Level 4 Project

Improving Primary Teachers Motivation for Computing

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Contents

1 Introduction

Computing Science [CS] is an important curriculum area, that should be taught at all level of compulsory education [2], including during Broad General Education [BGE], which is the focus of this report. Computing Science has the ability to teach students not just core computing skills, but allows them to both learn and build on core foundational skills, such as Computational Thinking (CT) which the current computing curriculum is designed around [1]. Computing Science can also be used as a vehicle to teach other curriculum areas including numeracy, literacy, art, etc, making it not only an important subject in itself, but also for the development of other subject areas.

1.1 Curriculum Pain Points

Currently the BGE curriculum for computing, is in general not taught to its fullest potential, with a number of pain points with the current curriculum identified as being possible causes for this. These pain points are defined as follows:

Vague and Undetailed Lack of detail in the curriculum specification, making it challenging for teachers to interpret

Restricted Time Limited time in Computing Science makes it difficult to gain and build skills and conceptual understanding

Lack of Teacher Understanding Teachers in general do not have an adequate understanding of Computing, and therefore struggle to teach it effectively

Technical Language While the curriculum uses less subject specific language than other frameworks, it still makes use of terms that without clear definition, teachers may struggle to understand

Lack of Justification While Computing Science can be used to develop and build a number of core foundational skills for use in multiple areas, this is not always known by teachers

Lack of Delivery Consistency The design of the Scottish curriculum gives large amounts of agency to individual schools/teachers, leading to inconsistent approach and knowledge when students progress to secondary school

When analysing these pain points, a core underpinning theme was identified, which was a lack of understanding or justification that teachers expected to teach computing science had. Before any of the pain points can be effectively addressed, teachers underlying motivations for teaching computing science need to be modelled and understood, so the teachers who are core stakeholders for any improvements, are motivated to engage with any future improvement processes.

1.2 Motivation

In order to model teachers motivation I am using Expectancy Value Theory developed by *Eccles, S., et al* [3]. While this theory was developed to model learners motivation, it can be used to model a teacher's motivation to teach a subject, because there is a significant learner journey involved with teaching anything, especially when teaching an unknown subject.
This theory explores motivation based on two primary factors, **expectation (of success)** and **value (of learning)**. These factors effect a persons achievements, effort and persistence of a given task [17], which in this context is computing science lessons. The theory then further divides value into sub-factors, which are defined below, alongside specialised descriptions of how they fit into a teaching context.

Attainment Value (Importance) The importance of doing well in a given task
Both the *level of importance* that a teacher feels to do well in the delivery of the computing curriculum, and *how measurable* that success factor is for the teacher to understand and gauge their success. Both personal and institutional (eg their School).

Intrinsic Value The enjoyment obtained from performing a given task
The enjoyment, as measured by the teacher of both their own enjoyment when creating and delivering computing lessons, alongside their perception of the enjoyment of their students during computing lessons.

Utility Value (Usefulness) How well a task fits into future plans and goals
How useful the content and skills taught though computing education, are thought to be for a teacher's students, both in their current education and beyond.

Cost How one task may limit engagement in others, how much effort is required and emotional cost

2 Motivational Challenges

2.1 Perceived Value

The perceived value of computing that a primary teacher holds, is a core aspect of their motivation to teach the subject, as defined in Expectancy Value Theory. Perceived value for computing is generally low, which can be understood by splitting value into its subfactors defined in the theory, and outlined in section 1.2.

2.1.1 Attainment Value

A primary teacher has limited reasons to assign a high importance value to teaching the computing science curriculum fully.
Looking at a teachers personal attainment value, as computing science is only a small part of the curriculum it is not likely to be seen as a major subject area [16, 15], and as such does not carry much

importance or consequences for students if not fully taught. As there is no standardised testing in BGE for computing, the teacher is responsible for evaluating their students progress, using their professional and subject knowledge [13]. Because many teachers do not have background knowledge in computing, this restricts how effectively they evaluate their students progress, and subsequently evaluate if they are succeeding in teaching it.
Now looking at the institutional effect on importance value, within a school there are not likely to be many teachers actively engaging with computing, limiting the importance for a teacher to improve their own skills to ensure a consistent standard with colleagues. Many teachers report their colleagues feel cautious about engaging with computing, and can feel isolated when teaching computing science in their school [11, 12].

