**Usability Engineering**
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Module - 06
Lecture - 19
Requirement Analysis - III

Welcome to module number 6 and this is the last phase for our discussion on the Requirement Analysis phase and this is phase number III. Now, in this module we are going to discuss about quantitative methods, we are going to discuss about the various tools and techniques in brief, that are used and which are classified as quantitative methods of data collection.

We will also look at some of the equipments and see how these equipments helps us in collecting data that are quantitative in nature. And finally, we will look at the ways through which we synthesize data from all these techniques that we have discussed be it qualitative or quantitative. That would end our requirement analysis phase and subsequently we will then focus on the next phases.

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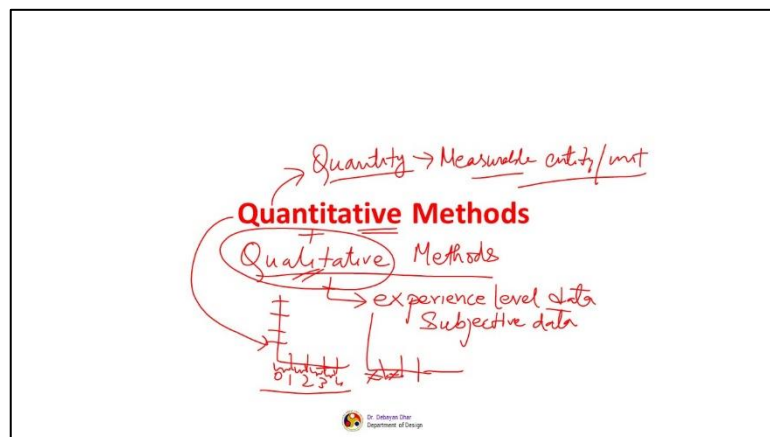
So, let us begin our discussion on quantitative methods. So, the word itself when we talk when we say quantitative it in itself tells us things that can be measured. Until now, we have discussed about qualitative ways in this module, we will discuss about quantitative methods. The first and most important question that comes in all of our minds, when we use the word quantitative qualitative is, what is the difference between these two?

In design process or in design-based projects and studies you would see, majority of the time there is a prevalence of techniques that are qualitative in nature. Now, these techniques help us to identify the experience level data. And these data are often referred to as qualitative in nature many people also use the word subjective data.

But, it would be incorrect to say that design-based studies or design-based projects specifically projects, which can be classified as user experience project or HCI based projects. They are solely and only dependent on qualitative data, no that is not the case. Many a time you would see there are studies that clubs these two together quantitative and qualitative.

So, here what you would realize is that, it focuses on quantity it is a measurable entity or unit. Now, the difference one of the basic differences which I would like to discuss right now before we enter into the detailed discussion is that, if you plot these two types of data in XY axis for quantitative you would see the data can be plotted across units that are constant in nature right.

These are constant for example, 0 to 1, 1 to 2, 2 to 3, 3 to 4, these are constant in nature and you plot this data accordingly right similarly in XY axis. Unfortunately, in the case of qualitative data we cannot ascertain the same. This is not equal to this, you are not sure about these quantitative differences. And therefore, they are primarily termed as qualitative in nature right.

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So, data essentially when we talk about data collection methods, user research methods the first thing that should come in your mind is that, data is essentially of two types. One the qualitative data and then the quantitative data.

Now, we will discuss this later when we talk about the module the last module where we talk about usability testing in detail, but let me give you a brief idea about some of the techniques that we use during the requirement analysis phase as well. Now, qualitative data consists of observational findings focus on this word, it consists of observational findings and these findings identify what we identify design features which are easy or hard to use.

So, the scale is between whether the features are easy or they are hard, that is the scale probably we focus on; while we investigate qualitative data. In case of quantitative data, it is in the form of one or more metrics ok, some of the metrics we have discussed earlier as well.

Few are like completion rates whether your customer or your end user is able to complete a particular task which you have devised as a designer in the product. Probably in the software if somebody is able to register himself and then go on to select a product and buy it and complete the entire transaction process, that can be classified as a task completion.

And how many people can complete the task? That can be a measure of the task completion rates or even task times. We had detailed discussions on it regarding our novice versus expert users and how these two groups vary in their amount of time they take to complete the task, because the concept of learnability is there. One group is learning while the other has already learnt and now the focus is on completing the task as fast as possible right.

