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'Computer' and 'Information and Communication Technology': Students' Culture Specific Interpretations

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ABSTRACT

Given the use of information and communication technology (ICT) and computer as synonyms in ICT-integration research on the one hand, and the potential problems in doing so on the other, this contribution tries to gain insight in the understanding of the words computer and ICT in different settings. In five different countries (Belgium, Finland, Germany, Ghana and South-Africa) participants engaged in a word-association study. Each study addressed the following research question "Can the notion 'computer' be used as a proxy for the notion 'information and communication technology'? A word-association task with 'computer' and 'information and communication technology' as stimuli words was used in the different studies. Data gathering methods followed the same basic principles but were adopted to diverse contexts of study. In order to analyse the data a shared classification scheme was developed. A chi square test was used to check the similarities and dissimilarities of the categories. In the results, while similar associations are generated by the two stimulus words, it is also clear that computer has a more technical connotation and ICT a broader, more communication-oriented connotation. Different findings in the different cultural settings constitute a warning for naïve use of culture-specific research instruments.

Keywords

ICT-monitoring, word-association, computer, information and communication technology, context

Introduction

In a growing knowledge society information and communication technologies (ICT) are becoming more and more important in all corners of the world. Not surprisingly, preparing the next generation for a knowledge society and the adequate use of information and communication technology is regarded to be an important aspect of educational policy (Kozma, 2005; Reynolds, Treharne, & Tripp, 2003). For various economical, educational, and technological reasons it is regarded to be important that ICT gets integrated in education. To enhance the integration of ICT in education policy makers are willing to invest in infrastructure and establish various kinds of support structures. These efforts are inspired by research on the integration of ICT in education (e.g., Kozma, 2003; Smeets, 2005; Tondeur, 2007) and monitored through means of specific instruments, so called ICT-monitors (Unesco, 2006; SITES, 2006). Normally, in these monitors and studies questions are asked on learners' and teachers' ICT-usage, perceptions and competencies. In order to be as concrete as possible the notion 'computer' is often used in the survey instruments to cover all the different aspects under study (SITES, 2006; van Braak & Goeman, 2003). Similarly, when measuring participants' perceptions about the relevance of ICT to their schools, Albirini (2006) formulated the item as follows: "computers will not make any difference in our classrooms, schools, or lives". The students' or teachers' answers on 'computer'-items are thus assumed to also count for other ICT-devices and technologies such as iPods, television, Internet, WLAN and more. For instance, when measuring students' attitudes towards ICT, the item is often formulated as 'I like working with computers', or 'The use of computers is useful for me' (van Braak & Goeman, 2003). This is certainly the case when primary school pupils are involved. Research on survey wording, however, reveals that the wording of an item can have a large impact on the results, especially when measuring attitudes (de Vaus, 2002; Presser, Rothgeb & Couper, 2004; Shummer & Presser, 1981; Wood & Williams, 2007). Furthermore, it has been shown that similar words may have different meanings in different contexts. In other words, it is not clear whether the use of different terms such as 'computer' or 'ICT' would generate similar answers as the different terms may generate very different associations. 'Computer' and 'information and communication technology' are conceptually very different constructs. Wikipedia for instance (retrieved May 25 2009) presents the

following with respect to information communication technology': "***Information and communication technologies (ICT)*** *is an umbrella term that includes all technologies for the manipulation and communication of information. The term is sometimes used in preference to* ***Information Technology (IT)****, particularly in two communities: education and government. In the common usage it is often assumed that ICT is synonymous with IT; ICT in fact encompasses any medium to record information (magnetic disk/tape, optical disks (CD/DVD), flash memory etc. and arguably also paper records); technology for broadcasting information - radio, television; and technology for communicating through voice and sound or images - microphone, camera, loudspeaker, telephone to cellular phones. It includes the wide variety of computing hardware (PCs, servers, mainframes, networked storage), the rapidly developing personal hardware market comprising mobile phones, personal devices, MP3 players, and much more; the full gamut of application software from the smallest home-developed spreadsheet to the largest enterprise packages and online software services; and the hardware and software needed to operate networks for transmission of information, again ranging from a home network to the largest global private networks operated by major commercial enterprises and, of course, the Internet. Thus, "ICT" makes more explicit that technologies such as broadcasting and wireless mobile telecommunications are included.*

It should be noted that "ICT" by this English definition is different in nuance and scope than under "ICT" in Japanese, which is more technical and narrow in scope.

ICT capabilities vary widely from the sophistication of major western economies to lesser provision in the developing world. But the latter are catching up fast, often leapfrogging older generations of technology and developing new solutions that match their specific needs.

