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How to address Integration of ICT in Teaching Practice? Research on Factors influencing the use of ICT in Education

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Integrating ICT in teaching and learning is high on the educational reform agenda of developed and developing countries. For developing countries, ICT can be seen as a way to merge and even leapfrog into a globalizing, technological world. Yet in practice the use of ICT for teaching practice is limited at best. Much research is therefore done on factors influencing or constraining the use of ICT for teaching practice. In essence factors enabling and constraining ICT applications are the same in both developed and developing economies, although they obviously differ in terms of importance. This study investigates how to best address integration of ICT in teaching practice in teacher education in an emerging developing country, at the beginning of integration of ICT in education. In Vietnam essential factors have been developed in such a way the country becomes a case to watch. In 2008, the Ministry of Education and Training launched the 'Year of ICT' to produce a breakthrough in educational reform. This research draws a descriptive picture of teacher educators' use of ICT in teaching practice at the start of this 'Year of ICT'. Exploratory multiple regression analysis is carried out to measure the importance of the different factors at the educators' level, focusing on factors that can be manipulated.

Keywords ICT integration in education; Teacher education, Developing countries, Professional development

1. Introduction

Integrating ICT in teaching and learning is high on the educational reform agenda. Often ICT is seen as an indispensable tool to fully participate in the knowledge society. ICTs need to be seen as "an essential aspect of teaching's cultural toolkit in the twenty-first century, affording new and transformative models of development that extend the nature and reach of teacher learning wherever it takes place" [1]. In the school year 2008-2009 the Vietnamese Ministry of Education and Training (MOET) launched the year of ICT in education. ICT is conceptualized as a tool that can effectively support the innovation of teaching, learning and education management, and that contributes to improve efficiency and quality of education [2]. Educators in Vietnam are encouraged to reasonably implement ICT applications in new and innovative methods of teaching and learning at each grade [2].

At the beginning of 'The Year of ICT', a study took place, addressing factors influencing or constraining the use of ICT of teacher educators of five teacher education institutes in five provinces in the middle and the north of Vietnam. This research paper aims to find out how to address integration of ICT in teaching practice in teacher education in Vietnam. The five institutes participating in the research are stakeholders in a development cooperation program aimed at improved educational quality through integration of ICT in teaching practice. In the first place we want to describe to what extent ICT is integrated in teacher education in an emerging developing country, by assessing to what extent ICT is used in teaching practice. Apart from that we want to estimate the importance of a series of influencing or constraining factors for the integration of ICT in teaching practice.

2. Theoretical framework

2.1 Influencing/constraining factors for the use of ICT for teaching practice

Although countries are at the beginning of using new technology, its future use in education cannot be underestimated [3]. It is assumed that ICT brings revolutionary change in teaching methodologies. The innovation lies not per se in the introduction and use of ICT, but in its role as a contributor towards a student-centered form of teaching and learning [4]. But recently, more and more critical voices are raised and two observations temper expectations: first there has been a disappointingly slow uptake of ICT in education even though high investments have taken place in improving access to technologies and improving skills of teachers and learners; secondly there doesn't seem to have taken place an educational revolution in teaching and learning [5]. So far, computers have not transformed teaching practices [6]. Researchers as Kirkup and Kirkwood [7] indicate an abundance of computers and technological infrastructure in higher education institutions. In campus-based contexts, teaching staff learn to use those technologies which they can

incorporate into their teaching activity that offer affordances for what they already do most easily, rather than those which radically change teaching and learning practices [7].

Much research is therefore done on factors influencing or constraining the use of ICT for teaching practice. These factors can be categorized in different ways. In a framework addressing challenges to classroom technology use, Groff & Mouza [8] distinguish between critical factors including legislative level factors, district and school level factors, factors associated with students and teachers, factors inherent to the technology itself and factors associated with the technology-enhanced project. Mumtaz [9] distinguishes three interlocking factors: institution, resources and teacher. Ten Brummelhuis [in 10] categorizes influencing factors in factors which can be manipulated and factors which cannot be manipulated, which cannot be influenced directly, like age, sex, teaching experience. Examples of manipulative factors are attitudes towards teaching and ICT, ICT skills and availability of ICT support [10]. At the school level, important contextual factors are socio-cultural setting of a school and structural characteristics like government ICT policy, ICT infrastructure and school type. At teacher level, two types of barriers are common; external or first-order barriers, such as limited resources or lack of technical support, and internal or second-order barriers, which include teachers' attitudes to ICT [Snoeyink and Ertmer in 11].