2.1.2 Intrinsic Value

Now turning to look at the enjoyment a teacher perceives for both themselves, and their students when engaging with Computing Science.
Firstly looking at a teachers own perceived enjoyment of computing, In general a teacher without adequate knowledge of computing will have low confidence and a general concern towards teaching computing lessons [10], with specific concern around the potential for something to go wrong, and then being unable to recover from it [6]. These negative feelings around computing lessons are going to limit the potential enjoyment a teacher will have, both when planning and delivering a computing lesson.
On the other side a teacher may have the perception that their students are going to find a lesson boring and irrelevant, especially if that teacher does not feel they have adequate knowledge to make content engaging [14]. Students without CS experience often describe the idea of the subject as boring and difficult [5, 4], partly confirming the expectations of teachers that students will not enjoy their lessons.
Both the teachers own perspective and the teachers perceived perspective of their students contributes to a low overall expected enjoyment associated with computing lessons.

2.1.3 Utility Value

Turning to how a teacher perceives the usefulness of teaching computing for their students.
In order to understand how useful computing is a teacher needs to understand what computing can give their students, understanding the core skills that it develops. If a teacher does not understand what skills computing gives their students, they are unlikely to believe it holds much usefulness to their students when taught [7, 9].
Alongside this teachers also need to understand how computing can be integrated into other subjects to enhance the teaching of both subjects skills, to understand how useful the subject is as a vehicle to teach the curriculum. As most teachers only teach computing as a stand-alone subject and don't attempt to integrate it [11, 15], it is likely they either do not know the usefulness of, or know how to, integrate computing.
Further to these points if a teacher does not feel they have adequate subject knowledge, they are unlikely to have the confidence that they are going to teach the content properly to their students [12, 6, 8]. If the content is not properly taught, then it is not going to hold much usefulness for their students.

2.1.4 Cost

Turning to the final value factor described in Expectancy Value Theory, the cost of preparing for and teaching computing lessons, both the expected cost, what the teacher perceives as the cost ahead of time, and the real cost of the task. While these values can be different, it is important to attempt to lower both of them (in sync), to make computing a more appealing subject to teach, and therefore increasing motivation.
The main cost associated with teaching computing science is the resource and material preparation. As most teachers have limited knowledge of the subject, they require resources to guide and support their lessons. Finding these resources can be time consuming if the teacher does not know exactly where to look, while there are many resources on the internet teachers have to evaluate these resources for both quality and relevance [14] alongside adapting them for the Scottish BGE curriculum if they are not specifically designed for it. Each of these stages *find, evaluate and adapt* take time and effort from the teacher, and require an understanding of computing science, which many teachers do not have.
Alongside preparing materials for their lessons, teachers often need to learn the content they are teaching as they are not familiar with it, and on-top of this will often want to learn additional content to try

and keep their knowledge ahead of their students, and allow them to effectively support them [11]. This learning process is another large cost factor for computing.

2.2 Teachers Expectations

Expectation of success is the second core factor in Expectancy-Value Theory, and an important part of teachers motivation, specifically focused on present factors [3, 17]. Teachers have reported numerous challenges and struggles related to developing and delivering CS lessons, which all create a general low expectation that they will deliver a successful computing lesson.

One factor influencing low expectations is the lack of subject knowledge and experience faced by many primary school teachers. Many teachers have no computing background or experience and therefore don't know and struggle to understand the concepts they are trying to teach, making it difficult for them to effectively teach these concepts to students [11, 6]. On-top of their lack of subject knowledge, it is common for teachers to feel that their students have more knowledge than them, and therefore the teacher is not going to be able to develop that student's knowledge [12].

Another factor effecting expectations is teachers lack confidence in their ability to support students, especially when coming across bugs, technical issues or unexpected behaviours [6]. This then leads to concern that students experiencing serious issues could derail the teachers lesson, with them not possessing the ability to adequately support the student, while progressing with the lesson.

Finally teachers do not have access to or knowledge of high quality teaching and support resources for the relevant curriculum [11, 6, 12, 10, 14], so they have to rely on either creating their own resources based on limited curriculum guidance or adapting content found though internet searches, which may not be from the correct curriculum or level. Due to the limited knowledge that teachers posses for CS they will likely struggle to correctly develop/adapt and understand the material for their lesson. If teachers are not confidence in their material then they are unlikely to be confident teaching it.