For 'computer' Wikipedia specifies: "*A computer is a machine that manipulates data according to a list of instructions.*"

Looking at the different Wikipedia definitions, it can be witnessed that even the term ICT generates different meanings and also, different context-specific implementations are visible here. Although conceptually different, computer is sometimes used as synonymous to ICT. Whether this is warranted is, still, unclear. Indeed, a conceptual difference between these two notions does not automatically imply that in the thinking and reasoning of individuals this difference is also relevant. Hence, this contribution tries to gain insight into the understanding of the notions 'computer' and 'ICT' in different cultural contexts. The ultimate aim is to develop more valid research instruments to study the integration of ICT in contemporary educational practice.

In order to address this issue the word association method was selected because it is regularly used (e.g., in marketing and psychology) to investigate whether the appropriate meaning is associated with particular words. Lykke Nielsen (2002) describes the word association method or test as follows: "The word association test is a common method within psychology, which has been used to reveal the private world of an individual. In its simplest form a series of disconnected words (stimuli words) are projected orally or in writing to the respondents who must respond with the first words, which come to mind (response words). These associations reveal the respondents' mental model of word networks, verbal memories, thought processes, emotional states, and personalities. Psychologists examine the nature and probabilities of the response words, and sometimes the amount of time it takes to respond." (p. 51).

Overall methodology

This contribution presents the results of a series of studies in different contexts and countries. While the research question, overall methodology and analysis instrument were alike, in all the studies the data gathering approach was adapted to different and unique circumstances of the sites under scrutiny.

Each of the studies addressed the following research question: Can the notion "computer" be used as a proxy for the notion "information and communication technology"?

In order to answer this question, a word-association task with 'computer' and 'information and communication technology' as stimuli words was used in the different studies.

In order to analyze the data gathered in the different studies, a shared classification scheme (see Table 1) was iteratively developed. Using ten percent of the data from the computer part of the Belgium study a first draft of the scheme was elaborated bottom up. This initial classification system was discussed by three members of the research team. The discussion mainly pertained to the conceptual clarity of each of the categories in the classification scheme and the unique allocation of specific answers to parts of the scheme. Based on this discussion a new version was elaborated. This new version was then presented to all members of the research team. They were asked to control the scheme and to check whether it would also fit to their local context and country-specific data. Once more, questions related to the conceptual clarity of the different parts of the scheme and problems with respect to allocating specific associations to categories in the classification scheme were raised. The discussion on these issues resulted in the final scheme that was used in the analysis of all the data in the different studies. Table one presents the scheme and a clarification of the different categories of the scheme.

Data were gathered with slightly different methods and with very distinct populations in Belgium, Finland, Germany, Ghana, and South-Africa.

Data analysis for each of the studies proceeded as follows. First each of the answers (task associations) was assigned to one of the cells in the classification scheme by one of the researchers. This allocation was controlled by at least one of the other researchers and any problems were discussed until consensus was reached. No distinction is made between primary and secondary associations. Next, the proportion of the answers assigned to each of the cells was calculated. A comparison of these proportions for the two key words 'computer' and 'information and communication technology' indicates similarities or dissimilarities in the associations. In order to test the significance of these similarities and dissimilarities chi-square tests were applied for each category with percentages higher than 0. Categories for which a significant difference was retrieved are indicated.

Table 1: Classification scheme

<table>
<tr><td rowspan="11">1. Technology
The association refers to technology related issues</td><td colspan="3">1.1 General notions / concepts

The association refers to general technological categories</td></tr>
<tr><td rowspan="3">1.2 Hardware

The association refers to specific technological objects</td><td rowspan="2">1.2.1 Hardware tools
The association refers to hardware that are identifiable objects in their own right.</td><td>1.2.1.1 Desktop / laptop related
The association pertains to clearly desk- or laptop related tools.</td></tr>
<tr><td>1.2.1.2 Other
The association pertains to technological tools without a direct link with desktops or laptops</td></tr>
<tr><td rowspan="2">1.2.2 Hardware components

The association refers to hardware that is part of a larger tool, it is part of a hardware tool or enables its functioning</td><td>1.2.2.1 Desktop / laptop related
The association pertains to clearly desk- or laptop related hardware components.</td></tr>
<tr><td>1.2.2.2 Other
The association pertains to technological components without a direct link with desktops or laptops</td></tr>
<tr><td rowspan="5">1.3 Software