With this research we want to assess what manipulative factors at the teacher level are important for the use of ICT in teaching practice of Vietnamese teacher educators. This will allow us to focus the intervention in the five teacher education institutions. Based on described literature (see section 2.2, 2.3, 2.4) and experience with integration of ICT in education in Vietnam we distinguish different factors influencing or constraining the use of ICT in teaching practice. Non-manipulative factors are sex and years of experience in teaching practice. Influencing first-order manipulative factors are access to ICT, intensity of use, confidence and skills. Second-order or internal factors are perceived values of ICT and conceptions of student learning. In what follows we draw the theoretical background, reflecting on the factors of access, confidence and skills, on digital divides and on the role of attitudes towards ICT and educational beliefs for the integration of ICT in teaching practice.

2.2 Barriers of access, use, confidence and skills

Mumtaz [9] points out that a lack of computers and software can seriously limit what teachers can do in the classroom with regards to integration of ICT. Access to ICT is a first and necessary step in the integration process even though mere access will not automatically lead to use of ICT for teaching and learning. According to Campbell [12] the digital divide refers to situations in which there is a marked gap in access to or use of ICT devices. Another crucial barrier to the integration of ICT is ICT competence or skills and ICT confidence. A very significant determinant of teachers' levels of engagement in ICT is their level of confidence in using the technologies. Teachers who have little or no confidence in using computers in their work will try to avoid them altogether [Dawes, 2000; Larner and Timberlake, 1995; Russell and Bradly, 1997 in 11]. Jones' review demonstrates that there are close relationships between barriers to the integration of ICT. Lack of personal access, technical problems or lack of teacher competence can lead to lack of teacher confidence, but in turn, a lack of confidence could itself magnify the effects of these three barriers [11].

2.3 Digital divides

Individual differences between educators influence access to ICT, use, confidence and skills [11]. Often non-manipulative factors at the level of the teacher like age and gender are described [e.g. 13, 14-16]. Computer anxiety is often highlighted as the fundamental problem behind the digital gender divide [13, 14]. However, there are contradictions in research about the influence of gender on the use of ICT and even the very notion that there is a gender problem is problematised [17]. Also age can influence the uptake of ICT for teaching [11]. Prensky [16] distinguishes between ICT natives, who are born in a digital world, and digital immigrants who have to learn the digital language and for whom ICT will always be a second language.

2.4 Attitudes towards ICT and educational beliefs

At the core of *effective* integration of ICT in teaching and learning lie capacities which go beyond mere access and ICT literacy. There is little point in providing large quantities of equipment if teachers do not have the attitudes necessary to change their classroom practices [Ertmer in 11]. Many researchers move from investigating environmental barriers of access to individual teacher characteristics like beliefs and attitudes [18, 19]. One key area of teachers' attitudes towards ICT is their understanding of how it will benefit their work and their students' learning [11]. Cox [20] expresses the need to measure, among other factors, the teachers' beliefs and understanding of the role of IT within the subject being taught. Kirkup & Kirkwood [7] distinguish innovators who are enthusiastic for the technology as valuable itself, and later adopters who are less interested in the technology and need evidence that it will improve their lives or work. Hermans et al. [18] shed light on the mediating role of teachers' educational beliefs in the resistance and receptiveness to integrate computers in classroom practice. Mumtaz [9] concludes in a meta-analysis that teachers' theories about teaching are central in influencing teachers to use ICT in their teaching. Teachers' educational beliefs can be barriers to

ICT integration [Ertmer in 18]. Becker [in 18] suggests on the other hand that highly active computer users seem to adopt a constructivist position. Findings have been inconsistent though [19, 21]. Positive attitudes towards ICT or constructivist perspectives on learning will not automatically lead to the uptake of ICT or innovative teaching practice. Judson [22] suggests that there may be little correlation between stated beliefs and actual practice.

