THE EFFICIENT TAILORING OF IT PRODUCT, SPECIFIC TO THE STAKEHOLDERS' NEEDS THROUGH DIRECT, PERSONAL INVOLVEMENT AND UNDERSTANDING

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Introduction

There are a few factors which may be the recipe for a successful IT project. First of all is an idea – the concept for a good product. It must be originated by finding the niche of the market. The niche market idea is the way to distinguish our product from others already existing in the market. If it is our intention that a target group will be youth, it is necessary to propose innovative and attractive solutions to encourage them to use the product. We – by giving a proposal to the Polish Ministry of National Education [Pols09a] to realise the "e-Experiments in physics" project – decided to "go even one better", to convince that our innovative product will have an educational use and value in completion of the curriculum in schools (in particular – upper secondary schools). However an idea, even the best one, is not enough. Therefore, we set the research question of how to achieve success, or how to carry out the project in order to create a product that will be well-received by the target group, i.e. students and teachers. The aim of this study is to identify and formulate methods and criteria for success. This is a very important issue in today's world based on IT technology, because there are still too many projects which end in failure [Standish09].

When we have a concept, we have to develop relevant software to satisfy the market and make it attractive for those who will be using it (in this case an educational market). It is also important to choose adequate technology. It should be stressed that in today's IT world one of the most significant characteristics are portability and flexibility [ChunPL09]. Our product should be planned to be software and hardware independent, multi-platform, available for multiple, different operating systems and types of computer equipment (desktops, laptops, tablets, etc.), and multimedia boards. It is also important to ensure the possibility of running a program directly using a web browser (without the need of prior installation on the computer) or installed as a simple application when a computer is not connected to the Internet or access to the Internet is limited.

Therefore, in the first place we need to fully understand the requirements of both the end user and the recipient of our product [RozaW05]. In our case the recipient of the e-Experiments is the teacher and the end user is the student. To tailor the program specifically to their needs we invited them – our stakeholder to work with us. Their executive support in the project is exceptionally helpful in resolving any problems or issues such as adapting e-experiments to the conditions prevailing at school. Their expertise at teaching physics to upper secondary school student is invaluable in the first stage of development and we have utilised input from a methodologist from one of the best secondary schools in Poland.

Afterwards our e-experiments are presented to the teachers from selected schools taking part in the project and finally, during product testing we get feedback from the students. All these opinions will be considered to enable modification of the product to make it more attractive to the user, adding new features, functions, or suggestions for other exercises.

The paper describes the process of the e-experiments development paying special attention to stakeholders, user and recipient, participatory design and active participation in information system development. Authors present their own experience and methods for different group of stakeholders involvement and usage of their creativity support.

Structure of the paper is as follows: at the beginning we introduce into the subject by explaining the context of the project and its product, and how it fits into the niche of the market. Next, we describe the target groups and process of gathering requirements, due to designing and development of software. Then we describe methods of validation and verification of final product. Paper ends with conclusion remarks.

Niche of the market: about the project

Obviously, physics is an experimental science. Carrying out the experiments allows students to "touch" the problem, forcing the scientific activity. Let us stress, that only the self-experimentation by students leads to a correct and deep understanding of the processes and physical laws, according to the famous maxim of Confucius: "Tell me and I forget, show me and I remember, let me do and I understand". On the other hand, there are many practical problems when carrying out experiments at schools. Laboratory equipment is very expensive. Usually, there is only a limited number of experimental sets, so only selected students are able to carry out the experiments, while the others are only watching [PłotSJ11, Pols09b, Pols10].

Moreover, there are only the basic instruments in schools. But the lack of proper equipment is not the only problem. Preparation and experimentation takes time, also some willingness and ability of the teacher is required to perform experimental lessons. Some teachers may restrict student's freedom in experimenting, being afraid of the experimental set-ups. This freedom is – of course – also limited by the physical conditions or for technical reasons – e.g. we cannot change the gravity or perform experiment in the accelerating train! It is also obvious, that there are some fields of physics (atomic and nuclear physics, astrophysics), in which carrying out experiments at school is not possible (e.g. for organizational, budgetary, safety reasons). Next, usually it is not possible to establish and carry out experiments by a student at home – this is a very strong limitation (it is very well known, that repeating things allows for better understanding and memorization) [PłotSJ11, RuttvJvdV12].