Elements that enable the use of hardware</td><td rowspan="4">1.3.1 Programming languages / tools/ operating systems / LMS
Association refers to software elements or technological specifications that cannot be used on their own or provide a toolset</td><td>1.3.1.1 programming languages</td></tr>
<tr><td>1.3.1.2 operating systems / software contexts</td></tr>
<tr><td>1.3.1.3 LMS</td></tr>
<tr><td>1.3.1.4 Supportive tools / technical specifications / software components</td></tr>
<tr><td rowspan="2">1.3.2 Specific customer programmes / software</td><td>1.3.2.1 customer programmes</td></tr>
<tr><td>1.3.2.2 websites</td></tr>
</table>

		products / websites/ Applications Software tools that are directly used by a user in view of accomplishing a goal / executing a task	1.3.2.3 other
	1.4 Manufacturer The association refers to hardware / software producers		
2 Major functions The Association refers to notions or elements that directly pertain to a major function of computer / ICT	2.1 Information delivery / Multimedia features / elements		
	2.2 Communication		
3. Persons The association refers to a human being.	3.1 General Non-identified persons		
	3.2 Real person Identified person		
	3.3 Virtual person (profile name)		
4. Activity The association refers to what you can do with / use ICT/computers for	4.1 Activity itself The association is a verb, referring to what you can		
	4.2 Activity domain / context The association refers to the context (situation / task) in which ICT/computers are used.		
	4.3 Activity locality The association refers to the locality where ICT/computer is used. It provides an answer to the question “where is it used”.		
5. Assessment / reflection/ Description The association is mainly an adjective that expresses some kind of attitudinal evaluation of ICT/computer	5.1 Positive The assessment expresses a positive attitude or evaluation.		
	5.2 Negative The assessment expresses a negative attitude or evaluation		
	5.3 Neutral The assessment expresses a neutral mostly descriptive attitude or evaluation		
6. Objects The association refers to objects / things that are not directly technological			
7. Other / unclear			

For each of the studies the specific data-gathering approach including the target group will be specified.

The Belgium study

Specific methodology

Participants in the Belgium study were first year bachelor students (mainly female, average age of 19) in an educational sciences programme at the Katholieke Universiteit Leuven. Data were gathered at two distinct moments. During a regular lecture participants (n=151) were requested to generate ten associations for the notion ‘computer’. Four weeks later, the same group of participants was requested to generate five to ten associations for the notion ‘information and communication technology during experimental sessions in which they had to participate.

Results

The group raised a total of 1495 associations, implying that each student generated on average 9.9 associations. Four weeks later the group (n=147) raised in total 673 associations or 4.58 on average per participant. The difference between both stimulus-words with respect to the number of associations can be attributed to the difference in the description and the context of the task as well as to the actual stimulus word.

Given that chi-square tests cannot be performed in case of empty cells, for nine out of 26 categories no chi-square could be calculated (see Table 2). For another eleven categories the chi-square test reveals no differences in the proportion of associations between the two stimulus-words. For six categories a difference is revealed. For only one of these categories the proportion of associations is larger for ICT than for computer. The relative prevalence of neutral assessments/descriptions (5.3, Chi-square: 4.43, df 1; $p < .05$) is higher for ICT than for computer. For the following five categories the relative prevalence of associations is higher for computer than for ICT: desktop-related hardware components (1.2.2.1, Chi-square: 22.12, df 1; $p < .01$); software, learning management system (1.3.1.3, Chi-square: 4.04, df 1; $p < .05$); software, websites (13.2.2, Chi-square: 8.59, df 1; $p < .05$); function: information delivery (2.1, Chi-square: 12.37, df 1; $p < .01$), locality of activity (4.3, Chi-square: 4.04, df 1; $p < .05$).

Table 2: Results Belgium study

				Stimulus word	
				Computer	Information and communication technology
1.	1.1			208 (0,14)	144 (0,21)
	1.2	1.2.1	1.2.1.1	164 (0,11)	106 (0,16)
			1.2.1.2	3 (0.00)	37 (0,05)
		1.2.2	1.2.2.1	**289 (0,19)**	**45 (0,07)**
			1.2.2.2	4 (0.00)	6 (0,01)
	1.3	1.3.1	1.3.1.1	0 (0.00)	0 (0.00)
			1.3.1.2	22 (0,01)	7 (0,01)
			1.3.1.3	**50 (0,03)**	**5 (0,01)**
			1.3.1.4	12 (0,01)	5 (0,01)
		1.3.2	1.3.2.1	90 (0,06)	18 (0,03)
			1.3.2.2	**121 (0,08)**	**22 (0,03)**
			1.3.2.3	3 (0.00)	0 (0.00)
	1.4			5 (0.00)	6 (0,01)
2	2.1			**129 (0,09)**	**18 (0,03)**
	2.2			47 (0,03)	39 (0,06)
3.	3.1			5 (0.00)	9 (0,01)
	3.2			19 (0,01)	0 (0.00)
	3.3			1 (0.00)	0 (0.00)
4.	4.1			91 (0,06)	56 (0,08)
	4.2			65 (0,04)	42 (0,06)
	4.3			**39 (0,03)**	**5 (0,01)**
5.	5.1			25 (0,02)	14 (0,02)
	5.2			27 (0,02)	15 (0,02)
	5.3			**16 (0,01)**	**43 (0,06)**
6.				32 (0,02)	2 (0.00)
7.				28 (0,02)	29 (0,04)