3. Research objectives

With this explorative research we aim to generate a clearer understanding of the extent to which ICT is integrated in teacher education in an emerging developing country, by describing to what extent ICT is used in teaching practice and by assessing the effect on ICT use of the various barriers identified in our theoretical framework. Additionally, we aim to estimate the influence of external and internal manipulative factors over the influence of non-manipulative factors of age and gender. These variables are expected to have an influence on use of ICT for teaching practice, but should be controlled for when measuring the contribution of manipulative teacher level factors. This information will allow us to reflect on which manipulative factors to target and on appropriate strategies to integrate ICT in teacher education in an emerging developing country like Vietnam.

4. Methodology

4.1 Data collection and participants

Data collection took place in the beginning of the school year 2008-2009, using a self-report questionnaire presented to a total of 863 teacher educators of five teacher education institutes in five provinces in the north and the middle of Vietnam. The questionnaires were developed based on literature research (see section 5). They were translated into Vietnamese and back translated to English in order to check for mistakes and misunderstandings due to cultural adaptations. Adaptations were discussed with Vietnamese ICT experts. All staff members of the five teacher education institutions were invited to fill out the questionnaire. In total 783 questionnaires were filled out during plenary sessions in the five teacher education institutes, resulting in a response rate of 91 %.

4.2 Statistical analysis approach

Descriptive frequency and exploratory correlation analysis will draw a picture of the situation of teacher education institutes in Vietnam concerning teacher educators' use of ICT for teaching practice.

Exploratory multiple regression analysis will address the influence of the non-manipulative and manipulative external and internal factors at the teacher level on the integration of ICT in teaching practice. A hierarchy of sets of independent variables is formed and tests are done on the significance of increments to R^2 by means of the F ratio. The hierarchy of sets is an important part of the investigator's hypothesis statement [23]. In our research we start with non-manipulative variables of age and gender (set 1). These variables are expected to be relevant to the dependent variable, but should be controlled for when measuring the contribution of manipulative teacher level factors. In the first place we want to assess the importance of access to ICT (set 2) and intensity of use (set 3) after which we want to assess the net influence of ICT skills and computer confidence (set 4), attitudes towards ICT (set 5) and finally conceptions of student learning (set 6).

5. Variables

A set of questions and instruments is developed, based on existing scales, to measure the described influencing/constraining factors and the dependent variable.

Given the particular context of a developing country, at the beginning of integration of ICT in education, *access to computers and intensity of use* is measured using the list of ICT Core Indicators, developed by the Partnership on Measuring ICT for Development, an international, multi-stakeholder initiative to improve the availability and quality of ICT data and indicators, particularly in developing countries [24]. A *computer competence scale* (five point scale) is developed as an aggregate of the qualitative indexes of van Braak [25], which is a self-perceived computer competence scale. The index focuses on the in-depth knowledge of ICT skills. Three different subscales measure different ICT skills: competence in basic software applications; internet skills (use and design); and maintenance and ICT security skills. A seven point Likert scale is used to measure computer confidence with high scores indicating comfort in the use of a computer and perceived control over the computer [26]. The *cognitive attitude towards ICT scale* is a highly reliable subscale of the computer attitude scale developed by Kay [26]. It is a self-report measure expressing the perceived value of computers on a seven point Likert scale, while three subscales measure perceived value of computers in general, perceived value of computers for the personal life and perceived value of computers for students. Vermunt

and Vermetten [27] define *conceptions of learning* as a coherent system of knowledge and beliefs about learning related phenomena. They distinguish five conceptions of learning: construction of knowledge, intake of knowledge, use of knowledge, stimulating education and cooperative learning. In this study only two conceptions of learning are assessed, due to pragmatic reasons: ‘Construction of knowledge’ and ‘Intake of knowledge’. The first one refers to conceptions of learning as constructing own knowledge and insights. Most learning activities are seen as tasks of students. ‘Intake of knowledge’ refers to conceptions of learning as taking in knowledge provided by education through memorizing and reproducing; other learning activities are seen as tasks of teachers [27]. Respondents were asked to indicate on a 5-point scale the degree to which the described views and motives, in the form of statements, correspond to their educational beliefs.