Our product, as opposed to existing ones [KąkoŻ10], is designed to resolve the above problems and limitations, but not in the real world, but in the "virtual" one. We live in a rapidly changing world, in which both the computers and the Internet are a natural environment for young people. Thanks to that, e-experiments, as the computer programs being equivalents to the real experiments, have a great chance to encourage this target group to use them, as a complement for the 'real' physics. Let us mention here, that e-experiments are just computer tools supporting traditional methods – we do not want to displace or replace the actual, real experiments. They are designed to show some physical issues in a broader perspective than is possible with real experiments, allowing for free experimenting – according to the rule: design, build, perform the experiment, then analyze and visualize results. This will allow students for a deeper understanding of the problem, for building better understood models, cause-effect sequences and sets of dependencies, which are necessary to describe the phenomena. e-Experiments are the very first such didactics tools, fulfilling the above criteria, thus filling the niche on the market.

Target group: stakeholders identification

At the beginning of the project careful stakeholder identification was carried out. The best efforts to complete a list of people, institutions, organisations and non-human (subject-matter) that could be affected in any way by the project considering any legal, economical-financial, organisational, technical and, above all, social environment affects [Gott02, GottR05, RozaW05]. Depending on the relationship between stakeholders and the project and actual involvement in the project there can be distinguished following groups of interests:

- Customer – Polish Ministry of National Education, intermediary institutions for the EFS programmes implementation,
- Project team – academic staff and students of the Gdansk University of Technology – subject matter experts group leaded by the assistant of the project manager supported by coordinator and methodologist that is responsible for the scenarios (requirement specification) of the e-experiments, numerical engine and the exercise books,
- Developer – Young Digital Planet SA, responsible for technological tasks: coding, providing graphics and user interface to the application,
- Consultant – L.C.G. Malmberg B.V. is to provide substantial support such reviewing and test ready-made e-experiments reports,
- Administration – staff that care for the project’s security in terms of legal, technical, financial as well as control progress and compliance

with project documents project manager, monitoring and evaluation specialist, public procurement specialist and IT, financial, legal, office together with technical services,

and stakeholders that this paper gives more attention:

- End users – physics teachers,
- Recipients – students, in particular (but not limited to) of the upper secondary schools,
- Community – decision-making board, education and academic circles and net surfer,
- Non-human – teaching programme.

Stakeholder engagement into project

End user and recipients

For the purpose of the project physics teachers who use e-experiments as educational tools during her/his lessons at upper secondaries schools and their students who were given classes using e-experiments tool as a recipients were used during development. Both groups are directly affected by the product so their opinion is of the paramount importance for the project shape. Their participation in this development is described below in the section 'Validation with the use of Stakeholder's acceptance tests'.

Community

A community is not considered as a direct customer, user or recipient of the project but its opinion and/or decision can have a material impact on shape and future of the project as they have a direct influence in the successful mainstreaming of the product, after the testing stage. This group includes decision- and opinion- making bodies such as education, academic institutions/organisations related to education (e.g. National Thematic Network for Education and Higher Education – a forum of experience exchange and evaluation of innovative projects that may help in popularising and incorporating into the mainstream), education/academic institutions (also in higher education and especially in the field of technical and natural sciences). Full consideration will be given to opinions expressed by institutions/organisations and specialists (e.g. user interaction experts) and feedback has and will assist with further development.

Also net servers, potential users (maybe other physics teachers or students) can also provide relevant feedback assisting in an accurate assessment of the product and focus on their interface experience. Perhaps their independent opinion will help improve (e.g. add new functions/features) and make more attractive the proposed educational tool.

Decision- and opinion-making bodies: institutions/organisations, education and academic circles

During continuous development it is essential that we continue to strive to produce an effective tool that will perform and produce results that accurately compare to existing requirements and is able to adapt to future needs [PłotS12, RuttvJvdV12]. Therefore, the project can be of educational importance and can exercise significant influence not just on the testing group but for the whole future curriculum. Teachers using it and the students who according to this programme, modified/enriched teaching programme, will pursue education on physics and science and if the final product is admitted to dissemination and incorporation it into educational mainstream in Poland, it is essential that consideration and application of any valuable opinion from the educational, academic and subject-matter community is made.

In the end, if e-experiments do not raise any concern, National Thematic Network for Education and Higher Education that is made up of experts, innovation European projects beneficiaries and educational organisation representatives by validation of the product will recommend it's incorporation into mainstreaming.

Technology

To assure the attractiveness of the e-experiments, we decided to produce them with use of the rendered, often 3-dimensional graphics, very similar to the look and feel of the real equipment. Thanks to that, user has an impression of working in the same manner as he would do in the real laboratory. However, we try to keep a reasonable compromise between the attractiveness of graphics and the educational values, so that the user is not distracted at work.

e-Experiments are implemented in modern and convenient technology – Adobe Air. This technology allows users to run them as they wish – as a Web or standalone application, independent on hardware and software platforms. One can even run them on the tablets, with full use of touch interface. Thanks to that we do not limit in advance the circle of potential users.