The Finland study

Specific methodology

In the Finland study data were gathered through means of two separate web-based surveys, delivered through the multipurpose study data system “Korppi” of the University of Jyväskylä (see https://korppi.jyu.fi). For the study, the invitations to participate in the surveys were sent to a mailing list of together 800 students of the Department of Mathematical Information Technology. First, an invitation to react on the “computer” word association survey in Korppi was sent out to the mailing list. Next, after three weeks, an invitation to react on the “Information and communication technology ICT” word association survey was sent out to the list. Notably here, both of the survey invitations were sent out only once as independent assignments and also, the participation in both of the surveys was fully voluntary. In total, 203 students replied with 96 students (average age 31.3) for the 'computer' keyword and 107 students (average age 29.9) for the “information and communication technology” stimulus word.

Results

A total of 708 associations were generated by 96 students for the computer stimulus word (or on average 7.38 associations per respondent) and a total of 648 associations by 107 students for the ICT stimulus word (or on average 6.06 associations per respondent).

Chi-square tests cannot be applied when one of the cells equals zero. So chi-square tests were done for 20 categories. The test reveals a significant difference only for five out of 20 remaining categories (see Table 3). For three categories relative prevalence of associations is higher for computer than for ICT. This is the case for hardware components related to desktop/laptop (1.2.2.1, Chi-square: 10.69, df 1; $p < .01$), for information delivery as a function (2.1, Chi-square: 9.38, df 1; $p < .01$) and for objects not technological (6, Chi-square: 4.17, df 1; $p < .05$). For two cases the relative prevalence of associations is higher for ICT than for computer. This is the case for hardware tools computer/desktop related (1.2.1.1, Chi-square: 5.98, df 1; $p < .05$), and hardware tools other (1.2.1.2, Chi-square: 11.46, df 1; $p < .01$). All other comparisons have failed to reveal a significant difference.

Table 3: Results Finland study

				Stimuli words	
				Computer	Information and communication technology
1.	1.1			151 (0,21)	138 (0.21)
	1.2	1.2.1	1.2.1.1	**15 (0,02)**	**61 (0.09)**
			1.2.1.2	**5 (0.01)**	**75 (0.12)**
		1.2.2	1.2.2.1	**90 (0.13)**	**16 (0.02)**
			1.2.2.2	10 (0.01)	26 (0.04)
	1.3	1.3.1	1.3.1.1	4 (0.01)	23 (0.04)
			1.3.1.2	30 (0.04)	18 (0.03)
			1.3.1.3	0 (0.00)	2 (0.00)
			1.3.1.4	11 (0.01)	4 (0.01)
		1.3.2	1.3.2.1	20 (0.03)	3 (0.00)
			1.3.2.2	15 (0.02)	24 (0.04)
			1.3.2.3	0 (0.00)	0 (0.00)
	1.4			7 (0.01)	8 (0.01)
2	2.1			**70 (0.10)**	**25 (0.04)**
	2.2			31 (0.04)	23 (0.04)
3.	3.1			15 (0.02)	14 (0.02)
	3.2			2 (0.00)	0 (0.00)
	3.3			0 (0.00)	0 (0.00)
4.	4.1			57 (0.08)	31 (0.05)
	4.2			43 (0.06)	45 (0.07)
	4.3			1 (0.00)	2 (0.00)
5.	5.1			10 (0.01)	15 (0.02)
	5.2			26 (0.04)	12 (0.02)
	5.3			30 (004)	40 (0.06)
6.				**55 (0.08)**	**27 (0.04)**
7.				10 (0.01)	16 (0.02)

The Germany study

Specific methodology

Participants were 62 German students of the University of Koblenz-Landau, on average 22.45 years old (SD = 3.70). Fourteen male students and 47 female students participated in the study (with missing gender-data for one participant). Forty-three students (69%) of the participants were psychology students, 11 students (18%) were educational sciences students. The other eight students came from different disciplines such as social sciences and

sports. Participation was voluntary. Participants received 10 euro or two research credits for their participation in the entire experiment.

In the Germany study all data were gathered during experimental sessions. The word association task figured as an intermediate task between different stages of an experiment. For half of the participants the first intermediate task consisted of giving five associations for the notion ‘computer’ and the second intermediate task of five associations with the notion 'Information and communication technology'. The other half first received the 'ICT'-association task and than the 'computer'-association task.