To measure the *use of ICT in teaching practice*, a 4 point scale is developed, inspired by Simpson and Payne [28], consisting of items which gradually address more innovative ICT applications for teaching practice. One of the characteristics of innovative use of ICT for teaching according to Drent and Meelissen [10] is that there is a variation in ICT-use: different ICT applications are combined. When only one application is used, it is less likely that the teacher educator has integrated the use of ICT in support of a student-oriented arrangement of education. The use of ‘word processing software for production of documents’ or ‘presentation software for lecturing’ is replacing traditional practices of hand-written preparations and overhead slides. ICT can be used as a source of information e.g. through the use of ‘CD-ROM/DVD as resource material during lecturing’ or the ‘internet as source of information’. ‘Integration of subject specific software in lessons’ or ‘electronic communication with students’, can add more value to teaching and learning. One item asks about the ‘use of classroom management software’ in teaching practice in a computer classroom setting. High scores on the scale indicate a more regular and more diversified use of ICT for teaching practice.

6. Results

6.1 Reliability of developed scales

Reliability of the instruments is examined using Cronbach’s alpha when applicable. Most instruments show satisfactory internal consistency, except for the scale on conceptions of ‘student learning as intake of knowledge’. Only the reliable scales are used for the multiple regression analysis.

6.2 Use of ICT applications for teaching practice

Most teacher educators do not use many ICT applications intensively (see table 1). 57.6 % never or rarely uses subject specific software for integration into lesson practice, 65.3 % never or rarely uses electronic communication tools like e-mail for communication with students, and 86.0 % never or rarely uses classroom management software. The picture is different for other applications like word processing software and presentation software where respectively 73.7 % and 55.0 % of teacher educators using these applications on a more regular basis (sometimes or regularly). 57.4 % sometimes or regularly accesses information through a CD-ROM or DVD and 73.6 % sometimes or regularly uses the internet as source of information.

Table 1 Descriptive statistics of the ‘Use of ICT for teaching practice scale’

	M	SD	Never (%)	Rarely (%)	Sometimes (%)	Regularly (%)
Production of documents	1.95	.909	8.9	17.4	43.9	29.8
Presentation	1.48	1.030	23.7	21.3	38.2	16.8
Integration into specific subjects	1.19	1.037	34.8	22.8	31.2	11.2
Access offline information	1.55	.975	18.8	23.8	41.1	16.3
Electronic communication	1.01	1.059	44.3	21.0	23.6	11.0
Access online information	1.88	.971	13.7	12.7	45.5	28.1
Classroom management	.47	.850	72.1	13.9	9.2	4.8

Correlation analysis shows strong and significant correlations (with $p < 0.05$) between the use of different ICT applications for teaching practice.

6.3 Influence of non-manipulative and external and internal manipulative factors

Hierarchical multiple regression analysis results in 6 models which each significantly explain a proportion of variance in the use of ICT applications for teaching practice (see table 2). Non-manipulative factors at the teacher level alone

explain 14.6 % of the variance. Women tend to a more limited use of ICT for teaching practice than men and age has a negative influence on intensity and diversity. The influence of gender and age remains significant after entering variables of access to and intensity of use of ICT in the model, but loses significance after entering factors of ICT skills and confidence. Internet access has a significant positive influence on the use of ICT in teaching practice, especially for teacher educators who have access to the internet at home as well as in the teacher education institute ($\beta = .548$). This influence loses significance after entering variables of intensity of use. Use of the computer for working purposes positively contributes to the use of applications for teaching practice ($\beta = .302$). It is remarkable however that ICT use in general, when controlling for use of ICT for work, has significant negative influence on the use of ICT for teaching practice ($\beta = -.159$). This correlation remains after entering skills, computer confidence and internal variables of attitudes towards computers and conceptions of student learning. Access to a personal computer in the institute, when controlling for personal access to a computer at home, negatively influences the uptake of ICT for teaching practice. For ICT skills, only internet skills is a strong influencing factor ($.429 < \beta < .435$) and together with computer confidence ($.143 < \beta < .150$), these factors remain significant after adding other variables to the model.

Internal factors like attitude towards computers and conceptions of student learning as construction of knowledge do not significantly influence the use of ICT applications for teaching practice. Model 5 and 6 do not significantly differ from model 4 in explained variance. The final model explains 57.0 % of variance in the dependent variable. The factor contributing the most to the explained variance in the final model remains internet skills and computer confidence, as well as intensity of computer use for work ($\beta = .183$). A negative influence of personal access to a computer in the teacher education institute only ($\beta = -.062$) and the intensity of computer use for purposes other than work ($\beta = -.114$) remains.

