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Formal and Informal Methods: Different Approaches, Similar Conclusions

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Abstract

This paper presents a synthesis from a series of articles in which formal and informal methods are used in different case studies from different domains. Formal methods seem to be difficult, expensive, and not widely useful. [2]. A method is formal if it involves mathematical specification, given by a formal language, that ensures precise definition, specification, implementation and correctness. Formal methods are more often used internally within the analysis and for communicating the specification. Informal methods are more often used to communicate with clients and for easier understanding of the formal specifications. The term of informal methods in education is often used as informal learning, and it is serves as a supplement to classical formal methods of teaching.

1 Introduction

From the papers taken into consideration, one presents case studies that indicate that analysts believe that users or clients cannot understand the more formal models such as Object Modelling Technique (OMT) or Unified Modelling Language (UML) diagrams, and that variations on use cases, ad hoc diagrams or rich pictures are more appropriate informal models with which to communicate the specification to users. A research approach is presented in the paper, as well as case studies and findings and interpretation of them, along with a discussion about all the research.

Another study focuses on formal methods, presenting most well-known seven myths about these formal methods. Each of them is debated, with pro and against arguments. As a result, the formal methods can be better understood at large. They are powerful tools, effective and useful for a large variety of applications.

From educational approach, formal and informal learning are considered to be complementary contexts. After common evaluation and research questions, the presented study reaches to conclusion that informal science learning might be well integrated in formal science learning.

Although at first side the it has nothing in common with the other articles, another presented study on a data set about an individual or a group uses two modes of data combination for a predictive or diagnostic purpose. The clinical method relies on human judgment that is based on informal contemplation and, sometimes, discussion with others. The mechanical method involves a formal, algorithmic, objective procedure to reach the decision. Empirical comparisons of the accuracy of the two methods show that the mechanical method is almost invariably equal to or superior to the clinical method.

All these articles will be summarised below, and in the end we should notify if they lead to similar concussions. Each part of the article was entitled with the title of the article that is support for summarization.

2 "Formal and Informal Methods in Object-Oriented Requirements Engineering"

The summary below synthesised the most important ideas from the article that presents a case study of formal and informal methods in object-oriented requirements engineering.

Various definitions and approaches to the requirements engineering processes are suggested in literature, and in the article. For the beginning, define software engineering as the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software, and the study of these approaches; that is, the application of engineering to software.

Requirements analysis in systems engineering and software engineering, encompasses those tasks that go into determining the needs or conditions to meet for a new or altered product, taking account of the possibly conflicting requirements of the various stakeholders, such as beneficiaries or users. Requirements analysis is critical to the success of a development project. Requirements must be actionable, measurable, testable, related to identified business needs or opportunities, and defined to a level of detail sufficient for system design.

Systematic requirements analysis is also known as requirements engineering. It is sometimes referred to as requirements gathering, requirements capture, or requirements specification.

Requirement engineering is a sub-discipline of systems engineering and software engineering that is concerned with determining the goals, functions, and constraints of hardware and software systems. In some life cycle models, the requirement engineering process begins with a feasibility study activity, which leads to a feasibility report. If the feasibility study suggests that the product should be developed, then requirement analysis can begin. If requirement analysis precedes feasibility studies, which may foster outside the box thinking, then feasibility should be determined before requirements are finalized.

Object-oriented methods for information system development lead to a need for the development of object-oriented approaches to requirements engineering.

In an object oriented modelling processes several models are usually produced, categorised as either static models or dynamic models.

Static models describe objects, their characteristics and the relationships between them, e.g class and object diagrams, component notation and templates, object models, class cards, hierarchies and collaborations, object/class models, object and layer models.

Dynamic models define states of objects, state transition, message passing and event handling, e.g. state transition and event diagrams, state diagrams, object charts, interaction diagrams, object communication models.

The research approach used was multiple sequential-case studies. It involved taped semi-structured interviews with individual practicing professional requirements engineers.

The case studies were opportunistically selected, participants were recruited through industry. Some participants provided contact for subsequent participants. All the participants were currently working in the field of object-oriented requirements specification.

Although the core of the data was gathered from taped and transcribed in depth interviews, several other data sources were used: phone, email, questions in need of clarification which emerge from the transcript process, comments from participants.

One should distinguish between formal models and informal models: formal models are considered to be those models that require training in order to be understood or explained: models that contain specific, graphical notations, such as OMT models, UML models, interaction models or state models; informal models are considered to be models that can be understood and explained without specific training: most common are natural language models including text descriptions, use case scripts, ad hoc diagrams and interactive demonstration models as often produced for prototypes.

The findings from the case study indicated that analysts believe that users or clients find formal models much too complex, both conceptually and technically, to understand and that the use of informal models such as rich pictures, diagrams and use cases, particularly use case scripts which are closer to natural language models, are perceived to be better models for communicating and validating specifications with clients.

Requirements engineering process involves two groups: the users/clients and the professional consultants. The specification needs to be validated as correct from both points of view – the formal or consultant’s point of view and the client’s informal point of view. For this agreement to take place there needs to be two levels of modelling: informal modelling for communicating the specification to the user for information and validation; and formal modelling for the analyst team to pass on to the design and implementation team.

The implications for practice in these findings lie in the recognition of the social aspects of the requirements specification process. The errors which arise due to inconsistencies, omissions and ambiguities in functional specifications often result in the costly maintenance or failure of software systems. If, as the findings of the research project suggest, the models used for validation of the specification with the clients are different to the models used in design and implementation, then this may indicate that inconsistencies, omissions and ambiguities might arise. The extension of use case models and concrete scenarios may assist in addressing these issues.