So, these are the two different types of data, we have been talking about in the requirement analysis phase 1 and phase 2 of the module, we have discussed a lot of the techniques that focuses primarily on the qualitative aspect of the data be it contextual inquiry right be it other interviews. While we have also discussed about quantitative data like card sorting, tree testing; we will also briefly discuss about them again here.

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Now, qualitative data offer a direct assessment of the usability of a system. Now, researchers observe participants struggle with specific UI elements and they infer which aspects of the design are problematic and which work well. That means, the focus is again here is on easy versus hard.

They can always ask participants follow up questions and change the course of the study to get insights into the specific use issue, that the participant experiences. Quantitative data on the other hand it offers an indirect assessment of the usability of a design.

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They can be based on user's performance see, the focus is on performance and this is specifically given to a task. That means, task completion rates success rates, number of errors, a major issue while we are trying to understand the usability of a system or it can also reflect participations, participants perception of usability.

Because remember it is this perception that is going to influence their interpretation of the system, their ability to interact successfully with the system. Because perceptions influence satisfaction scores the appraisal that is going on continuously inside the customer or your end user this perception influences that right.

So, quantitative metrics are simply numbers; numbers mean numerical 1 2 3 4 5 all these are numbers. And as such they can be very hard to interpret in the absence of a reference point. Remember during interviews when we discussed about reference criteria frame of reference; this is a very important aspect in quantitative metrics.

What is the frame of reference? Take the example say if 60 percent of the participants in a study were able to complete a task. Now, is that a good measure or a bad measure, how do you interpret that data? Now, it is very hard to say in absolute terms whether that is good or bad and that is simply why many quantitative studies usually aim to compare it with a known standard.
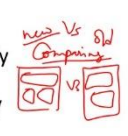
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That means say for example, you have come up with a UI design right and you test it with the old one. That means, you are comparing between the old and the new. So, this is a comparison between the old and the new interfaces.

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And these comparisons provides a deeper insight into the reference point of reference, their frame of reference, that we are trying to understand. It is only then when you compare and you get this data which is quantitative in nature it has a meaning for the design team, for the designers. Otherwise quantitative data does not have any meaning, if they do not have a frame of reference.

Another important aspect of quantitative data is statistical significance, this is a very very important term we will discuss it in detail in our subsequent modules. But, in research or in UX research this is a very important parameter, why?

Because one advantage of the quantitative data over the qualitative data is statistical significance. I think this is a typo error you should interpret this as a qualitative right, not as qualive that is not correct ok. So, one advantage of the quantitative data over qualitative data is statistical significance.

Now, quantitative data come with a certain protection against randomness; randomness means any outcome that has happened by chance; randomly it has happened. It does not have any cause specific cause because of which the outcome has happened. And usually mathematical instruments such as confidence intervals this is highly influenced by the errors in sampling etcetera other types of errors, this influence us lot.

And statistical significance that tells us how likely it is that the data reflect the truth or whether they may be just an effect of random noise. See essentially what we are trying to understand from these studies is, whatever observation we are making is the observation real; that means, is it for sure that this is what we are observing. And therefore, even you

would realize that in our discussions with qualitative data I have time and again talked about looking at the trend.

So, you go on repeating collecting quality data until and unless you look you see a trend. That means, majority of the people who are trying to provide you with data that is dominant in nature, the same holds true for quantitative data as well.

So, while doing a quantitative research or collecting data using quantitative methods, it is of paramount interest to the research community or the researcher that whatever data he is collecting it should be truth it should be true data.

That means this is what is infact happening in true, it is being observed. This is not something that you have observed out of chance that you have collected just because of some error in your see in your data collection error in the participants or error in the environment or error in the system, whatever error it can be. It is not because of the error, but in reality that is what exists. That is what is the focal point of our interest, when we are going for any type of user study technique.

And specifically in quantitative we use the terms which is called statistical significance right. So, perhaps an artifact of this specific participants that we happen to recruit or of the conditions in which this study was run, there can be errors of from any of these aspects.

So, it is our role to ensure it is our duty to ensure that the data that we are collect are statistically significant. The data should not be the case of randomness by some errors that we collected the data. And therefore, the question of statistical significance is so importance.

We will discuss about that in detail when we discuss the research aspect of usability testing in subsequent modules. But, in short as of now you can understand statistical significance as a measure of truth versus randomness.

If a data is statistically significant it means it is true data, it is a true phenomena, it has not occurred due to any chance by or by randomness. Similarly, what confidence intervals tells us is that you are using a particular amount of sample. And you are collecting data and you are saying that based on this data you are trying to project that your entire population will behave in that manner.

