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# Professionalism in the First year of a Software Engineering Curriculum

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**Abstract:** Professionalism is an important part of any subject of study where graduates subsequently move into a professional career following their degree course. Most professional bodies therefore require accredited degree programmes to include this topic in the curriculum. The British Computer Society gives guidelines to institutions in the UK. These guidelines have been followed in the construction of the current Software Engineering Curriculum in the Department Of computer Science at the University of Sheffield. However it is unclear how effective the current form of presentation is. This report seeks to investigate this and look to possible ways of improving the presentation, particularly in the first year. I conclude that the most important factor in teaching professionalism; is the professionalism of the teachers. Students seem to learn these skills best by example, and therefore the greatest improvements are likely to be found by implementing common standards for teaching practice across the syllabus.

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## Introduction

Degree courses currently perform two different roles for the students that take them. On one hand they provide theoretical and academic interest and on the other they provide training for students who are about to enter the real world of business. This report focuses on the business side of the education and in particular on professionalism. It will consider only the first year of the software engineering degree program at the Department of Computer Science at the University of Sheffield.

It is a requirement of the accrediting body of the software engineering course, the British Computer Society (BCS), that professional issues are tackled as part of the course. Professionalism is defined by the BCS to mean the way in which a professional would act legally, ethically and socially in some given situation.

This sounds precise, but an exact and universally agreed definition of professionalism is hard to come to. In order to structure this investigation and understand the complex issues at play the author requested participation from students and staff in the Department of Computer Science. Their views were captured through informal interviews and statements in response to my request. The staff and students' views were then compared with the published views of accrediting bodies and the author's experience in order to critically analyse this aspect of the course. A specific description of these sources may be found in the appendix.

This report divides the views into two key categories: In the first the definition of professionalism is considered from two perspectives. Firstly we consider if professionalism is something that should be learnt and secondly we consider the casting of professionalism in an undergraduate course, given that it should be on the

curriculum. The second part of the report considers how professionalism is currently implemented on the course and some possibilities for improvement.

## **Should undergraduates learn professionalism?**

The first issue that has to be addressed is that of why professionalism should be taught as part of a software engineering course. Answering this question begins to illuminate what is meant by the term, and what teaching it might mean.

Professionalism is a concept that is not easily accepted by academia in general. It can be cosy to just consider theoretical notions and mark essays on ones own in depth subject area. However not all students will be perennial academics, indeed most will enter some form of professional career. As a result many degree programs incorporate some form of practical skills orientated training. This is also a common requirement of professional bodies accrediting degrees:

“Students should not perceive legal, social, ethical and professional issues as peripheral to, or less significant than, technical skills detailed in the syllabus.”

*(British Computer Society, 2004, p 17)*

This extract from the BCS portrays a view of professionalism that is an important part of the degree programme and the BCS stresses that it should be integrated throughout individual modules. This is in marked contrast to the description of professionalism defined in the single program specification (point K5 abstracted below) which seems to have led to a focus on a singular presentation of professionalism to the students.

“K5 An appreciation of human, social, legal and professional issues relating to the use of computers”

(“Software engineering program specification”, 2004, p 2)

This gulf in the perception of professional issues certainly seems to reflect a mismatch between the needs of an engineering society, which is slowly establishing itself within a far more mature community, and academics that are in the main more interested in research and only occasionally education.

I would maintain that it is of increasing importance that as a department we must address the issue of professionalism as job prospects are becoming more significant in the race for student recruitment. The figures that represent the number of graduates that find employment are taking a higher place in the ratings of departments nationally and so form an important aspect in the recruitment of students. This is perhaps in sharp contrast with the stated ambitions of the curriculum which in a traditional way focus on knowledge that can be expressly taught.

Moreover, most of our graduates do not carry on in the computing profession, with only a 1/3 joining such companies. This means that the professional issues must not only be taught but be taught in a way that applies across professional disciplines. By providing students with a working knowledge of practical professional issues we can only increase the chances of them finding work. I suggest that the students need to learn these professional skills not just as tools but as behaviour. In the long term this can also only benefit the prestige of the department and shows the importance of providing such skills.

