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Informatics at secondary schools in the French-speaking region of Belgium: myth or reality?

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Abstract. In this article, a relation is made between: (1) the informatics skills that secondary students can (ideally) acquire (on the basis of curriculums), (2) the skills they possess after having passed the secondary education and (3) the topics actually taught in school, described by teachers themselves. These data offer an overview of the informatics place in secondary school in the French-speaking region of Belgium which is, in many respects, subjects to improvement.

Keywords: informatics curriculums content, informatics teachers' viewpoint, informatics skills of university students, informatics in secondary education in Belgium

1 Introduction

If teaching informatics makes sense within the professional community, the non-initiated persons interpret it by many ways: discovering digital culture, mastering software, using technology in the classrooms, teaching about the basic functions of a computer and how to use it, coding, programming and so on.

However, the professional community agrees to say that informatics is now completely dissociated from the computer. It speaks about computational thinking (Wing, 2006; Wing, 2011). Before using a computer to solve a problem, the problem itself and the ways in which it could be resolved must be understood. Looking up a name in an alphabetically sorted list, cooking a gourmet meal, doing laundry or planning a route on a map: computational thinking helps us with all these tasks.

While its European neighbors (France, England…) have realized the importance of teaching it for some years, computational thinking is not present in curriculums in the French-speaking region of Belgium. Fortunately, informatics curriculums are offered to students in secondary schools. But the related courses are mostly optional and the taught topics are often software-related ones. In the same way, the current situation of K-12 informatics education in Flanders is also very chaotic: no informatics curriculum, optional courses and software-related topics.

adfa, p. 1, 2011.

In 2013, the informatics background of francophone students completing their secondary cursus was measured (Henry & Joris, 2015). This article proposes to complement these measures by adopting the posture of teachers. Who are the teachers of informatics courses? Which informatics do they teach?

The structure of the Belgian education is similar to that of many European countries. However, a summary of this structure will be made in section 2 to facilitate the reading of this article. The section 3 proposes a quick reading of the informatics curriculums. Topics covered in these programs will help to define a theoretical informatics background. In the section 4, the informatics background of students will be discussed. These results will be compared to informatics topics actually taught by teachers in classrooms. Last but not least, as this article should be considered as a draft definition for informatics education in Belgium, some lines of action will be discussed as outlook in section 5.

2 Education structure in Belgium

The Belgian school has a three-tier education system, with each stage divided into various levels: basic education including nursery school (children aged 3-6) and primary school (children aged 6-12), secondary education (children aged 12-18) and post-secondary education organized by universities or schools of higher education.

In Belgium, secondary education includes three cycles (usually abbreviated D1, D2 and D3). Each cycle lasts two years.

At the end of primary school, the pupils have to obtain their “Basic Education Degree”. If they succeed, they go to the “common D1” (1C-2C). This first cycle provides a broad general basis, with only a few options to choose from.

In the D2 and D3 levels, secondary school is divided into four types: general secondary education (GSE), technical secondary education (TSE), art secondary education (ASE) and vocational secondary education (VSE). TSE and ASE are divided into two groups of education: one focuses more on technical aspects (TSET, ASET) while the other focuses more on practical matters (TSEP, ASEP). Each type consists of a set of different directions that may vary from school to school. Its basic structure includes four components: a common basis, a mandatory option, a free option and a strengthening. The importance attached to each component depends on the type and not all schools offer every type. In this article, we wouldn’t take ASET, TSEP, ASEP and VSE into account because of the specificities of their curriculums.

In the French-speaking region of Belgium, schools are divided into three groups: the schools owned by Wallonia-Brussels Federation (WBF), the subsidized official schools (SO) and the subsidized free schools (SF).

D1	1C	1D				
	2C	2D				
	GSE	**TSET**	**ASET**	**TSEP**	**ASEP**	**VSE**
D2	3G	3TT	3AT	3TP	3AP	3V
	4G	4TT	4AT	4TP	4AP	4V
D3	5G	5TT	5AT	5TP	5AP	5V
	6G	6TT	6AT	6TP	6AP	6V

Table 1. Secondary ordinary education system in the French-speaking region of Belgium

3 Informatics in curriculums

Each of the three groups of schools proposes some curriculums in informatics. For all of these programs, a “content inventory” is provided below.

For easier comparison between the different curriculums, a standardized vocabulary and an abbreviation system were chosen to describe the topics mentioned inside these programs.

