of digital activities and develop similar digital habits in all three countries. A total of 3400 students (15-17 year olds) in general study programs voluntarily participated. None of the students who were present declined to take part in the survey.

Instrument

Students answered a questionnaire on different aspects of school situations and propositions about schools. The questionnaire was partly self-developed and partly adapted from internationally validated scales and surveys, such as the "Student related aspects of school climate scale", "Approaches to learning scale" and "Disciplinary climate scale" from PISA 2009 and Tangney, Baumeister, and Boone's (2004) "Self-control scale". The work was done within a classical test theoretical paradigm in which psychological constructs were contextualised through a set of individual questions that were asked of the students. To assess the measurement reliability of the indicators for each of the scales, Cronbach's alpha was used. Alpha coefficients of .70 or higher were considered to be acceptable (Nunnally et al., 1994). Three of the concepts had an alpha lower than .70. However, this can be explained by only two items being used. The students were asked to respond to questions that included a Likert scale. Seven constructs were included in the structural equation model: self-regulatory skills in academic settings (per_I), α=.62 (e.g. "I experience difficulties in concentrating (reversed)"); motivational conflict induced by ICT (con_I), α=.68 (e.g. "I lose focus on my school work when I use the PC at school"); school motivation (val_I), α=.67 (e.g. "I enjoy school learning"); teacher's explanatory skills (tea_I), α=.84 (e.g. "Teacher explanations make it possible for me to solve difficult problems"); teacher expectation (exp_1), α=.76 (e.g. "I look up to teachers who set high academic standards"); classroom management (clm_I), α=.87 (e.g. "The students do not manage to work well", reversed); and internet use at school ("Time spend online while at school"). ICT use was measured by the following question: "How many hours per day do you spend on the internet at school?"

Procedure

The students completed the paper-based survey and handed them in to their teacher, who in most cases collected the questionnaires on behalf of the project and who sent them to the research coordinator. The students were asked to respond to questions that included a 6-point Likert scale with alternative response choices: Strongly disagree (1), Disagree (2), More disagree than agree (3), More agree than disagree (4), Agree (5) and Strongly agree (6). An exemption was the last-mentioned construct (where students chose one of the following boxes: 0-1 hours, 1-2 hours, 2-3 hours, 3-4 hours, 4-5 hours, more than 5 hours).

Data analysis

A regression analysis (Table 1) confirms significant associations between the regressors and the dependent variable (regulatory strength). Confirmatory factor analysis (CFA) was used to assess the factor structure. The assessments are based on the p-value for the χ2-statistic, RMSEA (root mean square error of approximation), CFI (confirmative fit index), GFI (goodness-of-fit index) and TLI (Tucker-Lewis index). The standard criteria of $p > .05$, RMSEA < .05 and GFI and CFI >.95 have been used for good fit (Kline, 2005). The measurement and the structural model were estimated with IBM SPSS Amos 22. The values RMSEA = .043, GFI = .974 and CFI = .967 indicate that the structural model in Figure 3 has an acceptable fit. Structural equation modelling (SEM) was used to analyse the direct and indirect relationships between the variables. SEM allows for the analysis of latent variables with multiple indicators and multiple equations and the testing of complex causal theories with multiple pathways. Ellipses represent the latent variables, circles represent measurement errors and rectangles represent the observed measured variables. The structural model consists of terms with paths (arrows) between them. The path arrows indicate theoretical common causes and the figures (standardised regression coefficients) reflect the measured strength of the connections. The strength increases with the numerical value.

	Unstandardised coefficients		**Standardised coefficients**		
Significance	**B**	**Std.Error**	**Beta**		**t**
Constant	**8.887**	**.344**		**25.869**	**.000**
Teacher's explanation	**.086**	**.016**	**.095**	**5.493**	**.000**
Classroom management	**.026**	**.009**	**.045**	**2.787**	**.005**
Teacher expectation	**.065**	**.023**	**.052**	**2.897**	**.004**
School motivation	**.263**	**.017**	**.294**	**15.806**	**.000**
Motivational conflict	**-.306**	**.012**	**-.387**	**-24.483**	**.000**
ICT use	**-.090**	**.038**	**-.037**	**-2.352**	**.019**

Table 1: Results of regression analysis when students' regulatory strength was the dependent variable

Results

The structural equation model shows the pathways (the arrows) between the variables in Figure 3. The analysis shows:

- Hypothesis 1: School motivation's effect on regulatory strength is significant ($p<0.01$), moderately large and positive [$b(val\_I \rightarrow per\_I) = 0.30$]. This means that the null hypothesis is rejected in favour of hypothesis 1 at the 1% significance level. One interpretation is that the higher level of school motivation that students report, the higher level of regulatory strength they report having.

