Engineering Psychology Course Pack
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Methods of Engineering Psychology

Let's go back to our example of Jenny who works at an electronic medical records company. Jenny heard in the development meeting that her product is getting a new set of clients, family practice doctors in a large clinic. Previously, her product was used only by the doctors in a hospital. She knew many of her customers well enough that she felt comfortable calling them on the phone. She called the hospital and asked for Dr. Hapt who she knew. Dr. Hapt worked in a geriatric medicine clinic. From her knowledge of medicine overall, she knew that a geriatrician would see a wide variety of clients and deal with a wide variety of health challenges in her patients as a family practice physician. Dr. Hapt called Jenny back later that day and they planned to have lunch together to discuss the challenges.

Jenny realized that this would be her opportunity to talk with a subject matter expert or SME from the onset of the new branch of this project. She drafted some questions that would help her to understand the challenges that the developers would face, the new family practice doctors would face, and the patients of these doctors would face when the new software was implemented. Here are some of Jenny's questions for Dr. Hapt.

1. What is the most challenging part of your geriatrician practice when keeping your patient records up to date?

2. Who are the stakeholders in an electronic medical records software on a practice level?

3. What part of a visit with a patient is the most critical, the part that you need to record the most information and get it absolutely spot on correct?

4. How do you like the hospital software, what is not working right? What could be better?

Jenny wanted to be sure that the questions were open ended so there was a lot of room for Dr. Hapt to give her more details. She wanted to keep to only a few questions and she wanted the questions to be general enough that she would know more about the entire problem space, not just Dr. Hapt.

At lunch, Dr. Hapt was pleased to answer the questions. After lunch, Jenny wrote down what she found in the notebook in her car before she went back to the office. When she got to the office, she typed the notes into a report along with additional information such as how Dr. Hapt looked during each answer. Did she look angry, did she seem happy, did this part of the software frustrate her?

Jenny shared the report with her manager, Rick. She set up a meeting with him to discuss what she wanted to do next on the project. Then, she reviewed the notes again and started to formulate the studies that she would need. Jenny determined that she would need the following studies:

a. A comparative analysis of the existing software that the family practice was using and the one that they had previously used.

b. A task analysis of what a typical physician's day looked like when using the software and seeing patients.

c. A focus group of family practice physicians describing what they liked and disliked about the software.

d. A list of user requirements of the new software which included pain points and frustrations that she had observed in the previous studies.

e. A mockup of a design of the new software

f. usability testing of the mockup to discover additional pain points and frustrations

Jenny met with Rick. Rick shared that their budget had been cut and they could afford only two of these studies that Jenny needed and that she would need to hire an outside consultant to meet the initial design deadline of two weeks from today. Jenny chose to do the task analysis (b) and the usability test (f). She decided that she could do her own rough mockup of the software design and that during the task analysis, she could ask questions of the physicians. Jenny asked Rick for a list of contacts at the family practice clinic.

She set up a task analysis for later on in the week. Jenny would be working with Dr. Jean and Dr. Sherman on two separate days. Jenny started reviewing the materials that she would need for the task analysis and started looking through her LinkedIn list for an outside consultant who could help her.

Let's talk about some of the methods that could be used to help design a product.

Formative Tests

Comparative analysis

A comparative analysis is a method where the analyst compares similar products or services to the one that they are helping to develop. It is similar to a market analysis in that it examines all aspects of the competitive product or service including the current and potential users. A comparative analysis is usually done before the product is developed or when the ideas for the product haven't been fully specified yet. This type of test helps the development team understand where their product will fit in the overall product landscape. They may get ideas for additional functionality or ideas of how to design a feature in a better way. The purpose of a comparative analysis is to discover what's currently available so that the team doesn't replicate what has already been offered.

To do a comparative analysis, you must obtain information on most of the products that are currently available to the public. This can be done through an internet search or by ordering the products. With large products such as car dashboards, it would not be feasible to obtain all of the possible cars. This is where the analyst has to be inventive. The analyst might poll her friends and see if she could take pictures of their car dashboards. She might go to a rental car company and see if she could take pictures of their dashboards or she may go to an automotive dealer.

The results of the comparative analysis list all of the features of the different items being compared. These results are often used in requirements documents.

Task analysis

A task analysis is done when it's unclear how the users usually do the task or the design team wants to make the task as close to a real task as possible. For example, designers know that most people will not have used an automated or self-driving car before. They expect that new users will be wary and easily confused the first time they enter the car. The design team wants to make the starting the car experience to be as close as possible to the way that people currently start their cars. Currently, there

are many ways to start a car. Some cars require keys that you put in the steering column and turn. Other cars have a push button that starts the car when the key fob is near and you press the brake pedal. Which task analysis should you choose? Who are your potential users?

Let's say that you determine that the potential users of your automated car are people who have bought new cars in the past 5 years. You determine that all of these cars have the push button type starter. In this case, you would do a task analysis using one of the new cars and its owner.

In the task analysis you would ask the owner to show you her daily routine in the morning on the way to work. You want to know what she does before and after she starts the car. One typical morning you and your assistant follow her around. You both take notes on what she does, how she does it, and how long it takes. You take the notes back to the design team and create a storyboard of what she is doing and what she does next. Throughout this process you discover that she often keeps her keys deep within her briefcase and that there are other things in her briefcase that interrupt the radio frequency signal in the key fob. She complains that she often has to dig out the key fob in order to get the car to start. These are the types of findings that task analyses are designed to discover. Small, seemingly insignificant habits that humans have that interfere with the system operation.