## How do we cast professionalism in an undergraduate course?

There are at least two views of professionalism that are broadly contradictory in nature. Fortunately it seems that staff members are more likely to practice professionalism across the programme despite the specification being interpreted as more restricted in scope.

As an approach, it is possible to isolate some defining themes from this ‘informal curriculum’. Here is a staff member’s account of such themes in a form that equates fairly easily to a formal approach:

“For me professionalism includes issues of intellectual property, copyright, plagiarism, ethical issues including the wider social and political consequences of a given job/assignment. Depending on the assignment there may be environmental or legal issues. Professionalism means taking all these matters into account, being aware and able to answer for the choices you made.”

(S2)

The next extract shows a more stealthy approach to professionalism in the department which is practically led on a series of courses. The Crossover project in the first year whilst not working with external clients, is of a similar style to those mentioned in the extract:

“As for the current curriculum, Genesys, Software Hut and Maxi projects deal with real clients. This is important because students have to understand that it is people and business which drive a lot of software development and be able to talk to people who are not developers. A part of it is an understanding that it is not a perfect system which is needed but the one which solves a business problem. Working in a team and

dealing with people with a different personality is another issue which can be expected of a professional.”

(S3)

In order to meet the joint academic and professional aims, professionalism must, I suggest arise in this way as a natural behaviour. This being the only way to satisfy the needs of the accreditation bodies:

“Awareness of professional standards, codes of conduct and relevant legislation must not be separated from the practice of designing and implementing systems. Whilst it is appropriate for some of these issues to be addressed in separate modules, it is essential that these topics are integrated into the course and should be referred to in the project.”

*(British Computer Society, 2004, p 17)*

“The incorporation of professional practice must be a conscious and proactive effort because much of the material must be interwoven into the fabric of existing curricula.”

*(IEEE/ACM, 2001, s 10.4)*

Such a supportive environment also naturally leads to an environment where professionalism is shown by example. For professionalism not to seem false when applied across the curriculum it must be consistent to context and not abused in the way illustrated by the following extract. There is a need to show that professionalism is as much about example as precept.

“The criteria for professionalism depend on the actual profession you have in mind, and ‘professionalism’ is often just a word used to criticise people who do not want to do more than they are actually contracted to do. I have certainly known, for example, of a secretary accused of being uncooperative (hence unprofessional) simply because she refused to allow her working practices to be changed at (literally) ten minutes notice. Some people would say her boss was being professional, as he was attempting to exert authority to solve a staffing problem, but I would have said her boss was being unprofessional by expecting something unreasonable of a colleague. Likewise, the secretary could be deemed either professional or unprofessional according to who is analysing the situation.”

(S1)

It is of course not always easy to agree in practice what constitutes a good example of professional behaviour, as the following comment of one staff member insightfully illustrates:

“For example, our students have to learn about discrete maths, and do so in a standard maths-lecture environment. Since they are not required to do any assignments for that module, there is no way that their general attitude (professional or otherwise) can be determined. Possibly you could argue that students who fail to attend are being unprofessional, but even that is open to question. Professionalism presumably includes showing initiative, so if students can find more productive and efficient ways to use their time, while still achieving all of their goals, that is something the ‘IT profession’ would probably praise rather than criticise. In other words, the same behaviour can be deemed professional or unprofessional according to context - getting students to behave professionally as students may actually involve training them in behaviours that hamper their professionalism once they are out in industry.”

(S1)



This quotation again illustrates the importance of context and shows that it is difficult to pin down the word 'professionalism'. Nevertheless, despite such complexities, it seems to me that the themes of integration, support and example provide essential criteria in the light of which it is possible to discuss the current degree program. Of course there will still be difficult issues in applying the concept, and it will be necessary to specify potential areas for improvement if the program as a whole is to model and develop a broad professional approach for its students.

## **Implementing professionalism**

As has already been shown professionalism as a concept is already partially addressed in the curriculum that we teach. This is necessary for the course to be accredited. However, it is also clear that the definitions of professionalism implicit in the professional bodies' statements imply that the ethos must be common over the duration of the course.

In this section I will consider a number of inter-connected themes. In order to make these distinguishable I have separated them into subsections. However in order to understand the issue as a whole it is important that they should be considered together.