Table 4: Results Germany study

				Number of associations (proportion) per stimulus word	
				Computer	Information and communication technology
1.	1.1			67 (0,22)	67 (0,22)
	1.2	1.2.1	1.2.1.1	12 (0,04)	27 (0,09)
			1.2.1.2	0 (0.00)	79 (0,26)
		1.2.2	1.2.2.1	**76 (0,25)**	**8 (0,03)**
			1.2.2.2	0 (0.00)	1 (0,00)
	1.3	1.3.1	1.3.1.1	0 (0.00)	0 (0,00)
			1.3.1.2	9 (0,03)	1 (0,00)
			1.3.1.3	0 (0.00)	0 (0,00)
			1.3.1.4	2 (0,01)	0 (0,00)
		1.3.2	1.3.2.1	14 (0,05)	0 (0,00)
			1.3.2.2	1 (0.00)	4 (0,01)
			1.3.2.3	2 (0,01)	2 (0,01)
	1.4			2 (0,01)	2 (0,01)
2	2.1			**21 (0,07)**	**9 (0,03)**
	2.2			13 (0,04)	22 (0,07)
3.	3.1			3 (0,01)	3 (0,01)
	3.2			2 (0,01)	0 (0,00)
	3.3			0 (0.00)	0 (0,00)
4.	4.1			28 (0,09)	14 (0,05)
	4.2			**7 (0,02)**	**21 (0,07)**
	4.3			10 (0,03)	1 (0,00)
5.	5.1			6 (0,02)	13 (0.04)
	5.2			11 (0,04)	1 (0,00)
	5.3			2 (0,01)	5 (0,02)
6.				1 (0.00)	11 (0,04)
7.				17 (0,06)	9 (0,03)

Results

The results show 306 associations for computers generated by 62 students (on average 4.95 per respondent), and 300 associations for ICT also generated by 62 students (on average 4.84 per respondent).

Given empty cells, chi-square could be calculated for only half of the categories (see table 4). For two of these categories with empty cells, however, it needs to be pointed out that there is a very large difference between the numbers of associations. For ‘computer’ no associations are provided for the hardware tools other category (1.2.1.2). The stimulus word ‘ICT’ results in 79 (or 23%) associations. A similar observation although less striking and the other way around is to be made for the category customer programmes (1.3.2.1). Only for the stimulus word ‘computer’ some associations are generated that belong to this category.

For 13 categories chi-square could be calculated. In three cases the difference in the proportion of associations for computer and for ICT seems to be significant. In two cases the prevalence of associations for the computer stimulus

word is higher than for ICT. This is the case for desktop/laptop related hardware components (1.2.2.1, Chi-square: 166.32, df 1; $p < .01$) and for the information delivery function (2.1, Chi-square: 5.50, df 1; $p < .05$). For the activity context (4.2, Chi-square: 3.84, df 1; $p < .05$) the prevalence of associations is higher for ICT than for computer.

The Ghana study

Specific methodology

In the Ghana-study four different groups participated in the study. An overview is provided in Table 5. Males and females were equally represented. 127 high school students (average age 18) participated; they were recruited during regular class hours in a Kumasi High School. Three groups from the University of Education of Winneba (UEW) – Kumasi Campus were involved. Sixty-five students followed courses on Certificate in Education (average age 30); 38 are students in a bachelor programme on information technology education (average age 25), and 111 in a bachelor programme on accounting education (average age 25).

Table 5: Distribution of participants in the Ghana-study

Participants	Stimulus word		Total
	Computer	ICT	
Senior High School	64	63	127
Certificate in Education Students,	31	34	65
Information Technology Education	19	19	38
Accounting Education	58	53	111
TOTAL	172	169	341

The study was conducted during regular classes at the senior high schools and the university. Each category of the participants/students was randomly divided into two groups (see Table 5). One group of the participants was asked to perform the 'computer associated task' while the other group was asked to perform the 'ICT association task'. Various groups of students in each category were asked to work independently and were effectively supervised by the researcher. They were given 15 minutes to complete the tasks.

Results

In total the entire Ghana group generated 1682 associations for the stimulus word 'computer' (on average 9.78 associations per participant) and 1600 for the stimulus word 'ICT' (on average 9.47 associations per participant). Overall, there is a very slight tendency that more associations are generated for computer than for ICT (see Table 6), this is not the case though for all groups of students.

Table 6: Associations per stimulus word for different groups

Participants	Stimulus word	
	Computer (mean / N)	ICT (mean / N)
Senior High School	10.52/673	9.86/621
Certificate in Education Students,	7.74/240	8.24/280
Information Technology Education	9.89/188	9.32/177
Accounting Education	10.02/581	9.85/522
TOTAL	9.78/1682	9.47/1600

An overview of the results is presented in Table 7. For the entire group it can be seen that computer and ICT generate similar associations. There are only three exceptions. First, significantly more desktop/laptop related hardware components are mentioned for computer than for ICT (1.2.2.1, Chi-square: 9.00, df 1, $p < .01$). This is the case in all groups where differences were found. Second, more communication related functions are mentioned for ICT than for computer (2.2, Chi-square: 6.51, df 1, $p < .01$). Again, this is also the case in the two subgroups where the same difference was retrieved. Third, ICT generates a broader variety of associations as can be seen in the larger number of associations for ICT in the 'other' category (7, Chi-square: 36.36, df 1, $p < .01$). A similar difference reaches significance only in the group of Information Technology Education students.