All of these factors echo the core issue that teachers do not have confidence that their lessons will be successful for both themselves delivering them, and for their students learning from them.

3 Improving Motivation

In order to improve motivation, teacher's perceived value and expectations teaching of computing science needs to be raised, by addressing the challenges identified in section 2. A number of possible solutions have been identified in section 3.1 and section 3.2, which aim to tackle the identified value and expectation challenges teachers face.

3.1 Improving Value

1: Communicate the core skills that teaching computing develops in students
This addresses the following challenges:

- The computing curriculum is a small area, with a limited scope and importance
- Teachers are not aware of the skills that computing develops for their students
- Teachers are not aware of the benefits of integrating computing with other subjects

2: BGE Computing can be taught without needing extensive computing knowledge
This addresses the following challenges:

- Teachers are cautious about computing
- Computing requires a large amount of prep time, taking away from other subjects

3: There are many different methods of teaching computing
This allows lessons to be designed to fit teachers own confidence level and computing experience
This addresses the following challenges:

- Teachers are cautious about computing

- Students might find the content boring, and the teacher is unable to make it engaging
- Computing requires a large amount of prep time, taking away from other subjects

4: Support and resources are available, for the Scottish curriculum
This addresses the following challenges:

- Teachers are cautious about computing
- Teachers feel isolated and unsupported when teaching computing
- Computing requires a large amount of prep time, taking away from other subjects
- There is a lack of awareness of computing resources for the Scottish curriculum

5: Computing can be used as a vehicle for teaching other subject areas
This addresses the following challenges:

- The computing curriculum is a small area, with a limited scope and importance
- Students might find the content boring, and the teacher is unable to make it engaging
- Teachers are not aware of the skills that computing develops for their students
- Teacher are not aware of the benefits of integrating computing with other subjects

3.2 Improving Expectation

Lack of Subject Knowledge Possible solutions:

- BGE Computing can be taught without needing extensive computing knowledge
- Support and resources are available, for the Scottish curriculum

Lack of support and debugging skills Possible solutions:

- There are many debugging and coding support tools available
- There are many different methods of teaching computing

Lack of awareness of materials and resources Possible solutions:

- Support and resources are available, for the Scottish curriculum

4 Proposed Solution

My proposed solution is to create a website containing a set of resources, mainly short videos, that are designed to tackle the challenges listed in section 3.1 and section 3.2.
The website will contain two main sections, one to demonstrate the **value of computing** (increasing teachers perceived value) and another to show **resources and methods** available to teach computing (increasing teacher expectations, and lowering cost), as outlined in Figure 1. Each stage will contain a number of short videos, focused on a specific challenge solution, in order to slowly increase a teacher's motivation for computing.

The site will be designed with teachers as the primary user-group, taking into account their limited time and background knowledge. The site will require no login, and limit the length of resources, allowing teachers to work though the site at their own pace, in the time they have available, and allowing them to revisit certain parts if required.

As justification and understanding were identified as underlying issues for a lack of motivation, the site will be designed in a way that teachers can understand the underlying theory behind it, but as a secondary aim and only if they are interested and have time to. In order to do this the site will contain an about page, separate from the main user journey (Figure 2), which will explain the theory, motivational challenges identified and how the resource aims to tackle them. Each video resource will contain visual

tags as to what area(s) of Expectancy Value Theory it is working within (Figure 3).

5 Conclusion

This report looks at how teacher motivation for computing can be modelled and understood though Expectancy Value Theory, a key first-step in improving primary computing education in Scotland. Through this theory different challenges where identified as potential reasons for teachers having low motivation towards teaching computing.

Solutions were then proposed to tackle the identified value and expectation challenges, in order to raise teachers motivation. Based on these challenge proposed solutions and taking into account teachers individual challenges as the primary stakeholders, a proposed solution was explained, consisting of an easy to use and access website, containing a series of short video resources, aimed at improving motivation by tackling the identified channellings from each area of Expectancy Value Theory.