Computer hardware	**HW**	Information retrieval	**IR**
Operating system	**OS**	HTML	**HTML**
Word processing app	**WP**	XHTML/CSS	**XCSS**
Spreadsheet	**SS**	email app	**@**
Presentation app	**P**	Network	**Net**
Image processing app	**IP**	Coding	**Code**
Sound/video processing app	**SVP**	Mathematical logic	**ML**
Databases	**DB**	Algorithmic	**Algo**
Web browser	**WB**	Programming	**Prog**
Search engine	**SE**	Informatics and Society	**I&S**

Table 2. Abbreviation system used in this article

Once the content is identified within each curriculum, a "theoretical" comparison is made between them, as a basis for discussion with the results of this article.

3.1 Wallonia-Brussels Federation schools.

Four curriculums are proposed in the WBF schools. “Introduction to informatics” (1) is organized in the D1 level as a mandatory option. This curriculum becomes a free option in the (GSE and TSET) D2 and D3 levels. “Informatics” (2) and “Computer science” (3) are related curriculums that are organized respectively in the TSET D2 and D3 levels as free options. Then, “Informatics for information management” (4) is organized in the GSE D3 level as free option.

	1 (GSE & TSET)			2 (TSET)	3 (TSET)	4 (GSE)
	D1	D2	D3	D2	D3	D3
HW	X		X	X	X	
OS				X	X	X
WP	X	X	X	X	X	
SS		X		X	X	X
P		X	X			
IP				X	X	
SVP						
DB						X
WB						X
SE	X		X	X		

	1 (GSE & TSET)			2 (TSET)	3 (TSET)	4 (GSE)
	D1	D2	D3	D2	D3	D3
IR				X	X	X
HTML				X	X	X
XCSS						
@	X		X	X	X	X
Net					X	
Code				X	X	
ML					X	
Algo				X	X	
Prog				X	X	
I&S				X	X	

X	Topic taught in a **mandatory option** curriculum
X	Topic taught in a **free option** curriculum
	Missing topic

Table 3. Content inventory of WBF schools curriculums

Except for sound/video processing application and XHTLM/CSS, all the topics are present in the WBF curriculums. However, the majority of them is reserved to D2 and D3 level. Students have more chance to learn informatics in the TSET type. Furthermore, word processing and email application are the most taught topics.

3.2 Subsidized official schools

Only one curriculum is organized in some SO schools (but not in all of them). It is a free option proposed in the TSET D2 and D3.

	D2 (TSET)	D3 (TSET)
HW	X	X
OS	X	X
WP	X	X
SS	X	X
P	X	X
IP	X	X
SVP		
DB		X
WB	X	X
SE	X	X

	D2 (TSET)	D3 (TSET)
IR	X	X
HTML		
XCSS		
@	X	X
Net		X
Code	X	X
ML	X	X
Algo	X	X
Prog		X
I&S		

X	Topic taught in a **free option** curriculum
	Missing topic

Table 4. Content inventory of SO schools curriculums

In the SO curriculum, some topics are never taught: sound/video processing application, HTML, XHTML and Informatics and society. Informatics is only present in the D2 and D3 of the TSET type. So, a student in the GSE type of a SO school will never learn any informatics.

3.3 Subsidized free schools

In the SF schools, informatics is considered as an educational discipline. Three curriculums are organized as mandatory option: one, “Education by ICT: introduction to informatics” (1), in the D1 level and two, both called “Informatics”, respectively in the TSET D2 (2) and D3 (3) levels

	1 (All types)	**2 (TSET)**	**3 (TSET)**
	D2	**D3**	**D3**
HW	X	X	
OS	X	X	X
WP	X	X	
SS		X	X
P		X	X
IP			X
SVP			X
DB			X
WB	X	X	X
SE	X	X	X

	1 (All types)	**2 (TSET)**	**3 (TSET)**
	D2	**D3**	**D3**
IR	X	X	X
HTML		X	X
XCSS			X
@		X	X
Net		X	X
Code		X	X
ML		X	X
Algo		X	X
Prog		X	X
I&S		X	X

X	Topic taught in a **mandatory option** curriculum

Table 5. Content inventory of SF schools curriculums

In the SF schools curriculums, all topics are taught. Some of them, such as image, sound and video processing applications, database and XHTML/CSS are only taught in the D3 level. The others, such as computer hardware, operating system, word processing application, web browser, search engine and information retrieval are taught in every levels. However, most of the topics are only proposed in the TSET type.

3.4 Theoretical informatics background

The perusal of the different curriculums and the identification of their proposed topics lead to define the informatics skills that secondary students can ideally acquire. These skills are different between the three groups and the type of secondary schools (GSE and TSET).

