Lecturers' Perceptions of the Leaving Certificate Computer Science Curriculum and its Influence on Higher Education in Ireland.

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Abstract.

A Computer Science (CS) subject is currently being rolled out nationally into upper second level education in Ireland since September 2018 on a phased basis. The first cohort of students from phase 1 of the subjects' national rollout completed the first ever Computer Science Leaving Certificate examination in June 2020. This addition to computer science education (CSE) in Ireland now offers students an opportunity to attain a formal qualification in CS prior to entering tertiary education. Irish higher education (HE) institutions will now begin to see a change in student intake on their undergraduate CS programmes, where 'LCCS students' might enrol in first year alongside students who do not have the same level of prior knowledge in the discipline. This qualitative study explores CS lecturers' perceptions of the Leaving Certificate Computer Science (LCCS) curriculum and its influence on teaching in HE through semi-structured interviews. Thematic analysis of the interview transcripts identified five key themes. The paper draws attention to aspects which may provide HE policy makers, heads of computer science departments and lecturers with greater insight into the realities of this addition of CS to the Leaving Certificate.

Keywords: Computer Science; Curriculum; Higher Education; Leaving Certificate; Lecturers' perceptions.

1. Introduction.

In recent years there has been increasing global interest in the introduction of Computer Science (CS) in schools. Keane and McInerney reported on the provision of CS courses in upper second level education internationally and how CS has had a long history in secondary schools in jurisdictions such as Israel (1998), Ontario (2009), New Zealand (2012) and England (2014) (Keane and McInerney, 2017). McGarr and Johnston suggest that interest at present "*has a considerably broader base of support driven by economic, societal, educational and vocational rationales*" (McGarr & Johnston, 2020). Enabling students to take CS in upper second level has

also been shown to lead to more students taking the discipline in higher education (Armoni & Gal-Ezer, 2014; Bell, Newton, Duncan, & Jarman, 2014). Other international research has been conducted on post-primary computer science education (CSE), many focusing on the provision and comparison of CS curriculum in schools and the challenges it presents for school teachers (Falkner et al., 2019). There is currently national interest in Ireland in the Leaving Certificate Computer Science (LCCS) subject that was added to upper second level education in Ireland in 2018. Much of the research to date on this new subject focuses on the curriculum, continuing professional development (CPD) for school teachers and the students (Quille, Faherty, Bergin, & Becker, 2018). It seems timely to frame what this change to student intake in higher education (HE) will have on lecturers delivering modules on undergraduate CS programmes at third level. Also, as identified further in this paper, considerable overlap in syllabus exists between upper second level and the initial years of an undergraduate CS programme at third level.

This paper attempts to answer the following research questions:

1. To what extent do lecturers in one department in a third level institution in Ireland display awareness about the computer science curriculum at second level?
2. How do lecturers there interpret the influence this new curriculum will have on their teaching?
3. Do these lecturers feel that adaptations will need to be made to their existing modules and programmes?
4. What is these lecturers' level of support/opposition to the introduction of LCCS within computer science education?

This study provides an in-depth description of lecturers' perceptions of the LCCS curriculum to help understand the phenomenon.

2. Irish Education System: The Computer Science Context.

The Irish education system consists of three stages; primary, post-primary (also referred to as second level) and higher education (third level). The landscape of Higher Education in Ireland is changing and provided mainly by Universities, Technological Universities, Institutes of Technology, as well as other Colleges of Education (Department of Education and Skills, 2004).

Entrants into HE in Ireland fall into three main groups, namely direct transfers from second level, mature students aged 23 and over, and international students. In 2017 transfers from post-primary accounted for 37,541 of the total 44,124 entrants. In the past few years, numbers have shown a slow but steady increase in the percentage of pupils transferring to third level education, rising from 61.9% in 2010 to 63.8% in 2014 to 64.7% per cent in 2016. (Department of Education and Skills, 2017).