Our solution is also very flexible: e-experiments can be presented to user in a several ways. The fundamental equipment is – obviously – a computer, but it can be accompanied by the multimedia projector or even an interactive board, allowing for better reception, adapted to the size and skills of the group.

Requirements

Our world is a rapidly changing world, in which computer and Internet are a natural environment for young people. This is where they are spending their free time or looking for educational aids [PłotSJ11]. However, is not the e-experiments goal to replace reality, experiments that should be conducted in physics laboratories at schools, but to support and complement traditional methods based mainly on theory that do not allow full understanding of the actual physics.

e-Experiments features such as:

- common set of tools (parts of experimental set-up, stopwatch, table, graph etc.) of a free choice,
- graphics derived from the real look of the experimental equipment,
- real-time, reliable calculations,
- the ability to change the frame of reference to enable specific experimental set-up and to repeat an experiment, using a different sets of parameters,
- allow the analysis of results by using the table and graph tool aimed at learning by mistakes by using alternative scenarios.

Verification

The verification, ensuring that product is developed in accordance with requirement specification (scenario) [Somm10]. This activity is concerned by the domain experts, project team members who check if there are no bugs that hinder the performance of the experiments. If there are any errors found they are reported to the developer team for correction.

This phase is to prepare a preliminary version of the product that can be used during test lessons at upper secondary schools.

As soon as software delivered by the developer is approved by the project team a new experiment is placed on the testing platform and project website in order to perform acceptance tests/validation by the stakeholders. The testing platform has been introduced for monitoring the way the students and teachers are using the software (e.g. how often some features are used, how much time the students spend on the exercise etc.).

Validation with the use of Stakeholder's acceptance tests

When the product is verified by the project team, it is passed on to the teachers, and then, at a later phase, the students, who by testing provide validation and acceptance of the product [HsuCLC08].

The prime objective of the project is to prepare an aid that can be found valuable (by the teachers) and attractive enough to be willingly used by the young people, students. Stakeholders' (user, and recipient) acceptance tests serve to develop a product that will meet both educational and practical needs, together with being technically and technologically up-to-date [PłotS12, RuttvJvdV12].

Stakeholders' acceptance test course

e-Experiments will be tested during the two-year mandatory course – during physics lessons in the classroom, in selected upper secondary schools. During these lessons, teachers will introduce the e-experiments in a uniform manner.

- The first year of testing (1st class):

– The teacher demonstrates a physical phenomenon in the classroom by using appropriate e-experiment and computer and projector, and/or whiteboard,

or

– classes are held in the computer lab, all students perform the e-experiment by themselves or in groups, depending on the organizational features of school.

Notwithstanding the above selection, the teacher asks students to do homework using the e-experiment.

- The second year of testing (2nd class):

The teacher informs students about the upcoming subject of the lesson. He assigns introductory tasks that students are expected to perform at home, using e-experiments. Next, an experiment is performed in the classroom:

– the teacher, using a computer and projector, and/or whiteboard,

or

– by selected student or group of students, using a computer and projector, and/or whiteboard,

or

– in the computer lab, all students individually or in groups, depending on the organizational capabilities school.

Notwithstanding the above selection, the teacher asks students to do homework using the e-experiment.

The general methodology of interaction between the teacher and students, through the testing platform, is as follows:

1. The teacher creates educational materials (he can add a description of the theoretical phenomenon, useful websites, additional literature, etc.) for a variety of physical problems that can be studied using an e-experiment.
2. The teacher creates various tasks (easy, difficult, very difficult – an individual approach to a student) in which he will need to use the e-experiment.
3. The student solves the tasks assigned to him, using the e-experiment – assembles experimental set, runs the experiment, creates and populates the tables, creates charts.
4. The student saves the status of the e-experiment, if it finds that he performed the task.
5. The student develops results in an external spreadsheet (if needed).
6. The student – on the basis of the results and his impression of the software – draws his conclusions and enters them into the interactive form.
7. The student sends to the teacher: a link to a saved state of e-experiment, the completed form with his conclusions, additional files (text, presentations, pictures, charts, spreadsheets, etc.).
8. The teacher receives a report form student; he can also view, test settings, perform an experiment (in the read-only mode).
9. The teacher – on the basis of a report – assesses the student; he can also view the statistics of student's activity on the platform. Then, the teacher's evaluation of student's issues, together with descriptive commentary, is sent back to the student.

The set of all the reports submitted by the student, along with a descriptive assessment of each report prepared by the teacher, together with various statistics collected by the platform, is then send to the project team, and used to evaluate the software.