Table 7: Results Ghana study

				Senior High		Certificate in Education		Information Technology Educ		Accounting Education		Ghana Total	
				Stimuli words		Stimuli words		Stimuli words		Stimuli words		Stimuli words	
				Computer	ICT	Computer	ICT	Computer	ICT	Computer	ICT	Computer	ICT
1.	1.1			87 (0.13)	62 (0.10)	44 (0,18)	47 (0,17)	41 (0.22)	47 (0.27)	133 (0.23)	111 (0.21)	305 (0.18)	267 (0.17)
	1.2	1.2.1	1.2.1.1	24 (0.04)	25 (0.04)	12 (0,05)	22 (0,08)	12 (0.06)	13 (0.07)	27 (0.05)	53 (0.10)	75 (0.04)	113 (0.07)
			1.2.1.2	2 (0.00)	1 (0.00)	4 (0,02)	16 (0,06)	19 (0.10)	29 (0.16)	**12 (0.02)**	**58 (0.11)**	37 (0.02)	104 (0.07)
		1.2.2	1.2.2.1	135 (0.)	116 (0.19)	**46 (0,19)**	**11 (0,04)**	**38 (0.20)**	**9 (0.05)**	**93 (0.16)**	**23 (0.04)**	**312 (0.19)**	**159 (0.10)**
			1.2.2.2	0 (0.20)	0 (0.00)	0 (0.00)	0 (0.00)	3 (0.02)	0 (0.00)	1 (0.00)	1 (0.00)	4 (0.00)	1 (0.00)
	1.3	1.3.1	1.3.1.1	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
			1.3.1.2	13 (0.02)	9 (0.01)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	2 (0.00)	0 (0.00)	15 (0.01)	9 (0.01)
			1.3.1.3	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
			1.3.1.4	8 (0.01)	7 (0.01)	1 (0.00)	0 (0.00)	1 (0.01)	0 (0.00)	3 (0.01)	3 (0.01)	13 (0.01)	10 (0.01)
		1.3.2	1.3.2.1	12 (0.)	20 (0.03)	0 (0.00)	4 (0,01)	0 (0.00)	1 (0.01)	4 (0.01)	3 (0.01)	16 (0.01)	28 (0.02)
			1.3.2.2	0 (0.02)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
			1.3.2.3	3 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.00)	0 (0.00)	4 (0.00)	0 (0.00)
	1.4			3 (0.00)	1 (0.00)	0 (0.00)	1 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.00)	3 (0.00)	3 (0.00)
2	2.1			49 (0.07)	38 (0.06)	13 (0,05)	16 (0,06)	16 (0.09)	17 (0.10)	39 (0.07)	40 (0.08)	117 (0.07)	111 (0.07)
	2.2			28 (0.04)	39 (0.06)	6 (0,03)	13 (0,05)	**9 (0.05)**	**21 (0.12)**	**26 (0.04)**	**70 (0.13)**	**69 (0.04)**	**143 (0.09)**
3.	3.1			0 (0.00)	9 (0.01)	1 (0.00)	0 (0.00)	7 (0.04)	3 (0.02)	3 (0.01)	1 (0.00)	11 (0.01)	13 (0.01)
	3.2			1 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.00)	0 (0.00)
	3.3			0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
4.	4.1			115 (0.17)	107 (0.17)	37 (0,15)	55 (0,20)	**26 (0.14)**	**8 (0.05)**	113 (0.19)	66 (0.13)	291 (0.17)	236 (0.15)
	4.2			37 (0.05)	29 (0.05)	3 (0,01)	1 (0.00)	0 (0.00)	4 (0.02)	25 (0.04)	12 (0.02)	65 (0.04)	46 (0.03)
	4.3			10 (0.01)	3 (0.00)	1 (0.00)	1 (0.00)	0 (0.00)	0 (0.00)	1 (0.00)	0 (0.00)	12 (0.01)	4 (0.00)
5.	5.1			84 (0.12)	96 (0.15)	21 (0,09)	35 (0,13)	9 (0.05)	4 (0.02)	31 (0.05)	13 (0.02)	145 (0.09)	148 (0.09)
	5.2			1 (0.00)	0 (0.00)	4 (0,02)	2 (0,01)	0 (0.00)	0 (0.00)	15 (0.03)	1 (0.00)	20 (0.01)	3 (0.00)
	5.3			18 (0.03)	1 (0.00)	**20 (0,08)**	**10 (0,04)**	2 (0.01)	0 (0.00)	12 (0.02)	1 (0.00)	52 (0.03)	12 (0.01)
6.				2 (0.00)	20 (0.03)	0 (0.00)	0 (0.00)	0 (0.00)	2 (0.01)	0 (0.00)	1 (0.00)	2 (0.00)	23 (0.01)
7.				41 (0.06)	38 (0.06)	27 (0,11)	46 (0,16)	**5 (0.03)**	**19 (0.11)**	40 (0.07)	64 (0.12)	**113 (0.07)**	**167 (0.10)**