Leaving Certificate Computer Science is currently being rolled out nationally, where in phase 1, the subject began being introduced into classrooms from September 2018. This involved 40 schools across the country who were identified as having the capacity, resources, and facilities to introduce the new subject. The students in those schools who opted for the new subject presented for certification in Computer Science at Leaving Certificate level in June 2020. As a result of COVID-19 calculated grades were offered to those students. The second cohort of students from phase 1 sat their CS Leaving Certificate examinations in May 2021. In phase 2, Computer Science was made available as a subject option to an additional 52 schools who have the capacity to offer it and they have been offering the subject at Leaving Certificate level since September 2020. Phase 3 of the national rollout is for any further schools who wish to introduce LCCS from September 2021. A new framework has been developed by an industry and Department of Education partnership to support the national rollout of the new Computer Science subject. The framework identifies key actions that will be taken to promote take-up of the subject at both ordinary and higher level in the Leaving Certificate examination. There will also be a focus on actions to support greater participation from females and other students that would not usually consider a subject like Computer Science for the Leaving Certificate (Department of Education, 2020). This may highlight potential and attractive career paths for students, therefore broadening the subject's appeal. As a result, HE institutions could see an increase in the number of students looking to continue studying CS at third level.

2.1 Computer Science Curriculum at Upper Second Level.

This new CS curriculum at upper second level is an optional subject that students can choose to study for the Leaving Certificate. According to the NCCA, the curriculum aims to provide students with the knowledge and skills that will help them to understand current computer technology and prepare them for emerging technologies. Skills and capabilities that will provide support for further study and learning beyond formal education, including learning in areas such

as computer programming, database analysis, computer science, computer engineering, software engineering, information technology and game development (Department of Education and Skills NCCA, 2018). Table 1 presents the curriculum which is divided into 3 strands and taught over the two years of the Leaving Certificate.

Table 1: Leaving Certificate Computer Science Curriculum (Source: NCCA).

Strand 1: Practices and Principles	Strand 2: Core Concepts	Strand 3: Computer Science in Practice Applied Learning Tasks (ALT)
• Computers and Society • Computational Thinking • Design and Development	• Abstraction • Algorithms • Computer Systems • Data • Evaluation/Testing	• ALT1: Interactive Information Systems • ALT2: Analytics • ALT3: Modelling and Simulation • ALT4: Embedded Systems

2.2 Computer Science at Third Level.

Of the higher education institutions in Ireland who offer undergraduate programme(s) in CS, it is common for such programmes to consist of a similar set of modules in their first two years prior to any specialisation. A review of modules on Bachelor of Science (Hons) in Computer Science or equivalent programmes was conducted where those HE institutions had this information available online. Table 2 presents the most common modules offered on those programmes having considered the module titles and their content. Generic titles have been given for the purpose of this study. It should be noted that many were found to be interchangeable between first and second year, for example, some HE institutions teach the theory of Operating Systems in first year while others teach it in second year.

Table 2: Typical modules found in 1st and 2nd year of a BSc (Hons) in Computer Science programme in Ireland.

1st Year Modules	2nd Year Modules
• Programming • Web Development (client-side) • Databases • Operating Systems • Networking I • Computer Hardware • Computer Architecture • Maths I	• Object Oriented Programming • Web Development (server-side) • Data Structures & Algorithms • Software Engineering • Networking II • Systems Analysis, Design & Testing • Maths II

While the three strands of the LCCS subject in Table 1 and the third level modules listed in Table 2 may not appear similar, a more detailed examination of the syllabi reveals that a large amount of similarity exists between them.

In a report published by the Higher Education Authority (HEA) in Ireland, the research they conducted calls for a better transition for second level students to HE (Higher Education Authority, 2015). This report specifies that the transitional issues which second level students are reported to have upon entry to HE lies with the stakeholders in second level education. However, I concur with the findings of Hong et al. who suggested that second level teachers and tertiary lecturers both play important roles in helping students with their transition (Hong et al., 2009). Although HE should not be a mere extension of second level education, there is both the need for lecturers to be aware of how the LCCS curriculum is taught at upper second level, as well as the need for second level teachers to be more aware of the needs of third level. This would ensure a coherent approach to CSE.

3. Method.

Qualitative data was needed to understand this phenomenon and furthermore to answer the research questions. Qualitative research stresses a model of investigation that provides an in-depth understanding of intricate issues and focuses on an understanding of the narratives obtained (Gonzalez et al., 2008). Interviews are an appropriate method to gather such data. Prior to the research commencing, ethics approval was obtained by Lancaster University. Participants were recruited via email, asking them to take part in the study by agreeing to be interviewed. Each participant was provided with an information sheet detailing the research, the interview process and the role of participants. Participants provided informed consent prior to participation.

