

An Empirically Modelled Student Post Room

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Abstract

Empirical modelling offers an alternative approach to traditional computing methods. At its centre lies the idea that programs should be built with less emphasis on formal methods, and more around real-world experiences and observations. This means that a distinction must be made between what we believe to be true and what can be observed to be true. Furthermore, the construction of a model should be based on our current understanding of a system and its behaviour, even if that is wrong. With that in mind, this paper will study, with reference to a practical model, whether this approach is in reality a feasible way of learning about and creating a dynamic interactive system.

1. Introduction

1.1 Empirical Modelling (EM)

The concept behind Empirical Modelling is the idea of “thinking-with-the-computer.” This is different from more classical programming approaches to computing, as it places the emphasis on experimentation with a computer, rather than building systems that are based on proven theory. The philosophy of model building in Empirical Modelling is based on an open-ended exploratory framework. This framework encourages an iterative approach to model building, where experiences and observations of a system play the biggest role in the outcome of the model, rather than a pre-conceived notion of its behaviour.

1.2 Constructionism

Constructionism is a concept introduced by Seymour Papert in his paper “*Mindstorms: Children, Computers, and Powerful Ideas.*” (Papert, 1980) In its simplest form, constructionism can be described as “learning by making”, although Papert in (Papert, 1991) argues that it is “*very much deeper in its implications, than could be conveyed by any such formula*”. Constructionist theory argues that the best way to learn is through constructing a product in a practical, real-world environment. As a person constructs something, they acquire knowledge, which can be used to aid in further construction. This incremental learning is fundamental to constructionism.

In (Beynon, 2004), Empirical Modelling is suggested as an appropriate method to give computer support to constructionism. Beynon suggests that instead of a conventional program, a ‘construal’ be used for constructionism. A construal provides a much more flexible way to interact with a system, where the result of an input can only be determined by observing the corresponding output.

1.3 Radical Empiricism

“To be radical, an empiricism must neither admit into its constructions any element that is not directly experienced, nor exclude from them any element that is directly experienced.” (James, 1912) Radical empiricism states that all human knowledge results simply through experiences, and that these pure experiences are connected to each other. The connection between radical empiricism and Empirical Modelling is through the way that they both “*account for logic and theory in terms of observation and experience, rather to account for observation and experience in terms of logic and theory.*” (Beynon, 2003)

This introduction to Empirical Modelling has served to build a foundation for the purpose of this paper. Arguments have been provided why Empirical Modelling is suitable for both constructionism and radical empiricism and how modelling using the principles of EM applies. But how will the principles fair when applied to an actual model building process? This paper discusses the effectiveness of building a model using Empirical Modelling principles and tools with reference to a model built by the author. It also looks at the claims that Empirical Modelling can be applied to constructionism and radical empiricism. The completed model is compared with the actual system, post-construction, in order to determine how effective modelling on solely observation and experience is.

2. The Student Post Room

In order to study EM principles effectively, the model produced must be built following its principles. The model must be based around observables and the experiences of the modeller. The model should also have an informal design, so that it can be built up incrementally from feedback and the experiences of the model building up to that point.

The system modelled for this paper is the University of Warwick student post room. The primary reason for using this system is that it is suitably complex and sized. Too small; there are too few observables, too large; the focus of the model is lost. To study EM in constructionism, the domain must also not be well known, as some learning through making must happen.

The first step in building a model of the student post room was to identify what services it provided and how the process of dealing with an entire university post worked. This was all done within the constraints set by the paper. The student post room provides a mail service to all the residents on the university campus. It sends out regular sized Royal Mail post to accommodation blocks directly, and holds over-size parcels, recorded delivery and courier service for collection by the student. If a student receives a parcel that has to be held in the post room, a mail card is sent out to that student informing them they have mail. The focus of the model made is on the collection of over-sized parcels, and how they are sorted and stored.

3. Model Construction¹

The model is built in EDEN, SCOUT, and DoNaLD, which are tools created specifically for Empirical Modelling. As can be seen in figure 1, the model is split into two viewpoints; the left-hand side, which shows what a student using the post room would see, and the right-hand side, which documents the mail records, and includes the model control buttons. This gives the model two different layers of abstraction.

The system clock is the agent that drives the entire model. When the model is first loaded, the system clock is initialised to the current date and time. Whether the post room is open is dependent on the time of day. The employees work from 08:30 to 17:00 with an hour lunch break at 12:00. The model can be in one of two states; automatic or manual mode. In automatic mode, at opening time the post room receives a delivery of mail, which the employees proceed to sort into the appropriate mail boxes and add to the mail ledger. Throughout the day students arrive to pick up their mail. In manual mode, the process is controlled by the user. When a student arrives to collect their mail, the model progresses through a number of states. As the transaction progresses the states change and are ticked off on the graphical interface.