### ***An integrated and consistent curriculum***

As a base line the IEEE offers some advice on the type of course that they would expect in a typical degree program. These are summarised as:

- Capstone courses; large development projects in the final year that tackle real world problems.
- Professionalism, ethics and law courses; these are covered by a single course allowing in depth analyses of these issues.
- Practicum/internship/co-op programs; either paid work or course credit is awarded for working in industrial placements.
- Team based implementation courses; give a broad overview as opposed to an in depth approach.

Over the three year bachelors curriculum the Department of Computer Science at Sheffield currently supports all these module types apart from the industrial internship. However the boundaries between these areas are less clear in the level one syllabus. Some aspects of professionalism are supported at least through direct teaching. For example in the context of programming one lecturer observes:

“We do try to teach our students professional standards in programming. They should design their algorithms before coding, write well-structured code and document it clearly. The program isn’t finished unless it is tested on some data. We teach the standard documentation style for the language, as used in standard libraries. Students keep to these standards with variable success. Sometimes the pressure to produce working code results in skimpy documentation.”

(S4)

Such an example illustrates the weak output that a non-integrated approach to developing professionalism can produce: professionalism can easily be sacrificed to achieve a technical result, rather than being the foundation of any result. This supports the theme developed in the previous section that any focus on improving professionalism must be in general across all the courses, as opposed to the specific provision of individual courses. However, many level one courses seem to be outside

of this unifying goal. This is probably because there is a strong distinction made between academic and vocational courses at level one. Therefore it would seem that some work is required to bridge this divide to fully embrace the requirements of the professional bodies.

### ***A supportive and professional learning environment***

As noted above a generalised approach to professionalism is particularly apposite at level one where the emphasis is perhaps more on giving the students enthusiasm for the academic subject. However it is also important to develop skills related to professionalism. A staff member commented on this balance by considering the alternatives that could provide an opportunity to study complex professional skills:

“We teach in a bottom-up fashion, building on concepts learned earlier, starting with small programs leading to big ones. An alternative model is the ‘inverted curriculum’, proposed by Christine Mingins and others at Monash University, Australia, in which complete systems are shown first and students learn how to break this down and build substitute parts for modules that are progressively removed. I’m not sure how comfortable students would feel with this approach, as it ties them into a particular system and so they cannot easily generalise from their experience of supplying the missing parts.

“Overall, I think the most successful approaches to teaching are those that build confidence in the students, through their self-conscious awareness of having acquired the skills that they need to complete the task. It should be possible to factor in professional standards without over-burdening the students.”

(S4)

Certainly supporting students and building up their confidence is essential if professionalism is to be realised in this subject. Indeed it is only through constructive feedback (professionalism modelled by the educators) that the students can improve. This is perhaps where the majority of modules are weakest at the moment; and it is clear from my own observations that the students are confused about the quality of work that is required for different modules. The lack of a consistent standard and quality feedback are perhaps the biggest problems. This is not un-noticed by the staff:

“The reasons for the failure to promote professionalism at level 1 are probably complex, but some of the following points may be important, regarding the teaching style:

- Substantial targets are set at each stage, with long delays until the feedback is eventually obtained. I feel that shorter-term, less open-ended targets should be set, with earlier constructive feedback and credit for team participation. There needs to be some notion of the “right result” for each design stage.
- Management meetings are held, in which groups are mentored for 10-15 minutes each. This is typically unrewarding for the lecturer, and boring for the students, as groups have typically not done what they were asked to do, such that the meetings consist of reminding them what they had been asked to do. The time spent managing the groups seems mostly wasted; and the other groups hang around waiting to be seen.”

(S4)

The interviewed students have similar concerns, as shown below. However it seems that as the students’ progress through the degree program they become more confident in their approach to this teaching style. Through my observations it seems clear that the more experienced students benefit greatly through this process of self management, ultimately reaching a high level of engagement. The challenge therefore is to help the

first year students engage more effectively, possibly by detailing how they should behave and the benefits that this could bring.

“In many courses it was difficult to tell what was expected by the lecturers in terms of documentation, often the timing of hand ins made it difficult to completely finish a project to our satisfaction. There seemed to be little consistency between the requirements of different modules and projects. This was confusing at times; although in hindsight it makes sense that the requirements in some projects were relaxed to allow us to focus on specific issues.”