A closer look at these subgroups indicates that ICT and computer generate very similar associations in the group of high school students. For none of the categories a significant difference could be established. For the group of certificate in education students a specific difference is retrieved for the number of neutral assessments (5.3, Chi-square: 4.17, df 1, $p < .05$) in addition to a difference also retrieved in the total group (1.2.2.1, Chi-square: 58.59, df 1, $p < .01$). More such neutral assessments can be found for computer than for ICT. In the Information Technology Education group we retrieve the same differences also found in the entire group (1.2.2.1, Chi-square: 47.37, df 1, $p < .01$; 2.2, Chi-square: 10.32, df 1, $p < .01$; 7, Chi-square: 21.99, df 1, $p < .01$). This is not self-evident given that this is the smallest group in the sample. One additional difference relates to the mentioning of more verbs for the

stimulus word computer than for ICT (4.1, Chi-square: 17.05, df 1, p < .01). The group of Accounting Education students specifies a specific difference in addition to two already mentioned for the total group (1.2.2.1, Chi-square: 37.50, df 1, p < .01; 2.2, Chi-square: 21.09, df 1, p < .01). They generate more non-laptop/desktop related hardware tools for ICT than for computer (1.2.1.2, Chi-square: 8.27, df 1, p < .01).

The South-Africa study

Specific methodology

By means of a questionnaire data were retrieved from 365 participants (on average about 38 years old). All participants are honours students who combine their study with actual teaching. All participants were requested to generate ten associations for both stimulus words. First they generated associations for 'computer' and after a number of in-between questions they were asked to provide associations for the 'information and communication technology' notion. For computer 2652 associations were generated (on average 7.27 per participant), for ICT 1454 (on average 3.98 per participant).

Table 8: Results for South-Africa study

				Stimuli words	
				Computer (total = 2652)	Information and communication technology (total = 1454)
1.	1.1			467 (0,18)	206 (0,14)
	1.2	1.2.1	1.2.1.1	55 (0,02)	82 (0,06)
			1.2.1.2	**36 (0,01)**	**115 (0,08)**
		1.2.2	1.2.2.1	**414 (0,16)**	**47 (0,03)**
			1.2.2.2	10 (0,00)	5 (0,00)
	1.3	1.3.1	1.3.1.1	0 (0,00)	1 (0,00)
			1.3.1.2	11 (0,00)	7 (0,00)
			1.3.1.3	0 (0,00)	0 (0,00)
			1.3.1.4	37 (0,01)	4 (0,00)
		1.3.2	1.3.2.1	**106 (0,04)**	**13 (0,01)**
			1.3.2.2	16 (0,01)	20 (0,01)
			1.3.2.3	0 (0,00)	0 (0,00)
	1.4			0 (0,00)	1 (0,00)
2	2.1			278 (0,10)	98 (0,07)
	2.2			**97 (0,04)**	**167 (0,11)**
3.	3.1			29 (0,01)	30 (0,02)
	3.2			0 (0,00)	1 (0,00)
	3.3			0 (0,00)	1 (0,00)
4.	4.1			341 (0,13)	194 (0,13)
	4.2			95 (0,04)	77 (0,05)
	4.3			0 (0,00)	5 (0,00)
5.	5.1			158 (0,06)	43 (0,03)
	5.2			82 (0,03)	22 (0,02)
	5.3			113 (0,04)	53 (0,04)
6.				27 (0,01)	25 (0,02)
7.				271 (0,10)	237 (0,16)

Results

First of all it is clear that more associations in general and on average per participant are provided for 'computer' than for 'ICT'. One possible explanation might be that the notion 'ICT' is less well known than the notion

'computer'. Associations for ICT (and not for 'computer') such as 'no clue' or 'what is it' indicate this might be the case.

Chi-square tests cannot be applied when one of the cells equals zero. So chi-square tests have been done for 16 categories (see Table 8). The tests reveal significant differences for four out of 16 categories. For two categories the prevalence of associations is higher for 'computer' than for 'ICT'. This is the case for hardware components related to desktop/laptop (1.2.2.1, Chi-square: 58.08, df 1, $p < .01$) and for Customer programmes (1.3.2.1, Chi-square: 9.09, df 1, $p < .01$). For two other categories the prevalence of associations is higher for 'ICT' than for 'computer': hardware tools other (1.2.1.2, Chi-square: 6.66, df 1; $p < .01$) and major functions: communication (2.2, Chi-square: 5.01, df 1, $p < .05$).