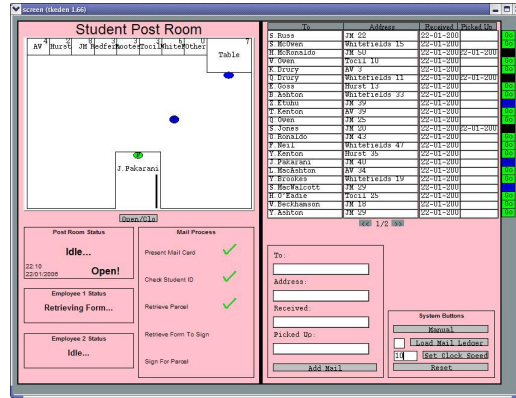


Figure 1: Screenshot of the completed model

The states have been modelled based on observations in the real post room. The mail ledger records all the mail that has come and gone throughout the running of the model. It can be added to manually via the “Add Mail” button or can have mail randomly added with the “Load Mail Ledger” button. The ledger has an initial capacity of 22, but when that limit is reached an extra page can be added to it, giving an unlimited amount of mail that can be recorded.

The construction of the model was built up in a number of stages. At each stage, new features were added to the model to continually improve the likeness of the model to the referent. The first stage was to build the framework to which dependencies, agents and observables could be added. This included constructing a simplified graphical representation of the post room, building in clocks for animation and system timings, and constructing a limited mail ledger that could hold at most 22 mail items. With the framework built, each new stage built in different scenarios based on the question “What would happen in this situation in the real student post room?” Examples of some scenarios encountered include “what is the student mail pick-up process?”, “what happens if the post room is about to close?”, and “what happens when the post room door is closed manually?” With each iteration further dependencies were introduced into the model, giving it an evermore similar behaviour to the real post room.

To fulfil the criteria of model construction using the principles of Empirical Modelling, the system is built using dependencies. The dependencies cover many different aspects of the completed model. For instance, the location of all the elements on the screen is dependent on the observables *entireWindowWidth* and *entireWindowHeight*. Also, the location and status window of the door is dependent on *pRoomIsOpen*, the status windows and employee and student locations are dependent on the state of the model, and when an employee is retriev-

¹ For a more detailed explanation of the model functions, please consult the model readme file.

ing a parcel, the mail box they go to is dependent on the address of the student.

Empirical Modelling principles have worked well in the construction of the model. The process of incremental development based on continuous observation of the referent and feedback from the model has shaped the outcome of the system. It has also provided a means to resolve a number of unforeseen problems in the modelling process. With regard to constructionism, the process of building the model has altered the perception of the author as to how the post room operates, and has resulted in the discussed “learning-by-making.” The blend of Empirical Modelling and constructionism provides a powerful way to model. The concept of constant feedback and incremental design complements the constructionist idea of gaining knowledge and applying that knowledge in further construction.

4. The Model vs. Reality

Having built a model through observation of the real-world, this section will now make a comparison with what was made and the referent. How successful has it been to model using solely Empirical Modelling principles? And how well is it suited to constructionism and radical empiricism?

In the referent, the mail is sorted in an alternate way to the model. Firstly, the post room differentiates Royal Mail, Courier, and recorded delivery, whereas the model does not. This is partly as a result of the simplification of the model, but also because of the seemingly unordered mail scattered around the post room making observation on the sorting and storage processes difficult. The storage of regular mail, which is what the model deals with, is stored alphabetically. Each letter has two boxes; the left for mail over a day old, and the right for new mail. This is something that was not apparent through observation. In the model, all mail remains in its mail box until it is collected. Although having two mail boxes for each letter is not essential, it makes life easier for the employees, which is something that was not considered at all in constructing the model.

An interesting difference between the model and real life is with the way that the post room deals with overflow. In the real post room, when the relevant mail box is full, the parcel gets stored somewhere else, and is recorded in that new location. This tends to be above the appropriate mail box and is marked in the ledger with an up arrow. This is something that is not even considered in the model as each mail box can hold an unlimited amount of mail. This is something that can easily be constrained to the model, but highlights that the model is, in this case, more flexible than the real world. As described in (Russ, 1997), EM looks to “*preserve in*

computer artefacts the openness that is characteristic of our real-world experience.” However, in this case the model has more openness and flexibility than the referent. Whether this is desirable is dependent on the purpose of the model. If it is to exactly reproduce a system, then the model must be constrained, but if in modelling a referent, simply an understanding of the system is desired then leaving this open could lead to some interesting and unexpected behaviours.

5. Conclusion

Overall, the model represents its real-world counterpart well. Its behaviour accurately mimics the processes involved with the operation of the student post room. Taking the approach of constructing a model using the principles of Empirical Modelling has proved to be successful. Although the model provides a very simplified version of the post room, the major features are present and can be used to produce a mental model of the operation of the student post room. The experiment of constructing a model simply from observations and experience has shown that the significant features of a system can be reproduced, but the lesser parts are likely to be overlooked as they are less likely to be observed.

Acknowledgements

The University of Warwick Student Post Room.

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