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Appendix

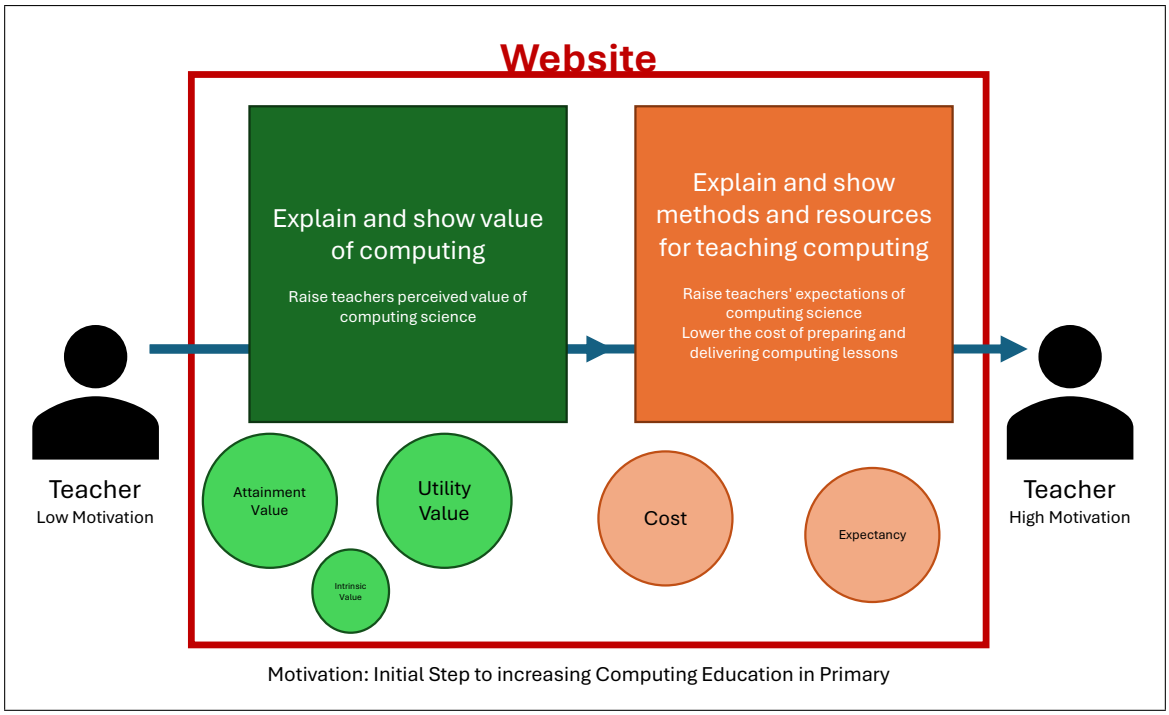

Figure 1: Website stages to improve motivation using expectancy value theory