Discussion and conclusion

In this contribution results from word association studies on "computer" and "information and communication technology" in five different countries were summarized. While results differ in different contexts, results in the different studies do also have clear similarities.

First, it seems that while conceptually the notions ICT and computer are clearly distinct, this is not in as much the case for different groups of students and practitioners. The empirical study shows that even though distinct, both constructs are thus clearly related and generate similar associations. In total and over all the studies only for half of the categories significant differences in the proportions of associations were retrieved. This implies that over all the studies for half of the categories similar proportions of associations were generated. This is very remarkable given that these studies have been executed in very different contexts and in countries that largely differ with respect to the overall presence of and access to technology. It is also remarkable because experience with and knowledge of technology-related issues may be presumed to be very different.

At the same time, however, it is also witnessed in this study that while similar, both the notions are not identical. When the categories are compared for which differences are retrieved, there is one difference that is found in all five studies. The difference relates to category 1.2.2.1. Consistently a larger proportion of associations refer to desktop or laptop related hardware components when the stimulus word is 'computer' in comparison to 'ICT'. There are three other categories for which a difference is found in more than one study. In three studies (Belgium, Finland and Germany) it is shown that a larger proportion of the associations refers to the function of information delivery when the stimulus word is 'computer' (category 2.1). Interestingly in two studies (Ghana and South-Africa) the proportion of associations is larger for communication when the stimulus word is ICT in comparison to computer. The third category for which a similar difference is found in two countries is non-desktop or laptop related tools. In both cases (Finland and South-Africa) a proportionally larger number of associations for this category is generated for the stimulus word 'ICT' rather than 'computer'.

While carefulness is indicated given the differences between the studies, it does seem that the notion 'computer' generates associations that are more related to hardware components and are more often associated with information delivery. ICT has a broader and fuzzier meaning. This fuzziness can be derived from the observation that associations are more spread over the different categories for the notion ICT while more concentrated for the notion computer. In addition, it seems – at least in some of the studies, e.g. the South-African study- that the construct ICT is not as widely known as the notion computer. This might be one explanation for the overall higher number of associations for computer than for ICT. A final indication is the finding in Ghana where ICT generated a proportionally large number of associations in the 'other' category. But in Ghana, like what happens in South Africa, among the Junior High school Students the notion ICT is not as widely known as the notion computer.

In this contribution the different studies were treated separately given the different data gathering methods that were used. While this is certainly indicated, comparing the results in the different studies at least suggest some intercultural differences. Some of the assessments for instance seem highly country specific. As an example, the assessment that computer and ICT may result in obesity is only provided in Germany. A further analysis of the associations might be illuminating in this respect. Of course, it is to be reminded that populations and data gathering methods were also country specific.

In the reflection basically four factors seem to contribute to the differences in the associations. First, it seems, with respect to a limited number of categories that the different stimulus words generate to some extent different associations. Second, the specifics of the methodology might also be responsible for some of the differences. Asking the same group of students to consecutively generate associations or splitting the group may account for some of the differences and similarities. Moreover, asking students five instead of ten associations may also affect the results. An additional analysis of the data might for instance indicate that differences between both concepts are larger or smaller when only the first five or the last five associations are considered, i.e. when a distinction between primary and secondary associations is explicitly made. Third, differences between groups may also account for the differences. Data from the Ghana study suggest that this might indeed be the case. It might be for instance that some groups are more familiar with computers and ICT and hence become more distinctive in their associations whereas students less familiar with the notions at hand generate more abstract associations for ICT as well as for computer. It is indicated that in future studies differences with respect to experience with and knowledge of technology-related issues are explicitly considered. Finally, the classification scheme is of utmost importance. While a lot of attention has been devoted to the systematic and bottom up development of the current classification scheme, some doubts have arisen while actually using it. The relative large number of associations in the 'other' (7) category on the one hand and the relatively large number of empty categories in the different studies, suggests that adaptations and more specifically refinements of the scheme might be indicated. A more refined scheme may reveal more specifically the differences between the two stimulus words as well as between different types in associations when different cultural contexts are considered. In elaborating such a more refined scheme, interviews with respondents and thinking aloud sessions may be of great help.

The present study has clear practical implications for ICT-monitoring instruments. In addition, the study also makes an attempt to contribute to effective communication among (international) practitioners in the field of educational technology by clarifying the cultural interpretations of common concepts in the field. However, given that in the study only three European and two African countries were involved, it is warranted to raise the question about the generalizability of the findings. This question can be addressed by a coordinated effort to do similar studies in a wider variety of countries.

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