3.1 Participants.

To gather an in-depth understanding of the subjective experiences of lecturers, I tried to get as close as possible to them (Creswell, 2007), to better understand their perceptions of the LCCS curriculum. To do this, interviews were conducted with a purposive sample of participants, six CS lecturers in a computing department of one HE institution in Ireland. As I am a lecturer in the same department, this research could be described as ‘insider’ research (Trowler, 2016). There

are advantages for an insider researcher, however I was also careful to be aware of the potential disadvantages and power imbalances which could create ethical and political dilemmas (Costley & Gibbs, 2006). Access to these participants and data collection was convenient and relatively easy. While the participants are my closest colleagues, with no differences in level of power, I am a relatively new staff member and still becoming familiar with the institution. I purposively selected lecturers who teach first year students and beyond, and that could answer the interview questions. They were three male and three female lecturers who deliver or tutor a variety of CS modules such as programming, web development, algorithms, operating systems, and cyber security on a Bachelor of Science computer science degree. Small sample sizes are appropriate in qualitative research as the purpose of the interview is to generate 'rich' data. The number of interviews undertaken was deemed adequate to provide saturation where it was unlikely that anything new would emerge from undertaking additional interviews. According to Patton, "*there are no rules for sample size in qualitative inquiry"*, with the size of the sample depending on what one wishes to know, the purposes of the research and what will be useful and credible (Patton, 1990).

3.2 Interviews.

I tried to minimize the distance (Guba & Lincoln, 1988) between myself and the participants by conducting the interviews on campus in a quiet and convenient room chosen by each participant. I developed and followed a semi-structured interview guide, which is provided in Appendix A. Each participant was emailed a copy of the interview questions, along with relevant LCCS documentation such as the curriculum specification, a coursework project brief and sample exam papers one week prior to their interview to provide time for reflection. A pilot interview with one CS lecturer from the same department, who was one of the participants of this study, was conducted to test the questions and observe reliability of the measures. As a result, some questions were restructured as they were deemed to be leading and might colour the participants responses. By refining the questions, validity for the newly created interview guide was obtained and so I planned the interviews appropriately to ensure that any bias was minimized. I strove to remain in a neutral position and resisted any temptation to voice my personal opinions about the second level curriculum prior to or during the interviews. As a result, participants were not aware of my own stance on this change, I believe this minimised any possible conflict between my dual roles of lecturer and insider researcher. During the interviews, each question was read aloud to the lecturer and the lecturer was then given time to answer as

specifically or generally as they wished. The natural flow of the questions was ensured and depending on the participant's answers, redundant questions were avoided. The interviews were conducted over one week, lasting on average 30 minutes each and consisted of 10 open-ended questions. Questions included "*How aware were you of the Leaving Certificate Computer Science curriculum before agreeing to participate in this study?".* As participants discussed their perceptions about the curriculum, I used prompts such as, *"what would that mean for your module(s)?*" and "*can you give me an example?"* to better understand their views without changing the potential meaning of the discussion. The final question invited participants to make further comments.

3.3 Transcription and Thematic Analysis.

With participant consent, the interviews were recorded and transcribed in real-time using an artificial intelligence application called Otter. The transcripts were listened back to verify the accuracy of the automatic transcription and necessary changes were made. Email was used as a follow-up mechanism to send transcripts individually to the participants so that they could check accuracy also. Transcripts were then imported to NVivo (v.12) for an inductive thematic analysis, following the procedure outlined by Braun and Clarke (2006). This technique of qualitative analysis involves reading raw data and making sense of it by deriving categories and themes. The primary goal of an inductive analysis is to allow research findings to emerge from the recurrent and prevailing themes in the data (Thomas, 2006). Familiarisation began with reading each transcript in its entirety several times before making notes of preliminary themes and ideas for each individual transcript. Notes were then transformed into emerging themes for each transcript, before seeking connections between emergent themes within the individual transcript. The generation of codes was an iterative process, focusing on each transcript through each stage of analysis before moving on to the next transcript. During this process, on-going review ensured that the meaning of the theme was still accurate and that each code was suitably allocated. Codes and themes for one transcript were cross-checked by an independent researcher.

4. Findings.

Five key themes emerged from the analysis. Each theme is expanded on below with detailed extracts from the interviews.

Theme 1: Aware but Unknowledgeable.