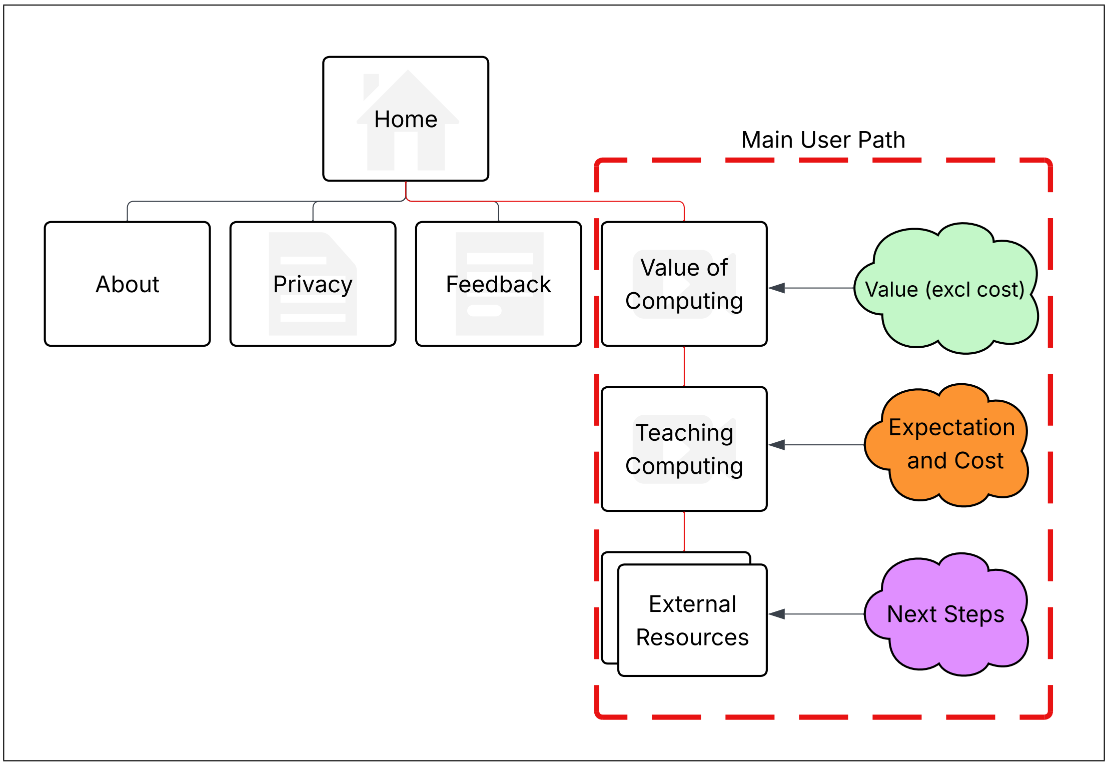

Figure 2: Website site-map and main user path

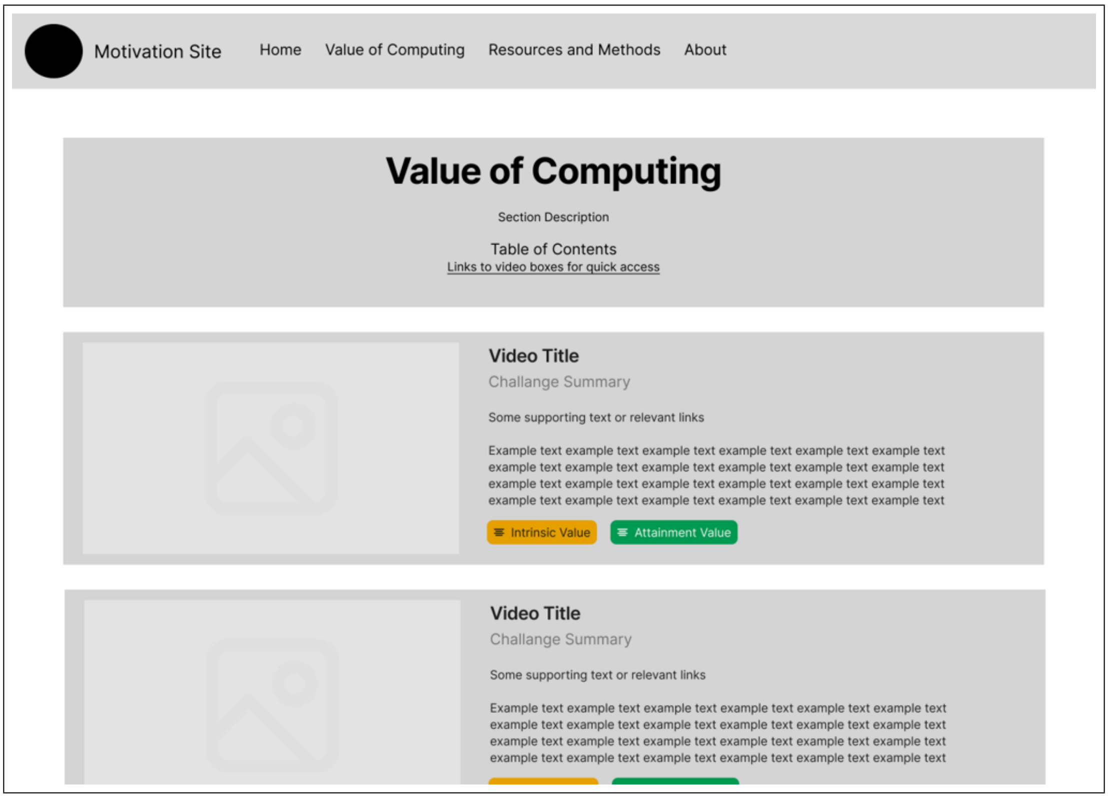

Figure 3: Basic Wireframe - Possible Video Page Layout