	WBF	SO	SF
HW	X		X
OS	X		X
WP	X		X
SS	X		
P	X		
IP			
SVP			
DB	X		
WB	X		X
SE	X		X

	WBF	SO	SF
IR	X		X
HTML	X		
XCSS			
@	X		
Net			
Code			
ML			
Algo			
Prog			
I&S			

Table 6. Theoretical informatics background in each group for **GSE** type

	WBF	SO	SF
HW	X	X	X
OS	X	X	X
WP	X	X	X
SS	X	X	X
P	X	X	X
IP	X	X	X
SVP			X
DB	X	X	X
WB	X	X	X
SE	X	X	X

	WBF	SO	SF
IR	X	X	X
HTML	X		X
XCSS			X
@	X	X	X
Net	X	X	X
Code	X	X	X
ML	X	X	X
Algo	X	X	X
Prog	X	X	X
I&S	X		X

Table 7. Theoretical informatics background in each group for TSET type

The informatics skills to be acquired in the GSE type are zero for the SO group (no course). In TSET type, if a student chooses all informatics courses proposed by her/his school, she/he could acquire a good level in informatics.

Nevertheless, all schools are free to organize informatics courses or not. In the WBF schools, only 75 (out of 118 proposing the GSE type – 63%) organize informatics courses. Only 10 (out of 39 proposing the TSET type – 25%) organize informatics courses. In the SO schools, 10 (out of 45 proposing the TSET type – 22%) organize informatics courses. Finally, in the SF schools, only 22 (out of 124 proposing the TSET type – 17%) organize informatics courses. This means that it's easy for a student to pass her/his entire secondary cycles without having any informatics. So her/his informatics background can be totally non-existent.

4 Informatics in the classrooms

The curriculums census only gives a vision of which informatics could be present in secondary schools in Belgium. It is necessary to compare this informatics to the one really taught in classrooms. To achieve this goal, two surveys were conducted: (1) the first one with the freshmen at the University of Liege who have just passed the secondary level and (2) the second one with the informatics teachers of secondary schools.

4.1 Methodology

In 2013, a survey was sent by email to 950 freshmen (17.2%) at the University of Liege (Henry & Joris, 2015). The questions were about the trajectory of students into secondary education (group, type) and their informatics background (attended informatics courses, acquired topics).

The second survey was sent by email to two discussion lists: CoP-PR-TIC and visaTICE. These lists were created as part of informatics-related projects in the secondary education. The study conducted here was a prerequisite for further study. So these lists appeared to be quick ways to make contact with informatics teachers (without really knowing how many of them are on the lists).

The survey included between 13 and 18 questions about the teachers themselves (initial training, experience), the schools where they work (group; type, cycle) and their courses (content).

4.2 Results and discussion

4.2.1 Informatics background of students

170 students out of 950 (17.9%) responded to the survey. 145 only matched the desired criteria, i.e. secondary education in Belgium and a type (GSE or TSET) which proposes informatics courses.

Out of these 145 students, 56 (38.6%) followed informatics courses. We deliberately haven't taken into account students repeating their first bachelor (in order to avoid confusion with the informatics courses offered at University). So our "with informatics courses" sample was finally composed of 39 students.

9 students were in a WBF school (sub-sample 1), 3 in a SO school (sub-sample 2), 21 in a SF school (sub-sample 3) and 6 had too specific trajectories (change of group, etc.) to be taken into account. All were in a GSE secondary education.

For each informatics proposed topic, students had to say "yes", "no" or "I don't know" (abbreviated by "?") about their classroom acquisition. The results are then compared to the theoretical informatics background (TIB) of GSE type.

Regarding the sub-sample 1 results, the WBF curriculums seem to be partially used by teachers. 6 out of 11 topics included in the TIB are acquired by more than 50% of the students. It is principally software-related topics. The others (hardware, operating system, databases, HTML and email application) have less success.

	yes	no	?	TIB
HW	33.3	33.3	33.3	X
OS	44.4	22.2	33.3	X
WP	**88.8**	11.1	0	X
SS	**88.8**	11.1	0	X
P	**66.6**	0	33.3	X
IP	22.2	**55.5**	22.2	
SVP	-	-	-	
DB	33.3	33.3	33.3	X
WB	**66.6**	0	33.3	X
SE	-	-	-	X

	yes	no	?	TIB
IR	**77.7**	0	22.2	X
HTML	22.2	**55.5**	22.2	X
XCSS	-	-	-	
@	33.3	11.1	**55.5**	X
Net	-	-	-	
Code	22.2	33.3	44.4	
ML	-	-	-	
Algo	0	**66.6**	33.3	
Prog	11.1	**66.6**	33.3	
I&S	-	-	-	