This theme reflects that all lecturers were aware that the new LCCS subject existed but prior to taking part in this study had very little knowledge of the curriculum or current phase of rollout. This was reflected in lecturer's comments such as:

> "*I was aware they were piloting the subject in some schools… I didn't know how many schools or parts of the country or what was on the curriculum."*
>
> *"I knew there was one [LCCS subject] on the cards, but I didn't realise it had started… I didn't know anything about the syllabus*…"

One lecturer expressed the view that:

> *"…it's been well documented online and in education circles that it [LCCS subject] was being considered and would be introduced. So, I was aware it existed… but I didn't go and find out about it myself*."

Not only did some lecturers explicitly state they knew very little about the curriculum being taught at upper second level, one lecturer who offered ideas of the extent it might impact third level relied on speculative language for example:

> "*I think there's only maybe about 20 schools. So, if there's approximately 30 students in each school then that would be a maximum of 600 students coming into third level*."

Although lecturers had some reservations about the LCCS curriculum, all were unanimous in their support of it. Two views expressed were:

> *"It's badly needed. I think every student should do it.*"
> "*I completely support it. I think it's a great idea. If these younger students can see the potential in learning computer science, we'd have far better programmers and computer scientists*.".

Two lecturers suggested the subject will benefit students when deciding on a field of study after

secondary school:

> *"… I think a lot of students who choose computer science at third level don't really know what they're choosing. At least this will give them an idea*."

It was also perceived that it may attract more female students into studying CS. One such comment was:

> "*it might benefit more students, particularly girls might think of studying computing on an undergrad course*."

As already mentioned, lecturers were provided with information about the LCCS subject such as the curriculum specification, a project brief and sample exam papers one week prior to their interview to allow time for reflection. Participants noted that their perception developed following this time to familiarise themselves with the subject and they were then able to articulate a range of views and concerns about the new second level subject. This is reflected in the remaining themes.

Theme 2: Considerable Amount of Syllabus Overlap.

This theme captures lecturers' reflections on the LCCS syllabus and the extent to which it appears to overlap with modules they teach to different stages of undergraduate level. Lecturers reported feeling surprised and this caused concerns. All lecturers identified modules where considerable overlap was found. Those modules were mainly first- and second-year modules. A lecturer who delivers a Web Development module found considerable overlap:

> "*I see a dramatic overlap in the web development syllabus which teaches HTML, CSS and JavaScript. This is more or less what I teach [in 2nd year]. I feel students who achieve very highly on the LCCS curriculum would need further challenges if they came into our computer science programme… there is a very big overlap there and we would have to look at that*".

A lecturer who delivers Algorithms to second and third years reported:

> *"…the algorithms modules that I teach here in year two and year three, the LCCS syllabus and sample assessments overlap in areas such as sorting algorithms, the analysis of algorithms, the big O notation, and recursion*."

Other lecturers who deliver first-year Programming and Operating Systems (OS) modules found an overlap in syllabus in their modules, to a slightly lesser extent but enough to cause concern:

> "*I tutor Java to 1st students, and there's a lot of overlap there in things like variables, methods, algorithms, sorting, arrays, and how hardware works. There are a lot of things that students bringing in from second level we should be aware of. They won't need as much teaching as new students will."*

> *"There's only a small bit of overlap with strand 2 of the curriculum and OS - stuff like CPU, registers, memory as well as data encoding and embedded systems that I cover also. When I looked at the Leaving Cert sample exam papers, the questions surprised me. They were not far off the level of understanding expected in a third level first year assessment*."

As previously mentioned, lecturers had some reservations about the LCCS curriculum, they felt it appears quite broad. It was noted however they had no information about the depth the subject is taught to in schools. Without this information it is difficult to comprehend the extent the syllabus overlaps. This raises the need for communication channels to be established between teachers and lecturers. Two lecturers also acknowledged the fact that third level syllabus should be taught at a higher level in accordance with QQI's National Framework of Qualifications (i.e., level 6 to the first two years of an honours degree) whereas the two years of the Leaving Certificate are taught to level 4 and 5.

Theme 3: Self-Reflection on Teaching a Mixed Ability Class.

This theme reflects another concern held by lecturers as a result of discovering syllabus overlap between syllabi. They perceive this as presenting a situation where lecturers will have students in the same class who have mixed ability in CS; those who have covered the LCCS curriculum and those who have not. They recognised this as a challenge and began self-reflecting on how they might manage this situation:

> "*Yeah I think we will have to look at it… Some of them will have done it previously and some won't. That's going to be a big challenge for teaching at third level*."