(G1)

“Not everybody looked at documentation in the same way. This was good because I was able to see the various styles and look for good ideas to add to my own. Also the standard varied, particularly in one course. Again this was a useful experience as it helped to highlight what was important. [However] at times it was difficult to identify how much documentation was required for courses. I knew I had to provide some, but different lecturers seemed to want different amounts. This seemed very unclear at the time. This was compounded by a lack of feedback, as to why marks were dropped, was it the documentation or the code itself?”

(G2)

I think that it is clear from these quotes that there is a need to define the standards for coursework that are acceptable across the board. This should come about as part of a professional approach to teaching. Our task as educators is to set an example through both our teaching and assessment; this can provide a unifying benchmark for professionalism for the students if it is consistent over all the modules.

## ***Professionalism by example***

It is obviously important that the staff and students have subject specific knowledge of professionalism. The students are most likely to understand the importance of this is they also see the staff following the same rules. The BCS requirements promote this as best practice.

“It is expected that all staff demonstrate and maintain high professional standards in their own use and practice of systems engineering.”

*(British Computer Society, 2004, p17)*

The BCS standard refers to professional practice in engineering by teaching staff: but students have limited exposure to this, and their perceptions are overwhelmed by their experience of staff not as subject specialists but as educators. Here such best practice is not always followed and consequently the students also had strong views on this. They felt strongly that when staff behaved professionally then the students would also follow:

“The professionalism or lack of it among some of the staff does not set a good example. In particular many courses lacked feedback; perhaps just a grade was delivered. This made it very hard to know how to improve in future assignments. Often lecturers are also hard to find, and seem uninterested in students seeking feedback. The best option would be to have written feedback that was delivered quickly.”

(G1)

I would suggest that the ethos of the previous BCS professional requirement should therefore also be translated to the teaching context. This is perhaps for the reader to judge personally, but the following extract shows the strong feelings students have about teaching practice:

“Some times it is hard for us to ask questions in lectures. Those courses which provided a sense of community worked best as I felt like I could represent a group. It may be beneficial to use seminar-like situations to help this, but we have not had any on the course. These would focus on explaining and discussing concepts and detailed exploration of class problems. All too often this is dealt with in lecture like situations where the solutions are represented on the OHP.”

(G1)

### ***Professionalism in practice***

The professional behaviour of the teachers needs to be able to influence how the students act. As an example this final section looks at how the various group projects on the programme are perceived by the students. The way that this works is crucial as this is the key way in which the students get to practice professionalism whilst working with others.

When students work with their peers in teams for coursework projects they have a chance to practice this behaviour for real. This leads to many issues rising to the surface which the supervising staff have to manage. The different approaches followed by individual students often enhance the experience, but they can also cause friction as this extract shows:

“Another aspect of being professional is dealing with hand in deadlines. Some people regarded it to be important to have it in on time, whatever the state of the work. However, others felt that the 80% cap imposed in most courses was unimportant as they were unlikely to reach this standard if they handed the coursework in on time. This was especially aggravating in group projects where you had to rely on your team mates.”

(G2)

This is a general problem among all courses with students often aiming to pass the course as opposed to achieving their best possible grade. This is perhaps due to a lack of enthusiasm for the course and the work that they are doing, and perhaps a lack of personal pride. The author has observed this most acutely on our 4<sup>th</sup> year project. Here, the students are generally upbeat as it is their final year and they are working with external clients. However if the client becomes too demanding, or team mates start to slack off, then the rest of the team becomes quickly demoralised. This also seems to occur at level 1:

“My experience of teaching Software Engineering to level 1 students is mixed. We teach the software lifecycle and standard formal specification and design notations, and we give students the experience of taking a project through the software lifecycle, but give them a realistic industrial experience by rotating the projects with respect to the student groups, after each stage. However, they seem to acquire quite poor habits when initially faced with apportioning work to team members and generally have trouble organising themselves and taking teamwork seriously. Partly, this is due to their inexperience; and partly due to the way the subject is taught. Student teams become discouraged as they fall behind and many fail to produce a working result. Though the projects may fail, the students eventually pass, though some with very low grades. They tend to learn from their mistakes, since at level 2, their teamwork performance is greatly improved on a similar project.”