Table 8. Sub-sample 1: informatics background of students *vs* TIB for WBF group of schools

The results of the subsample 2 demonstrate the existence of courses not related to a curriculum. As the WBF group, the most cited topics are software-related: word processing application and spreadsheet.

	yes	no	?	TIB
HW	33.3	33.3	33.3	
OS	33.3	0	**66.6**	
WP	**66.6**	0	33.3	
SS	**100**	0	0	
P	33.3	33.3	33.3	
IP	33.3	**66.6**	0	
SVP	-	-	-	
DBB	0	**66.6**	33.3	
WB	33.3	33.3	33.3	
SE	-	-	-	

	yes	no	?	TIB
IR	0	**66.6**	33.3	
HTML	33.3	**66.6**	0	
XCSS	-	-	-	
@	33.3	**66.6**	0	
Net	-	-	-	
Code	0	33.3	**66.6**	
ML	-	-	-	
Algo	0	**100**	0	
Prog	0	**100**	0	
I&S	-	-	-	

Table 9. Sub-sample 2: informatics background of students *vs* TIB for SO group of schools

Regarding the sub-sample 3 results, the (D1 level) SF curriculum seems to be almost totally used by teachers. 5 out of 6 topics included in the TIB are acquired by more than 50% of the students. Some additional topics even complete the TIB: spreadsheet, presentation and image processing applications. It could demonstrate the existence of courses not related to a curriculum.

	yes	no	?	TIB
HW	47.6	19	33.4	X
OS	**52.4**	9.5	38.1	X
WP	**95.2**	0	4.8	X
SS	**61.9**	14.3	23.8	
P	**66.7**	14.3	19	
IP	23.8	42.9	33.3	
SVP	-	-	-	
DBB	4.8	**61.9**	33.3	
WB	**52.4**	28.6	19	X
SE	-	-	-	X

	yes	no	?	TIB
IR	**57.1**	14.3	28.6	X
HTML	9.5	**85.7**	4.8	
XCSS	-	-	-	
@	28.6	47.6	23.8	
Net	-	-	-	
Code	19	42.9	38.1	
ML	-	-	-	
Algo	0	**71.4**	28.6	
Prog	19	**61.9**	19.1	
I&S	-	-	-	

Table 10. Sub-sample 3: informatics background of students *vs* TIB for SF group of schools

In the three groups, algorithmic and programming, not included in the GSE TIB, are logically unknown for a majority of students.

Now consider students who had no informatics courses (89, 62.4%). 36 students (40.4%) were in the WBF group, 2 (2.2%) in the SO group, 46 (51.7%) in the SF group and 5 (5.7%) conducted their studies in several groups. No group is spared by the lack of an informatics education.

4.2.2 Topics taught by teachers

36 teachers responded to the survey. Only one teachers out of 36 worked in the D1 level. 20 teachers worked in the D2 and/or D3 levels, in GSE and/or TSET types. So 21 responses were taken into account. This sample is absolutely not representative of the entire informatics teachers' population but it is a good opportunity to make a first analysis, especially for the GSE type secondary education.

Before talking about informatics topics sociodemographic profile of informatics teachers can be drawn. The majority of the teachers is male (65.2%) and is more than 41 years old (73.9%). The average years of experience is 17.3 (SD of 10.3). The average years of experience as informatics teacher is 15.1 (SD of 8.85).

In terms of initial education, a wide diversity can be observed. 13 informatics teachers (out of 21, 60.8%) have completed a "Hard Sciences" oriented curriculum: Engineering (5), Mathematics (2), Sciences (4) or Informatics (2). 7 teachers have completed a "Soft Sciences" oriented curriculum: Economics (4), Accounting (2) and Business studies (1).

The majority of the participants teaches in the SF group (17, 80.9%). Only 4 of them teach in the WBF group.

Out of the 4 teachers of the WBF group, no one teaches in the D1 level, one teaches in the GSE D2 level and 4 in the D3 level.

Regarding the results of the WBF group, the teacher of the D2 level uses the official curriculum (OC). The taught topics are then word processing application, spreadsheet and presentation application.

In the D3 level, 3 teachers work in the GSE type. One doesn't use a curriculum. The other ones use one or both of the provided official curriculum. Most of the topics are taught by more than 50% of teachers.