Table 2 Factors influencing the use of ICT for teaching practice: standardized regression coefficients, proportion of explained variance and F change

		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Non-manipulative factors	Age	-.368***	-.314***	-.251***	n.s.	n.s.	n.s.
	Gender (female)	-.233***	-.203***	-.158***	n.s.	n.s.	n.s.
Access to ICT	Personal access computer at home	-	n.s.	n.s.	n.s.	n.s.	n.s.
	Personal access computer TEI	-	n.s.	-.085*	n.s.	-.060*	-.062*
	Internet access at home and in TEI	-	.548***	.170*	n.s.	n.s.	n.s.
	Internet access at home only	-	.307***	n.s.	n.s.	n.s.	n.s.
	Internet access TEI only	-	.182**	n.s.	n.s.	n.s.	n.s.
Intensity of use	Computer use general	-	-	-.159**	-.117*	-.113*	-.114*
	Computer use for work	-	-	.302***	.183**	.183**	.183**
	Intensity internet use	-	-	.293***	n.s.	n.s.	n.s.
Skills and confidence	Basic ICT skills	-	-	-	n.s.	n.s.	n.s.
	Internet skills	-	-	-	.430***	.434***	.432***
	Maintenance and security skills	-	-	-	n.s.	n.s.	n.s.
	Computer confidence	-	-	-	.149***	.147***	.144***
Attitude towards computers	Attitude towards computers	-	-	-	-	n.s.	n.s.
Conceptions of learning	Student learning as construction	-	-	-	-	-	n.s.
Adjusted R ² 'Use of ICT in teaching practice'		.146	.268	.385	.571	.571	.570
F change		44.775	17.993	33.178	55.695	.267	.540
df1		2	5	3	4	1	1
sig. F change		.000	.000	.000	.000	.604	.463

Note: not included in model, n.s. not significant, * $p < .05$, ** $p < .01$, *** $p < .001$

7. Conclusions

Vietnamese teacher educators mostly use ICT in teaching practice in a way it mainly replaces traditional practice. Teacher educators sometimes or regularly use word processing software for production of documents, presentation

software is used for lecturing or they use ICT to access information. When it comes to more advanced, subject specific applications or electronic communication, which could activate students in the learning process, use of ICT remains low. Similar results are found in research on the use of ICT by teacher mentors. Cuckle and Clarke [29] found that their respondents used a range of ICT applications for lesson preparation, but that these applications were much less used in classroom teaching. Gülbahar [30] describes teachers who feel competent in using ICT available in the school, but no successful integration in the classroom is taking place. Mills & Tincher [31] describe pervasive use of computers by teachers in preparation for instruction, but limited use of computers by teachers for delivering instruction and integrating technology in the classroom. There are strong and significant correlations between the use of different ICT applications for teaching practice (from .226 to .650). This indicates that there are some Vietnamese teacher educators who are ICT minded, enthusiasts or innovators, in the sense described by Kirkup & Kirkwood [7]. These educators apply their skills in their teaching practice, while there are teacher educators who do not use ICT in any way for teaching practice. Teachers who could not be considered 'innovators' or 'early adopters' are unlikely to be adventurous in their use of ICT; instead they will use the technology to replicate or supplement existing teaching practices. Such uses do not require teachers to rethink their teaching practices or reconsider their understanding of student learning [Laurillard in 7].

For most teacher educators in the five teacher education institutions participating in the program on integration of ICT, access to a computer is not a barrier to the use of ICT for teaching practice. Personal access to a computer in the teacher education institute results in a lower use of ICT for teaching practice though, when controlling for personal access to a computer at home. It can be assumed that this personal access to a computer in the teacher education institute only, is for other purposes than use in classroom practice. As described in other research it could be that many teachers own and use computers for their own administrative work, but never use them in their classrooms [32]. Further analysis showed moreover that 5.9 % of the respondents are faculty members whose main responsibility is not teaching: they are head of department, administrator, ... Chi square tests showed that these faculty members have proportionally more access to a personal computer in their institute than faculty members whose main responsibility is teaching. The negative influence of personal access to a computer in the institute only, might be because these faculty members are not teaching much in general. Computer use for purposes other than work results in more limited use of ICT for teaching practice. Capability theory [12] instructs that deployment of ICT should always be informing about its added value or the opportunities it creates. Further in depth interviews could reveal more information concerning the deployment of ICT for teacher educators with personal access to a computer and concerning constraining effects of use of ICT for other purposes than work. Access to the internet is important, but loses significance after controlling for intensity of the use of the computer and the internet.