Another response included:

> "*Now that some of them will have this prior knowledge, I'm not sure how it's going to manifest itself really to be honest. We will still need to teach assuming no prior knowledge*."

Lecturers discussed the challenge of keeping all students active and engaged, regardless of prior knowledge:

> "*If I had a mix of students in the classroom who have completed LCCS and those who haven't, how do I keep both sets of students interested and engaged?"*

Teach Assuming No Prior Knowledge.

A prominent sub-theme resonating through lecturer's perceptions was that:

> "*We will still need to teach assuming no prior knowledge."*

> *"…when teaching we can't assume that people know the content, so you still have to cover the introductory content*."

They discussed the importance of keeping all students engaged and challenged but if they skipped over fundamental material, that would disadvantage those with no prior knowledge. Lecturers shared their experiences:

> "*This is a tricky one. Something I experienced in a HE institution in another country - students came in with varying levels of computing skills. Some had been introduced to computing before, and some had not. The approach taken there - we introduced everybody from the ground up assuming no prior knowledge. Because if we went too quickly and catered for the students who had previous computing experience, then those*

starting off would be completely left behind."

Theme 4: Open to Adapting Pedagogy.

This theme reflected lecturers' perceptions that adaptations may need to be made the current delivery of modules. Many expressed an open and positive attitude towards this:

"*I'm going to have to change some of my approach anyway."*

"I'm not opposed to reviewing the module content."

The majority expressed the need for more complex challenges for students who have studied LCCS:

"*I think we need to add maybe more complexity to what we're doing, so people who have done it before at least can see some kind of challenge*."

When asked for initial thoughts of teaching strategies and methods they might consider, some suggested they might look at diagnostic exercises to help evaluate the prior knowledge of all students in the class at the start of the academic year. Other methods suggested:

"… peer learning exercises could be something to introduce that could be beneficial here."

"Perhaps by having more challenging lab sheets for those students… particularly early in the year where they might get very bored with the introductory topics. So, we would have to consider some way of engaging them with material."

Theme 5: Start with Departmental Awareness.

This theme intersects with theme 1 where lecturers noted that haven spoken with other colleagues in the department, they too had no knowledge of the curriculum. It was highlighted that the department had begun acknowledging the LCCS subject:

"*we received an email from our HoD last year, looking for volunteers to liaise with*

secondary schools piloting the LCCS subject. I think they appointed two lecturers from the department, but I know that's very much in its infancy."

The importance of lecturers becoming familiar with the LCCS syllabus was highlighted and the need to know what students entering third level will know in the discipline:

"*In our department, we certainly need to read the syllabi and exam papers and take on board the fact that some will have done this*."

To encourage this, many suggested their department should organise a discussion session with its staff:

"*It might be important to have lecturers in the department made aware of it because I know from discussions, I've had with others not involved in this study, they are totally unaware of it. It wouldn't do any harm to have a discussion and circulate the leaving cert exam papers and syllabus, so they know what's being taught to students in second level...*"

When asked for their views on how their department may need to manage this change, solutions were suggested like:

"*We will be reviewing our own courses very soon in our upcoming programmatic review. This might be an opportunity to consider changes."*

"Perhaps one way that we might help students is to make our tutorial classes optional for the students who have done the LCCS subject..."

This is an interesting point and highlights the need for departments to evaluate the need to implement any necessary changes at programmatic reviews or the validation of new CS programmes in future.

Speaking about solutions that worked in the past, bridging studies and foundational courses (online or classroom-based) were also suggested. These would require students with no prior

knowledge in CS to complete a small course at the beginning of the year with the aim of getting those students up to a certain level to join students who did complete the LCCS subject:

> "*it worked very well, bridging studies could be something to consider*."

However, one lecturer predicted this solution might drive potential students away due to favouring another HE institution's entry criteria.

> *"…if our institute started making students do some sort of bridging or foundation course, and another Institute didn't, students would probably go to the other Institute because they might feel they're being delayed here, so we might lose some students*."

The HE institution that this study was conducted in is currently non-semesterised but are in discussions over changing to a semesterised academic year. It was reported that the bridging studies or foundational courses would only be possible if the institution remained non-semesterised:

> *"… because you couldn't start the main modules in the middle of October after bridging studies if you had it*."