You want to know how frustrating and how common this habit is among new car owners, so you do another task analysis with another car owner. In this case, you decide to do a cognitive task analysis. In a cognitive task analysis, you ask the person what they are feeling and thinking at each step of their morning. When you do this you find that men also lose the key fob in their briefcase. But, the two men that you interview keep an extra key fob in the glove box of the car. Both seem to be unworried about security issues this might impose. You bring this finding back to the design team. One of the developers mentions that this is the way his car was recently stolen. The team decides to explore different ways of storing a key fob/

Focus group

Whenever a product is in the initial design phases, the design team will call on previous and potential users to discuss the product. This is a Focus group. The hope is that the group will recall incidents with the product or have suggestions for better designs. In reality, focus groups are very difficult to conduct as the members will influence each other's opinion. Sometimes the discussion can evolve into a gripe session rather than a productive critique of the product. Other times, the members of the design team can get emotionally involved and subvert the conversations. It takes a very skilled moderator to lead a focus group to produce actionable results.

Summative Tests

Usability testing

Once there is a design for the system, it can be tested on users. Usually the test has one to ten tasks that the user does with the system. Usually, about five users are tested on the system. The purpose of the test is to find usability problems. Unlike a POEP, a usability test does not seek to expand knowledge and there is no control group. The researcher simply wants to know how a person acts with the product. The results of the test are then taken back to the design group for review. They will determine how severe the problem is and what should be done to improve it.

POEP- Plain Old Experiment

POEP- Plain Old Experiment. Most engineering psychologists are actually experimental psychologists with some extra coursework in Human Factors. Sometimes, the best way to discover what is happening is to conduct a carefully constructed experiment. Experiments are time consuming and costly. Often, in industry, professionals will choose to do a less expensive or quicker method first. To set up an experiment, the psychologist must identify an item that can vary (Independent Variable) and an item to be measured (Dependent Variable). Then, the psychologist must determine which states the independent variable should be in to produce the clearest measurement at the different times. The results are hoped to tell the psychologist which state produces the best human behavior and the best system behavior. A POEP is used when there are no existing methods that will answer the design team's question. Usually, their question has to do with which interface is the best or which button yields the fastest response. The results are governed by the non-disclosure agreement protecting the product. Most results are not publishable and only used to enhance the product's development.

Heuristic Analysis

Heuristic Analysis- There are several types of heuristic analyses. Heuristic analysis simply means how well something adheres to a rule of thumb or a general design rule. A heuristic is a general rule. The most popular heuristic analysis is Nielsen's 10 Heuristics (Nielsen & Molich 1990). They can be found here < https://www.nngroup.com/articles/ten-usability-heuristics/> These include visibility of system status, the match between the system and the real world, user freedom and control, consistency, error prevention, recognition, flexibility, minimalist design, recovery from errors, and a help function. Nielsen's heuristics have stood the test of time as universal design principles. When there is absolutely no budget for any type of user testing, experimentation or other analysis, a heuristic analysis is a quick and budget friendly way to be sure that some of the most damaging errors are avoided.

A heuristic analysis is done by at least one analyst; it is better if there are three analysts. The three analysts examine the product for each of the ten heuristics separately. Then, they discuss the product together. They make a list of the problem errors along with the severity of each one. This list of problems in order according to severity is then delivered to the design team to discuss. Usually, a design team will address the problems in order if they can be resolved. Sometimes, a problem cannot be resolved and it's up to the team to create training or another way to educate users on how the system works.

Measures of Workload, Usability, or Situation Awareness

Surveys. There are several surveys that measure different constructs between the human and the system. Surveys can measure how usable the system is with the SUS (Lewis and Sauro, 2009) or how difficult something is to operate with measures of workload such as the NASA TLX (Hart & Staveland, 1988). Sometimes surveys measure how much of the environment the person is aware of at the time through a situation awareness measure such as the SAGAT (Endsley, 1995). Each of these measures relies on a person's perception of their internal state at the time. Because of the subjective nature of these measurements, the surveys are typically given more than once to compare before and after. This assumes that the person's internal state remains constant and the only change is the system. However, surveys are usually paired with other types of observations before an expensive change is made to the system.

Conclusion

POEP is the basis for formulating most theory in Engineering Psychology. Using POEP, a lot of what we know about how humans have performed with other types of systems in the past is published in the journal comprising the body of knowledge for Engineering Psychology- Human Factors. Increasingly, expertise plays a role in system design. One part of the system may be designed for the main users (expert physicians) and another part of the system may be designed for novice users (patients). When expertise plays a role in the system design or evaluation, the Journal of Cognitive Engineering and Decision Making (JCEDM) is the body of knowledge as the type of studies vary from POEP and require a different type of peer evaluation. The remainder of this text will focus on what we know about how humans use systems, human performance, safety, ergonomics, and limitations. Within those sections we will revisit some of the testing methods and add a few more.

Where to go for more information.

http://www.hfes.org/
http://hcibib.org/

References

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