In conclusion, understanding the way models and methods are used in practice should lead to

- Improving existing modelling techniques and tools
- Developing new modelling techniques and tools appropriate for a creative and social process
- Developing new modelling techniques and tools appropriate for new environments such as electronic commerce

3. “Seven Myths of Formal Methods”

For most people from user/clients category, formal methods are unfamiliar and difficult to understand. Practical use of formal methods in a software-engineering company lead to conclusion that the myths about formal methods are not true. Seven myths about the use of formal methods were considered to be:

1. Formal methods can guarantee software is perfect.
2. They work by proofing programs are correct.
3. Only high-critical systems benefit from their use
4. They involve complex mathematics
5. They increase the cost of development
6. They are incomprehensible to clients
7. Nobody uses them for real projects

Each of these myths is largely discussed (either approved or partially dissaproved) related to a CASE project that lasted 90 weeks and involved the effort of 450 people’s effort, in which formal specifications were applied.

Instead of perpetuating the seven myths, the author proposes seven facts to replace them, accordingly.

1. formal methods are very helpful at finding errors early, and can easily eliminate certain classes of errors.
2. they work largely by making you think very hard about the system you propose to built.
3. they are useful for almost any application
4. they are based on mathematical specifications, which are much easier to understand than programs.
5. they can decrease the cost of development
6. they can help clients understand what they are buying
7. they are being used successfully on practical projects in industry.

4. "Bridging the gap between formal and informal Science learning"

Informal learning main characteristics were summarised and compared to formal learning characteristics as follows:

Formal learning	Informal learning
Compulsory	Voluntary
Structured	Unstructured
Sequenced	Unsequenced
Assessed	Nonassesed
Evaluated	Unevaluated
Close-ended	Open-ended
Teacher-lead	Learner -lead
Teacher-centered	Learner -centered
Classroom –context	Out-of-school context
Curriculum based	Non-curriculum based
Fewer unintended outcomes	Many unintended outcomes
Empirical mesured outcomes	Less directly measurable outcomes
Solitary work	Social intercourse
Teacher directed	Non directed or learner directed

From the summary of the article, we mention some ideas below:

The article begins with a discussion of the importance of motivation and varying institutional techniques in school learning.

Evidence are presented that informal science experience can be effectively used to advance science learning. An important distinction between learning context and learning methods is emphasized. Although connected in the past (e.g. compulsory school with formal learning methods and free choice context with informal learning methods), learning context and learning methods link is artificial, because a person-s knowledge cannot be limited to what is learned in schools. Instead, learning context and learning methods should be mixted to provide a good learning experience. The integration of informal learning experience within the formal school curriculum could make an important contribution in dealing with the issue of this mixing.

5. "Comparative Efficiency of Informal (Subjective, Impressionistic) and Formal (Mechanical, Algorithmic) Prediction Procedures: The Clinical - Statistical Controversy"

The main idea of the article is summarized in its abstract. As further details about the study in the article are not needed, we should focus on the main idea of the article, which best fits the interest of our article.

Given a data set about an individual or a group (e.g., interviewer ratings, life history or demographic facts, test results, self-descriptions), there are two modes of data combination for a predictive or diagnostic purpose. The clinical method relies on human judgment that is based on informal contemplation and, sometimes, discussion with others (e.g., case conferences). The mechanical method involves a formal, algorithmic, objective procedure (e.g., equation) to reach the decision. Empirical comparisons of the accuracy of the two methods (136 studies over a wide range of predictants) show that the mechanical method is almost invariably equal to or superior to the clinical method: Common antiactuarial arguments are rebutted, possible causes of widespread resistance to the comparative research are offered, and policy implications of the statistical method's superiority are discussed.

4. Conclusions… to conclusions

At first sight all articles mentioned and quoted in this paper seem not to have anything or very few in common. The first common thing that is easily noticed is the presence of words "formal" and "informal" in every one of these articles. The study upon articles led to formality can be enlarged, and can better help to the conclusions of this article.

Anyway, from the diversity of the chosen articles, we can express some of the conclusions as follows:

Formality was always associated with difficult accessibility, difficult understanding, and it is reserved to specialists that can deal with it. Informality can be better understood by majority of common people, but is has its lacks. Although they can be regarded as totally opposite terms, a link between them can be seen in each of the articles. The "inaccessibility" of formal methods can be resolved by finding a way to make them easier to be understood by common users. The informal methods are useful as they offer the first information due to common sense observation. The development of formal models starts with gathering information, or, at least, they are necessary to verify the developed algorithms.

Formalism appeared from the necessity of precision, general application in every context, general support for any user who request it. It's main characteristic can be considered the possibility of adapting it, starting from its generality.

Applications of formal methods in economy, medicine, law, education, etc. are easy to find and become more and more accessible to a larger category of people.

One thing that should be mention, last but not least, is a definition of formalism accessible to all web users. According to wikipedia, formalism is a theory that holds that statements of mathematics and logic can be thought of as statements about the consequences of certain string manipulation rules. Formalism is associated with rigorous method. In common use, a formalism means the out-turn of the effort towards formalisation of a given limited area. In other words, matters can be formally discussed once captured in a formal system, or commonly enough within something formalisable with claims to be one. Complete formalisation is in the domain of computer science… and the applicability of computer science has no longer any limit in any domain.

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