This is in the author's opinion the root of some of the problems at level 4, where the students have had bad experiences and are unwilling to repeat them, perhaps due to lack of support and fear of failure. It is also in the author's view an opportunity to promote professional issues at level 1 as a way of integrating the different working styles of the students. This could set up an example of best practice for other courses to follow.

## **Conclusions and Recommendations**

In the previous section the strands of Integration, support and example were considered. These led the author to consider how professionalism is reflected to the students by the staff. The degree program clearly already caters for professionalism but it is limited by the provision of explicit teaching resource and the teaching style of some staff at level one. This seems to rub off on some of the students when they practice professionalism who act with the academic mindset which often means that assignments are handed in just on time for example.

It seems from this analysis that the students are taught the key subject specific professional issues to an acceptable level throughout the course. However it is equally apparent that they do not, at least in the first year, naturally apply these skills. The polarised courses mean that academic subjects often fail to impress the need for professional standards. This failing is therefore dependant on the professionalism of the teachers rather than of the written curriculum.

No doubt the reader can recall experiences from his own education, research and teaching practice that have been influenced by professionalism. Typically these

experiences revolve around the influence of others, be they peers, subordinates (such as students) or superiors (such as teachers). Our behaviour is strongly influenced by these trend setters, and as teachers we have the responsibility to act professionally for example. Our challenge is to do this in an active and acceptable way that results in well balanced graduates!

Whilst it is perhaps impossible to peg professionalism with a simple definition this assignment has identified some key issues that can define our strategy to teach professionalism. Whilst this is targeted at a computer science programme it is likely resemble advice for other subjects:

- (Integration) There is a need to ensure that professional behaviour is used throughout the course. This has two perspectives; the example of the staff and the material provided to students. This forms the two strands of support and example.
- (Support) Students should be supported in all their work by providing departmental wide guidelines on the quality and standard of work required to achieve grade levels.
- (Support) Students should also expect that staff provide formative feedback after assessment so that they can continue to improve.
- (Example) Staff should seek to promote subject specific professionalism through appropriate course work, but also by acting as professional teachers.
- (Practice) Students should be made aware of their behaviour, specifically in team projects. This should be such as to raise the awareness of what it means to act professionally.

Despite these suggested improvements it is evident that the students already have a strong sense of professionalism once they reach the fourth year. This is brought into sharp focus when we compare them to the MSc students that join us from other institutions who are supposedly educated to the same standard. However further investment in this area could well significantly improve the impression that the

students get from the course, and perhaps over time help them to understand their own professional development better.

It is essential that professionalism is maintained in all courses in the department. As such it would be useful for a more detailed study to be carried out. In the first instance this would undertake to ask each lecturer how they address the issue of professionalism on the course that they teach. The results should be combined to form a policy that could help those lecturers who struggle with this aspect. In order to check that this policy is effective, second year students should be interviewed, with a focus on the difference between the first and second years and how this has influenced their picture of being a software professional. These actions would then need to be repeated periodically to monitor how the department responds to this challenge over a longer period.

## **Acknowledgements**

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## Quotation sources

The program specification for the degree programme (Software Engineering) (“Software engineering program specification”, 2004), provides an overview of the structure of the taught course.

The guidance given by the professional bodies; the BCS (*British Computer Society*, 2004), and the IEEE Computer Society (the accrediting body for universities based in the United States of America) (*IEEE/ACM*, 2001). Accredited departments are periodically reassessed by the bodies, and these documents describe the programme elements that are required.

Secondly, some staff in the department gave their opinions on professionalism or were interviewed, these were volunteers who had something that they wanted to say regarding these issues. The roles of the staff are noted in the sources appendix. Thirdly, three students in the 4<sup>th</sup> year were interviewed about their experiences on the degree programme and finally the author’s own views are taken into account.

Staff and students volunteered their views regarding professionalism. Initial responses followed a general email to the department asking for opinion. As a result of this one member of staff and the three students were interviewed using a non-directive technique that expanded on issues that they had raised.

Staff: S1, S2, S3: Lecturers in the department, comments collected by email.

Staff: S4: Lecturer and involved in structuring the overall curriculum, comments collected by interview.

Students: G1: two men, G2: one woman, comments collected by interview.