Finally, the product is validated by the stakeholders (internal validation) and will be discussed by the members of the National Thematic Network for Education and Higher Education, and they will judge if e-experiments can be incorporated into mainstreaming.

Conclusions

As is clear from the literature cited in the previous sections, close cooperation with stakeholders enables resolution of many (technical, organisational or subject-matter) problems or issues that may arise. This helps to ensure that the software is not just in accordance with their requirement but enhances their interface and provides simplified user friendly interaction in the first place and gives its user expected support in their work and encourages their validation of the product. Any feedback from the users/recipients etc during acceptance test/validation phase will allow for modifications and improvements before the final validation/approval of the product, in the described case by the National Thematic Network. All this serves a purpose of preparing a useful product that can be received by a well researched and targeted end user fulfilling their objectives and eventually is approved by the decision-making body of the organisation that are going to use it, (Polish Ministry of National Education in the case of educational tools that are planned to be incorporated in the mainstream of education) and, finally, end-users/recipients (teachers, students etc) that will be using it, directly working with the product.

The main limitation of this publication is the inability to fully evaluate the selected criteria. This is due to the fact that the project is still in progress. The future will show whether the application of the principles collected and described in this publication will prove to be sufficient for success.

Described case constitutes a subject of analysis (theory building element) in the positivist qualitative study into enhancement requirement engineering, Małgorzata's Ph.D thesis.

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Efektywne dostosowywanie produktu informatycznego do potrzeb udziałowców, poprzez ich bezpośrednie, osobiste włączenie, zaangażowanie i zrozumienie

Istnieje kilka czynników, które mogą być receptą na sukces projektu IT. Przede wszystkim jest to pomysł - pomysł na dobry produkt. Należy zatem zawsze rozpocząć pracę od znalezienia niszy na rynku. Dobry pomysł jest sposobem na odróżnienie produktu od innych już istniejących na rynku. Jeśli grupą docelową jest młodzież, konieczne jest przedstawienie innowacyjnych i atrakcyjnych rozwiązań, aby zachęcić ich do korzystania z produktu. My - dając propozycję Ministerstwu Edukacji Narodowej na realizację projektu "e-Doświadczenia w fizyce" - postanowiliśmy "pójść jeszcze dalej”, aby się upewnić, że nasz innowacyjny produkt będzie miał rzeczywiste zastosowanie i niósł dużą wartość edukacyjną. Jednak sam pomysł, nawet najlepszy, nie wystarczy. Należy oczywiście na jego podstawie stworzyć odpowiednie oprogramowanie, aby zaspokoić rynek (w tym przypadku rynek edukacyjny) i sprawić, że będzie ono atrakcyjne dla tych, którzy będą go używać. Ważne jest również, aby wybrać odpowiednią technologię. Należy podkreślić, że w dzisiejszym świecie jednymi najbardziej istotnych z cech oprogramowania są mobilność i elastyczność. Nasz produkt należało zatem zaplanować tak, aby był wieloplatformowy, dostępny dla wielu, różnych systemów operacyjnych i rodzajów sprzętu komputerowego (komputery stacjonarne, laptopy, tablety, itp.) i tablic multimedialnych. Ważne jest również, aby zapewnić możliwość uruchomienia programu bezpośrednio za pomocą przeglądarki internetowej (bez konieczności wcześniejszego instalowania na komputerze). Z kolei, gdy komputer nie jest podłączony do Internetu lub dostęp do Internetu jest ograniczony, udostępniona powinna być wersja off-line. Musimy też w pełni zrozumieć wymagania zarówno użytkowników końcowych jak i odbiorcy naszego produktu. W naszym przypadku odbiorca e-doświadczeń jest nauczycielem, a użytkownik jest uczniem. Aby dostosować program specjalnie do ich potrzeb, zaprosiliśmy ich do współpracy z nami. Ich wsparcie w projekcie jest wyjątkowo pomocne w rozwiązywaniu wszelkich problemów, takich jak np. dostosowanie e-doświadczeń do warunków i realiów panujących w szkole. Produkt (czyli e-doświadczenia) są przedstawiane nauczycielom z wybranych szkół biorących udział w projekcie i wreszcie, podczas testowania produktów otrzymujemy informacje zwrotne od uczniów - użytkowników e-doświadczeń. Wszystkie te opinie będą brane pod uwagę w celu umożliwienia zmiany produktu, aby uczynić go bardziej atrakcyjnym dla użytkownika (dodanie nowych funkcji, uwzględnienie sugestii dotyczące innych ćwiczeń itp.).