- Hypothesis 2: School motivation's effect on motivational conflict is weak. However, the null hypothesis is rejected at the 5% level ($p<0.05$) because of the large number of respondents in this study. Our inference is that the effect is small and negative [$b(val\_I \rightarrow con\_I) = - 0.06$] and that a further exploration of the links between school motivation and motivational conflict should be an avenue of further research.

- Hypothesis 3: Motivational conflict's effect on regulatory strength is significant. The null hypothesis is rejected at the 1% level ($p<0.01$). The effect is very large and negative [$b(con\_I \rightarrow per\_I) = - 0.65$]. It is reasonable to conclude that the null hypothesis is false and that the higher motivational conflict that students report, the weaker regulatory strength they report having.

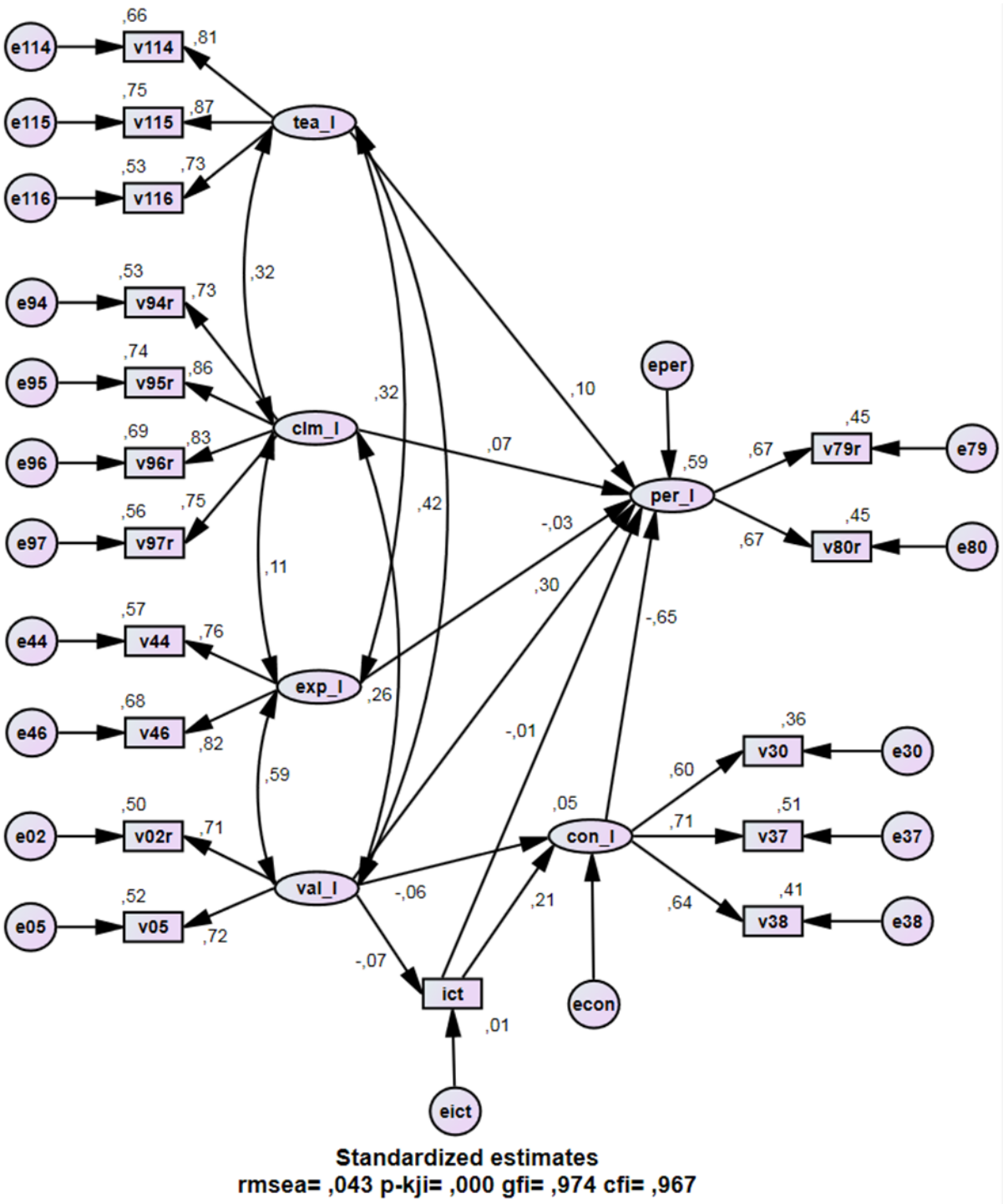

Figure 3: Structural equation modelling of exogenous variables (val_I = school motivation; con_I = motivational conflict induced by ICT; exp_I = teacher expectation; tea_I = teacher's explanatory skills; clm_I = classroom management; ict = ICT use at school) and the endogenous variable (per_I = students' self-regulatory strength).

- Hypothesis 4: Classroom management's effect on regulatory strength is weak but significant ($p<0.05$) because of the large number of respondents. The effect is small and positive [b(clm_I→per_I) = 0.07]. A further exploration of the links between classroom management and regulatory strength is needed.
- Hypothesis 5: Classroom management's association with school motivation is significant ($p<0.01$) and positive [b(clm_I→val_I) = 0.26]. One interpretation is that the higher classroom management that students report, the higher the school motivation score is.
- Hypothesis 6: Teacher expectations' relation to regulatory strength is not significant ($p>0.05$). The effect is very small and negative [b(exp_I→per_I) = - 0.03]. A further exploration of the links between teacher expectations and students' regulatory strength is an avenue of further research.
- Hypothesis 7: Teacher expectations' association with school motivation is significant ($p<0.01$), large and positive [b(exp_I→val_I) = 0.59]. It is reasonable to conclude that the null hypothesis is false and that the higher teacher expectations that students report, the higher the school motivation score is.
- Hypothesis 8: Teacher's explanatory skills' effect on regulatory strength is weak but significant ($p<0.05$). The effect is positive [b(tea_I→per_I) = 0.10]. A further exploration of the links between teacher explanatory skills and students' regulatory strength is needed.
- Hypothesis 9: Teacher's explanatory skills' association with school motivation is significant ($p<0.01$), large and positive [b(tea_I→val_I) = 0.42]. One interpretation is that the higher that students report teacher's explanatory skills, the higher the school motivation score is.