The same lecturer suggested if the institution changed to a semesterised academic year then an alternative solution might be:

> "*we could have computer science 101 type modules which cover the basic material, designed to be exactly fitting the Leaving Certificate curriculum, for students who haven't studied it*."

These solutions would only be appropriate if CS departments experienced a substantial number of LCCS students enrol on their programmes. All lecturers expressed the view that only time will tell just how much current practice and policies will be impacted:

> "*I think it's too early to say." and "I'm really not sure, to be honest, it's too early to say, and we may not get any of these students because they might have other ideas of going*

to other computing programmes or colleges."

5. Discussion.

The aim of this research was to explore lecturers' perceptions of the LCCS curriculum at upper second level and the influence they believe it will have on teaching in HE. It was found that all lecturers were aware of the LCCS curriculum but had little knowledge of its syllabus Theme 1: *"Aware but Unknowledgeable*". After receiving relevant documentation on it one week prior to their interview, lecturers were very positive and expressed unanimous support towards this change to CSE. Without the relevant knowledge, lecturers may display uncertainty about such a change. Knowledge is not only a pre-requisite to the ability of influencing the outcomes (Terry & Jimmieson, 1999), but knowledge about the reasons for change will also help reduce uncertainty and develop positive and supportive attitudes towards it. There was an element of uncertainty amongst lecturers' views, with many displaying concern in Theme 2 *"Considerable Amount of Syllabus Overlap*". Here lecturers were surprised and concerned to discover a substantial amount of overlap between syllabi in the Leaving Certificate curriculum and modules they deliver, demonstrated by the examples provided.

Their response to this led to Theme 3 "*Self-Reflection on Teaching a Mixed Ability Class*" where lecturers reflected on how they would teach an intake of students with such mixed ability; students who completed the LCCS curriculum and those who do not have that prior knowledge. Prior knowledge is the range of knowledge a student has accumulated on a specific domain prior to embarking on a course of study in that domain. Its impact on assessment in HE has been a focus of several studies (Hailikari, 2009; O'Donnell, Sharp, Wade, & O'Donnell, 2014). It has been suggested that this will impact on their engagement with the course content to such an extent that students may get bored if they have to revisit content with which they are already familiar (Weibelzahl & Weber, 2002). Much research has also been done in the past on students' prior CS knowledge, with a focus on computer programming experience and the learning experiences of students (Hagan and Markham, 2000; Holden and Weeden, 2003; Rosenschein et al., 2004; Pedroni and Oriol, 2009). The study by Pedroni and Oriol (2009) looked at students' prior experience in programming and the issue of transfer by comparing results of a study run in two universities. In the outcome of that study, they said it impacted heavily on the teaching that students accepted. They found that to teach programming both institutions used

programming languages students had very little experience with to "*level students out*" and not advantage one student over another (Pedroni & Oriol, 2009).

A comparable study conducted in 2005, looked at students entering mechanics programmes at third level with prior knowledge in the discipline. Its authors were concerned with the lack of awareness amongst academics in the engineering department, with regards the incoming knowledge of mechanics of their students. They reported similar findings to this study where if academics assumed no prior knowledge then the students who had studied mechanics previously would become bored. However, if they do assume prior knowledge of mechanics, which 58% of their participants did, there may be many students who do not have this knowledge. They concluded that students without the assumed knowledge could quickly feel disadvantaged and may struggle with the work which may result in them giving up the course (Lee et al., 2006).

As Campbell and Campbell (2008) suggest, in general when preparing any kind of module, much of a lecturers' efforts focus on the content they will teach and less time dedicated to planning and accessing students pre-existing knowledge. It has been argued that if a student finds module content too easy or too hard, differentiation is called for (Dai, 2010). Failing to realise this could have significant implications as acknowledged by the lecturers of this study, who recognised the need to implement varying instructional strategies as seen in Theme 4 "*Open to Adapting Pedagogy*". Depending on student intake, lecturers may need to employ differentiated instruction and adjust their teaching with the intent of maximizing each student's growth and individual success. If they don't and offer the same curriculum and instruction to all students, that would be to deny that individual differences exist (VanTassel-Baska, 1997). One way to identify if differentiated instruction is required or if a large variation in prior knowledge is present in the class, research has suggested the use of prior knowledge tests (Nitko, 1989; Dochy, 1996; Dochy et al., 1999). One participant of this study suggested using a diagnostic exercise as a form of prior-knowledge assessment, this would help identify any misconceptions or misunderstandings the students may have (Bixler, 2011).