		OC			OC
HW	**66.6**	X	**IR**	**66.6**	X
OS	**66.6**	X	**HTML**	**66.6**	X
WP	**66.6**	X	**XCSS**		
SS	**66.6**	X	**@**	**66.6**	X
P	**66.6**	X	**Net**	33.3	
IP	**66.6**		**Code**		
SVP	33.3		**ML**		
DBB	**100**	**X**	**Algo**		
WB	**66.6**	X	**Prog**	33.3	
SE	**66.6**	X	**I&S**		

Table 11. Topics taught in the GSE D3 level of the WBF group *vs* topics included in the two GSE official curriculums

The results appear more positive than those obtained with students three years ago. Not only software-related topics are taught. But there are few teachers expanding official curriculum topics. So, students passing through GSE type education of WBF group have little chance of acquiring algorithmic and programming skills.

Out of the 17 teachers of the SF group, one teaches in the D1 level, 11 teach in the D2 level and 14 in the D3 level.

Regarding the results of the SF group, the teacher of the D1 level doesn't work with the official curriculum and proposes 4 topics: hardware, word processing application and information retrieval (out of 6 topics included in the official curriculum) and email application.

In the D2 level, 7 teachers (out of 11) work in the GSE type. There is no informatics curriculum for this type. But 6 out of them use the official curriculum of the TSET type. The last one doesn't use any curriculum. Only 2 topics are taught by more than 50% of the teachers. There are software-related topics.

		OC			**OC**
HW		X	**IR**	42.6	X
OS	28.4	X	**HTML**	28.4	X
WP	**71.4**	X	**XCSS**		
SS	**71.4**	X	**@**	14.2	X
P	42.6	X	**Net**	14.2	X
IP	28.4		**Code**	14.2	X
SVP			**ML**	14.2	X
DBB	28.4		**Algo**	14.2	X
WB	28.4	X	**Prog**	14.2	X
SE	28.4	X	**I&S**	14.2	X

Table 12. Topics taught in the GSE D2 level of the SF group
vs topics included in the TSET official curriculum

In the D3 level, 8 teachers (out of 14) work in the GSE type. There is no informatics curriculum for this type. But 5 out of them use the official curriculum of the TSET type. The other ones don‘t use any curriculum. Taught topics are software-related topics.

		OC			**OC**
HW	25	X	**IR**	25	X
OS	37.5	X	**HTML**	**50**	X
WP	**75**	X	**XCSS**		X
SS	**87.5**	X	**@**	37.5	X
P	**62.5**	X	**Net**	25	X
IP	37.5	X	**Code**	12.5	X
SVP		X	**ML**		X
DBB	25	X	**Algo**	12.5	X
WB	12.5	X	**Prog**	25	X
SE	25	X	**I&S**		X

Table 13. Topics taught in the GSE D3 level of the SF group
vs topics included in the TSET official curriculum

The existence of courses not organized by the official curriculums is confirmed. Teachers use curriculums of TSET type. But all topics of these programs aren’t taught. Once again, the emphasis is on software-related topics. So, students passing through GSE type education of SF group have also little chance of acquiring algorithmic and programming skills.

The teachers’ results point in the same direction that the ones of students. However, they are slightly positive, reflecting perhaps a slow changing situation.

5 Outlook

Informatics curriculums are not sufficient to ensure a good informatics background to students. Indeed, it depends a lot on teachers. They seem to be more attracted by the software-related topics. They forget the “computational thinking”-related topics as code, algorithmic and programming. But curriculums are often limited to methodological recommendations and general objectives. These ones don’t constitute sufficient tags to establish an efficient course. The majority of the teachers are not trained to teach computer (Henry & Joris, 2013). So it is understandable that they teach only the topics with which they feel comfortable. If training the teachers might be a solution, it’s not the only one. Teaching of computational thinking to kids, standardizing curriculums and mandatory informatics courses for all… numerous possibilities should be considered. This study is only the beginning.

Regarding the results obtained in this study, only the ones of the GSE type secondary education have been treated. It would therefore complement these results using bigger (students and teachers) samples.

A more challenging improvement would be to expand the analysis on several years and to take into account Flanders and even another countries.

Regarding the methodology, interviews could be conducted with teachers and students to qualify their answers. A future work would be left a reflection of students on teachers' results and vice versa. Observations in classrooms and analysis of the resources used during the courses would also allow to collect richer data.

Finally, the informatics skills of students would be quantitatively measured (Vandeput & Henry, 2012).

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