- Hypothesis 10: School motivation's association with ICT use in school is weak but significant ($p<0.05$). The effect is negative [b(val_I→ict) = - 0.07]. A further exploration of the links between school motivation's associations with ICT use in school is needed.
- Hypothesis 11: ICT use in school's effect on motivational conflict is significant ($p<0.01$) and clearly positive [b(ict→con_I) = 0.21]. One interpretation is that the higher level of ICT use in school that the students' report, the more they report experiencing a motivational conflict.
- Hypothesis 12: ICT use in school's effect on regulatory strength is not significant ($p>0.05$) and is very small and negative [b(ict→per_I) = - 0.01]. A further exploration of the links between ICT use in school and students' regulatory strength is an avenue of further research.

Discussion and conclusion

The primary aim of this paper was to explore how time spent online in school and students' perceptions of being trapped between two worlds—one digital and one with academic demand—were statistically associated with students' perceptions of their ability to remain focussed and delay gratification through their regulatory strength. This choice of focus draws its legitimacy from two main assumptions: that students need to learn increasingly challenging higher-order thinking skills and develop deep knowledge and understanding at school, and that the level of mastery of these kinds of skills and knowledge relies to a high degree on students' differential investment of sustained and conscious mental effort. Even if we assess the use of the internet in classrooms in terms of the relation to students' regulatory strength, it does not mean that we see regulatory strength as a panacea for the problems in education. Indeed, it can be argued that regulatory strength should be regarded in curve-linear terms, in that both too little and too much can be detrimental to achievement (Ainslie, 2001). However, we justify our choice of focus on the grounds that previous qualitative research has identified focused attention among students as a crucial factor for systematic and sustainable advances in higher-order thinking skills and the development of deep knowledge (e.g. Blikstad-Balas, 2012). Acknowledging that spending time online in a classroom setting is played out against the backdrop of other salient contextual factors, we included four factors commonly held to be important for student achievement in general and student self-regulatory strength in particular. Thus, it becomes possible to quantify some of the interrelationships currently at work in classrooms. Based on the assumptions mentioned above, the choice of the theoretical framework seemed reasonable due to the similarities in the conceptualisation of learning as a product of the duration and quality of students' active engagement with particular tasks.