While lecturers displayed confidence in their ability to cater for diverse needs, all expressed the need to '*teach assuming no prior knowledge'*, at least until their module(s) and CS programmes have a student intake with a substantial number of LCCS students enroled on it. How soon in

the future, or how great an influence it will have is yet to be discovered. Something clear from this study, is that change is inevitable for CS departments and they need to begin preparing. According to Trowler et al. (2003) "*Small, incremental changes are more likely to be successful in the longer term than big bangs*" (p. 32). In Theme 5 "*Start with Departmental Awareness*", lecturers believe the first step CS departments should take towards managing this introduction to CS in the Leaving Certificate is to have a staff discussion on the LCCS curriculum.

This type of change will be cyclical and ongoing over many academic years and small incremental changes will be required as the number of LCCS students enroling on CS programmes gradually increases. Many factors will influence these numbers; the number of schools who offer LCCS, the number of students choosing to study the optional subject, how many of those continue studying CS at third level, the HE institution (Ireland or abroad) they apply for, and the CS programme they get accepted on. Trowler et al. (2003) believe that "*In HE the important contextual differences that affect the reception and implementation of an innovation relate to a) discipline and b) departmental context*", meaning that "*departments in the same discipline in different institutions will be different in important ways*" (p. 18). In Ireland this is certainly true, as applicants for HE places must satisfy the minimum requirements for their course of choice, and when demand for places exceeds the number of places available, places are allocated based on the rank order of students on the CAO points scale. "*All universities, institutes of technology, colleges of education and many private and partially publicly funded HE institutions use the CAO to select applicants. Each institution retains control of its own admissions policies and can change these policies if they wish*" (Hyland, 2011).

6. Limitations and Future Research.

Limitations of the study include the fact that the sample was comprised solely of academics from one computing department. It would be desirable to collect additional data from academics in other HE institutions to increase confidence in the findings. As the first cohort of students presented for certification in Computer Science at Leaving Certificate level in 2020 it may take many years before a HE institution has a substantial number of these students enrol in the first year of their CS programmes. A review on actual knowledge of the LCCS curriculum over expected knowledge could also be conducted. As suggested previously, much could be learned from establishing a communication channel between teachers delivering the CS curriculum and lecturers, this would help to identify to what extent there is syllabus overlap between the upper

second level CS subject and third level CS modules. This communication would also allow for a more accurate understanding of the depth at which the LCCS curriculum is being taught at second level and whether second level teachers also bear some responsibility to adapt to 3rd level.

7. Conclusion.

This research highlights the limited knowledge CS lecturers have on the LCCS curriculum and their perception of its influence to teaching in HE. While lecturers expressed full support towards adapting their pedagogy if necessary, they showed concerns over the perceived syllabus overlap and teaching a mixed ability class. They view student intakes in the future as consisting of students with prior knowledge after completing the LCCS curriculum, and students who will not have that prior knowledge. Research has suggested differentiated instruction is important and that diagnostic tests are a valuable strategy to implement in this situation. This study highlights to CS departments the need to make department staff aware of the curriculum and the benefit of identifying any modules on computing programmes where syllabus overlap exists.

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APPENDIX A

Lecturer Interview Questions

10 open-ended questions:

1. How aware were you of the Leaving Certificate Computer Science (LCCS) curriculum before agreeing to participate in this study?

2. What did you know about it before agreeing to this study?

3. Now having received and reviewed the LCCS curriculum, do you have any personal concerns regarding the curriculum?

4. What concerns, if any, do you have about students who completed LCCS enroling in first year of a computer science degree?

5. In what ways, if any, do you see it influencing modules that you teach?

6. Do you think you will adapt any of your modules?

    a. If yes, in what ways?

    b. If no, why not?

7. Do you support or oppose this change to computer science education and its introduction to 2nd level?

a. If support, why so?

b. If oppose, can you explain further?

8. Do you think staff in computing departments at third level need to start collaborating over what the change in potential incoming students may mean?

9. Do you have any ideas as to how your department can accommodate/prepare for this change?

10. Are there any other comments that you would like to make that we have not covered?

Include, where appropriate, questions relating to:

- Further detail or clarification
- Examples
- Specific teaching experiences