It is mainly internet skills of teacher educators and computer confidence which influences whether or not ICT applications are used for teaching practice. Teacher educators who have better ICT skills, in particular internet skills, tend to use more diverse ICT applications and on a more regular basis than teacher educators who perceive lower ICT skills. As described by Jones [11] lack of competence goes together with lack of confidence and both factors are very significant determinants for the uptake of ICT in teaching practice. There is a significant correlation (with $p < .01$) of .576 between ICT skills in general and computer confidence.

Gender and age influence the integration of ICT in teaching practice. The younger teacher educators can be seen as ICT natives [16] who have been more exposed to ICT. There is no significant influence of gender or age on the integration of ICT in teaching practice, over the variance explained by ICT skills and computer confidence though.

Perception on the added value of computers has no influence on the use of ICT for teaching practice ($p > .05$). Conceptions of teacher educators of student learning play no role in their use of ICT for teaching practice ($p > .05$). Richards [33] points out that abstract ideas about learner-centered pedagogy, life-long education and flexible learning are well known and even perhaps the theoretical orthodoxy today in many Asian countries. But Richards also observes that "... despite the attraction and obvious relevance of 'new learning' theories and policy, it is not easy in practice to give up or change the traditional habits of hierarchical organization and transmission model of the authoritative teacher-passive student relations" (p. 342).

8. Discussion

There are drawbacks to a self-report questionnaire: what we measure is the perception of respondents on certain factors of integration of ICT for teaching practice. Future research should be done for triangulation of the research results described in this paper. In depth interviews could give us more insight for example in deployment of ICT in education. Lesson observations could give a better idea of to which extent ICT is used in teaching and learning. Context-specific variables like ICT policy, budget and educational management also play a role in the integration process of ICT in individual teacher education institutions. As described by Selwyn [5] for the West, it is clear that also no educational revolution is taking place yet in Vietnam. Vietnam is at the beginning of integrating ICT in education and lessons can be learnt from research in the West. Integration of ICT in education is a slow process and observations bring to light a certain path or steps which are taken in the process. Researchers emphasize the notion of change as a staged process [34]. In the first place often investments are made in technology and skills training and ICT is seen as an object of

education. ICT as object of education refers to learning *about* ICT and the acquisition of ICT skills: teachers and learners have to know how to work with the medium, the technology and therefore have to acquire the necessary skills to become ICT literate. When having a closer look at lack of teacher confidence though, research shows that this may be caused by lack of self training, lack of skills training as well as lack of pedagogical training. Even though an element of ICT skills training is necessary [Preston et al. in 11], courses which lack pedagogical aspects are likely to be unsuccessful [Veen in 11].

The present study offers some answers to successful integration of ICT in teacher education in emerging developing countries. At this stage, access to computers is not a main barrier, even though it seems that personal access to a computer in the teacher education institute only implies that the computer is used for other purposes than teaching. Increased personal access for teaching staff and access to teaching technology could make a difference. Computers should end up in the right hands. Policy makers should provide a clear rationale for integration of ICT in education, by focusing on ICT as a tool for teaching and learning and not merely a tool for education administration. ICT skills training for educators is important, especially on more advanced internet applications. Skills training should be part of continuous professional development programs of teacher educators. Skills training can result in improved computer confidence and a more diverse use of ICT in teaching practice. Vietnam could make a difference though and aim to go beyond a skills-based approach, striving for integration of ICT in education as a tool for active teaching and learning. ICT training should include reflection on teaching pedagogy and trainees should be provided with opportunities to apply the acquired skills in teaching practice. Educational managers should provide appropriate incentives for faculty members to engage in continuous professional development. At the same time as improving access and training skills, teachers and teacher educators should be prepared for a changed teacher role and should know *how* ICT can be used in a way it improves the learning process towards active teaching and learning.

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