The empirical findings suggest that the negative associations between students' perceptions of a motivational conflict and their regulatory strength—a conflict partially fuelled by time spend online at school—is larger than the positive association between the three teacher-related constructs expectations, classroom management and explanatory skills and students' regulatory strength. Given that the theoretical assumptions embedded in the structural model are indeed valid, the findings thus suggest that the positive effects of teachers' explanatory skills and their efforts to regulate students' classroom behaviours are to some extent undermined by students' sense of being trapped between digital procrastination and real world demands—one dominated by instant gratification and one requiring its delay. The statistical associations between this motivational conflict and students' regulatory strength are strong, while the

associations between teaching attributes and regulatory strength is somewhat weaker. A possible conclusion is that it is just the perennial struggle between focus and distraction taking on a digital form in 21st century Nordic classrooms. However, students have always found ways to distract themselves when faced with tedious, too easy or too demanding tasks.

There could be an element of truth in this claim, but more research is needed before we can state clear conclusions. However, it is unprecedented that students are faced with hardware and software professionally designed to capture and maintain as much of students' attention as possible. Thus, the combination of open internet access and high student autonomy in upper secondary schools puts a premium on the successful exercise of regulatory strength, but this is increasingly hard to do even in the presence of good teaching. One might argue that it is the individual's responsibility to pay attention and keep focus, and the teachers can only inform students about the risks and let them make their own decisions. Yet recent research indicates that the degradation of focus is not merely individual but social (Sana, Weston, & Cepeda, 2013). This means that the exercise of regulatory strength is adversely affected even if the student is just in direct view of the screen of a distracted peer. There is also a worry that it becomes gradually more acceptable to succumb to instant gratification, and that educationally meaningful tasks that are not instantly intrinsically motivating are not carried out with the investment of mental effort required to develop important higher-order thinking skills and depth-oriented knowledge (Salomon, 1983).

The empirical findings show that the current use of the internet in Nordic classrooms is positively associated with students' perceptions of a motivational conflict. The strength of this empirical association is moderate. More research is needed to better understand these processes. If causal processes reflect this empirical association, it can be argued that the current provision of internet access in classrooms exacerbates a motivational conflict that can have serious ramifications for the necessary exercise of regulatory strength in academic work. We need also more research to better understand this link between students' motivational conflict and their self-regulatory strength. Furthermore, if the statistical associations between regulatory strength and motivational conflict reflect causal processes, we may say that one way of reducing the mismatch situation between school content and the students' spontaneous learning desire is for teachers to engage the student even more, to sugar-coat learning; or to make the learning task more palatable; or to concentrate more on the content of the curriculum that appeals to the students' spontaneous learning desire (Elstad, 2006). The empirical findings might indicate that the current provision of internet access in classrooms has the potential to undermine the development of students' higher-order thinking skills and acquisition of deep knowledge and

understanding; thus, it is negatively associated with the subsequent fulfilment of students' academic ambitions and in the long run is possibly detrimental to students' sense of personal agency stemming from experiences with overcoming obstacles by sustained effort in a school setting. An attractive way of reducing the extent of non-academic activity is to lay the ground for the students themselves to behave more responsibly with respect to the obligations they have to engage in the programme activities that lead to learning in the classroom. This includes inter alia skills in exercising agency and self-regulation. This requires that the students assume responsibility when the teacher performs transfer of agency over learning from herself to the student. However, more research is needed to better understand the mechanisms of these assertions.

The empirical analysis that has been carried out in this article rests on the premise that regulatory strength is an important prerequisite for success in school by contributing to depth in the learning process. The development of higher-order thinking skills and deep disciplined knowledge is important for intellectually and future-oriented school-based learning. In other words, we assume that high effort via self-regulatory strength is a typical attribute in a results-oriented school environment. This assumption, however, is neither self-evident nor uncontroversial. It is possible to argue that a school can and should adapt to developments in youth culture by providing a space for the type of internet activity that is characteristic of contemporary youth culture (Erstad, 2014; Ito et al., 2010). The distinction between curriculum and pedagogy is important to consider when these claims are put forward. While curricula reflect what a given society regards as essential knowledge, skills and attitudes based on a complex process of compromise between a number of legitimate stakeholders, pedagogy refers, among other things, to the processes through which the state-sanctioned content is supposed to be introduced to students. And while students' constantly changing spare-time activities and habits tend to have only a minor impact on the development of state curricula, they are crucially important for the competent teacher who uses students' life-worlds as a gateway to the development of thinking skills, deep knowledge and understanding. It is against this background that claims regarding the digital disruption of education should be understood, since while it is uncontroversial to say that teachers could reach more students by utilising knowledge about students' life-worlds in order to introduce the content of the curriculum, it is unsettling to a different extent to claim that the state sanctioned content of curricula should be dictated by dominant youth trends. The latter would require that we leave behind what we consider a key mission of education, namely, to provide a bridge between the knowledge, skills and attitudes developed and treasured by previous generations and the knowledge, skills and attitudes one might envisage as important in the future. We are thus debating a different type of education.

There can be a trade-off between the vertical acquisition of knowledge—which in political debate is coupled with ideas of the knowledge-based society—and a result-oriented school on the one hand and a school that embraces youth internet culture on the other. It is difficult to claim, on the basis of research, that opening up for or letting students themselves choose between off-task digital activities or academic pursuits within the school walls is without its problems. Our study provides empirical grounds to suggest that those who have strong opinions that schools should adapt to the extensive use of the internet, for instance, also need to acknowledge that such a move might have seriously adverse conative consequences, particularly for students lacking in impulse control and self-regulatory abilities. If the acquisition of higher-order thinking skills and a deep understanding of disciplinary knowledge is still a key function of education in the 21st century and if this function is to some extent contingent upon students' regulatory strength, it is critical to find ways to reduce students' motivational conflict and avoid increasing the tensions as the current integration of Internet in classrooms seems to contribute to.

Limitations and needs for further research

This section raises some concerns about the method used in this study and emphasises the need for complementary research approaches to develop a richer understanding of the links between students' access to the internet and their self-regulation. It was not practicable for us to couple our survey data with indicators for value-added measures during the period prior to data collection. Coupling the measurements of student attitudes with performance measurements is highly demanding in research terms because this requires measurements at several different times. It is also demanding because the Nordic countries have regulations that place limitations on the practical opportunities of researchers in empirical surveys that are based on relatively substantial data material. It is, however, possible to carry out analytically oriented small-scale surveys, which can be useful in research for assessing possible causal processes. This is clearly an avenue of further research.

This study has inherent limitations which apply to more or less every equivalent study based on a cross-sectional approach. We acknowledge these limitations and argue that they can serve as a point of departure for future research. Of course, a number of factors may influence behaviour. In order to build an even stronger case for causality claims, longitudinal, experimental and quasi-experimental studies are required, plus particularly more qualitatively oriented studies of operating causal mechanisms in context. Another limitation of this study is the use of self-reported questionnaire data. The subjective component of such data is undeniable. Cross-sectional studies only present still-images of dynamically developing and interacting phenomena. Furthermore, assumptions

inherent in the SEM model might be unfounded, e.g. reversed causation may play a role, omitted variables may have influenced the overall model or variables that are not included in the model could be important. This study's methodological approach makes it difficult to draw clear conclusions without first acknowledging the need for further validation of the findings that we regard as central. Some of the path coefficients are so small that we must urge caution. We believe, however, that our theoretical basic model is based on such a strong research foundation that we do not believe that the statistical associations highlighted in this study can be the result of coincidence or spurious connections. It should be emphasised that when we speak of teacher influence, the causal processes can go in either direction, from teacher to student or from student to teacher.

Our study, similar to other studies of student-teacher interaction, can be interpreted as an empirical support of the following statement: the student must also make an effort via regulatory strength if the teacher is to have a positive effect on the student's learning work. In common with so much other research, our study underlines the importance of the teacher (Piopiunik, Hanushek, & Wiederhold, 2014) but also the importance of school motivation and motivational conflict. We see that there is a string statistical association between students' positive perceptions of a teacher and the degree to which the students value the school as an institution. When we look at the three distinct teaching quality aspects put together, we see that there are medium or large positive associations between each of the first three aspects (explanatory skills, classroom management and teacher expectations) and school motivation (path coefficients=0.42, 0.26 and 0.59, respectively). Hence, the three quality aspects of teaching seem to have a medium positive indirect association with regulatory strength via the construct school motivation. Furthermore, the construct school motivation is also slightly negatively (but significantly) related to the use of the internet in class (path coefficient=-0.07) and students' sense of a motivational conflict (path coefficient=-0.06), thus adding to its influence on regulatory strength. This illustrates that a greater emphasis on student socialisation in the school community can also affect the same students' self-regulation in learning. However, we need more research to understand the mechanisms involved in the processes that contribute to making students value school more strongly as an institution.

An in-depth qualitative follow-up study could be interesting to gain insight into the underlying cognitive and motivational processes. In-depth case studies with think aloud protocols, observations and interviews with students and teachers could be an interesting approach.

Digital media has attained a considerable position among youth, and it contributes to promoting trans-national cultural tendencies. The investigation reported in this article is done among 15 to 17 year-olds in Nordic countries. A further validation of this study should be done in different countries, different school contexts and different ages. This is also an avenue for further research.

Implications for practice

Despite its limitations, this study contributes to our understanding of the antecedents of students' regulatory strength. If the associations between the independent and dependent variables represent causal relationships, our findings may have implications for practice: the need for teacher professionalism and the need for meta-cognitive awareness among students in technology-rich classrooms.

Technology has become an ever-present factor in more or less every contemporary situation, while digital media has acquired a considerable significance in the lives of young people. Students bring their own, predominantly vernacular, conceptions of the internet to school, where academic literacy practices are expected. Thus, conflicting conceptions and practices are integral to the affordances offered by internet use in school. However, the salience of these conflicts will vary both on the level of the individual student, the school subject, the teacher and the classroom, the school and the wider educational and social contexts. It follows that the implications drawn from the study must be understood as informed suggestions based on this study's particular set of assumptions, the questions asked and the results obtained, and they will consequently resonate more with some particular configurations of contexts than others. However, within these limitations, the study offers valuable new insights into how students perceive of their technology-rich environment in relation to their educational endeavours, which deserve to be taken into account when policy initiatives within this area are considered. The crux of the matter is the empirically identified associations between students' sense of a motivational conflict and their self-regulation.

The need for teacher professionalism

The first question one needs to consider is the extent to which the net result of the trade-off between the cognitive benefits and conative drawbacks of internet use in the classroom is cumulatively positive based on the educational purposes one is pursuing. Since the assumption made in this paper is the need for regulatory strength on the part of the student in developing higher-order thinking skills and acquiring deep knowledge and lasting understanding, the terms of the trade-off would include the extent to which internet use improves epistemic access—in other words, how internet use is instrumentally valuable in

terms of broadening and deepening students' understanding of the defining conceptual frameworks and modes of thinking in different school subjects. Making this kind of professional judgment requires teachers with expert subject knowledge and knowledge of the optimal ways to provide learning opportunities which demand original, independent and joint thinking about worthwhile disciplinary content for particular groups of students, in the individual school subject and in cross-curricular work (Abramovich, 2013; Debele & Plevyak, 2012).

The need for meta-cognitive awareness

The second question one needs to consider is the following: Is it possible to prepare students for the task of taking on more responsibility for engaging in activities conducive to educational learning via meta-cognitive awareness? The importance of this question is evident when considering the possibility that distracted students not only lose out on the pertinent content being presented or discussed, but they might also contribute to an understanding of opting out as unproblematic. Moreover, they may provide second-hand distractions for their fellow students. In such an environment, students require both *support* in their pursuance of their academic ambitions and *defences* against powerful short-term incentives which undermine their academic efforts. These support and defence structures are not limited to the individual's choices, but they are provided by the social and material context. In school, that context is first and foremost provided by the teacher. Metacognition includes skills in exercising agency and self-regulation, and the development of students' strategies for action control and maintenance of intentions becomes a critical task for schools and teachers as the ability to delay gratification gains importance in open, technology-rich instructional environments.

Teachers need to develop critical awareness of the trade-offs involved between the possible cognitive benefits and conative drawbacks of internet use. This development can help teachers decide how, when, for what purposes and for whom the cumulative effects seem advantageous or not in light of the educational goals they are pursuing. More attention is needed to strategies which strengthen teachers' pedagogical content knowledge to make them see viable compromises and alternatives. There is a need for increased emphasis on explicating both students' academic ambitions and their relation to net activities and habits and their appreciation of school and its relation to schools' academic mandate.

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