So, your sample should be representative we did talk about that representativeness of the sample, it should be representative of your population. That means, if you are working with students community the amount of participants that you have called for your studies, this should be representative of the student population of that specific zone or that country or that area; based on whatever studies you are doing.

And if there is an error your confidence interval; that means, the whatever mean you have predicted you are saying that the mean lies in the sample here. So, I am projecting I am anticipating that the mean would lie in the population here. Now, the range where the mean will lie will increase; that means, the focal point would be very very big and that highlights that your study has lot of error.

Because, it is all about prediction no? You are predicting the population qualities, you are predicting the population characteristics based on the study of your samples who are representing the population.

So, these are important terminologies we will discuss about them subsequently in our lectures in the later modules, when we did discuss about usability testing in the research paradigm in detailed way.

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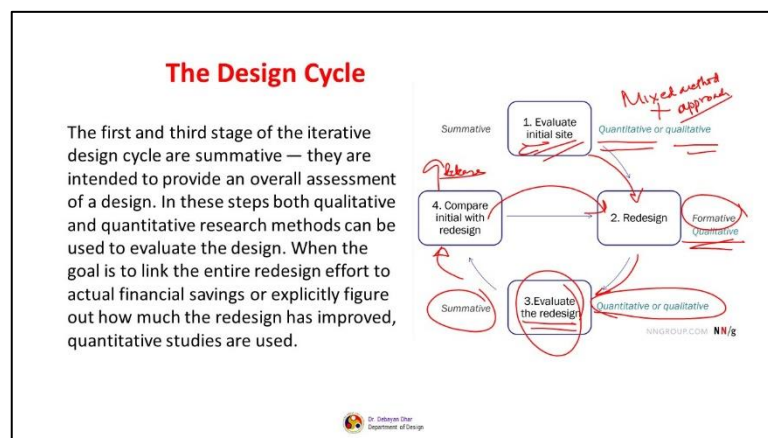
Now, let us come down to the design cycle. In the design cycle what you will see is that whenever there is a brief given to you, as a designer. Say somebody has come to you and said hey my site is not is old, it is not functioning I do not think it is working or it is addressing to the requirements of my customers or my application can you just redesign it.

What you would do? First of all, you would evaluate the initial site. And this evaluation can be quantitative and qualitative both this, when you use both these together it is often called a mixed method approach method approach alright. Then after this stage what you will do you will come down to the redesign stage.

Now, in redesign stage you need to understand some specific things about your users and primarily these things are more qualitative in nature. And these insights help you to improve your ideas to improve the ideas that you come up with. These are more qualitative in nature and hence these are called formative because they help you in improving your designs.

Finally, when you have your UI ready or the idea is realized you then want to evaluate the redesign. At that stage you again focus on the quantitative or the qualitative aspects of data collection methods. And this is summative in nature right and then you compare with the initial redesign, that is the stage that you are comparing between the initial site and the new design.

If there is an issue you again go fall back to the redesign stage otherwise you go for the release. Very nicely this have been detailed out from the Norman Nielsen group I have just used the representative image to discuss the idea, where and in which stage the quantitative and qualitative methods are being used.

So, the first and third stage of this iterative design cycle are always summative in nature. They are intended to provide an overall assessment of the design right. Now, in these steps both qualitative and quantitative research methods can be used to evaluate the design. When the goal is to link the entire design effort to actual financial savings or explicitly figure out; how much the redesign has improved. We use then what? It is all about numbers quantitative studies are used.

Now, the question is when do we go for qualitative and when do we go for quantitative? The last cycle that we talked about the iterative design cycle will give you a glimpse of when we go for each one of them. Now, qualitative studies are well suited for identifying main problems in a design the problems are issues, the gaps, the frustrations right.

So, qualitative studies are used to identify these main problems. For example, you know we can easily run a qualitative study to see what prevents users from submitting a form successfully. You have designed an online form and you see that people are not able to complete or successfully submit the form.

You can do a qualitative study you can do an interview, you can do a contextual inquiry, to understand an observational technique to see what is the issue with that form, with the users. and why they are not able to complete the task?

In contrast a quantitative study are done on a complete version of the site. So, it is a entire application you have designed an entire site, you do a quantitative study on the entire site. And the aim is or the purpose is to evaluate usability of the site based on some metrics, like we discussed earlier. And these are not just about identifying the issue rather directly informing the redesign process.

They are helping the designer to understand whether the redesign is significantly improving these metrices or not, and in order to inform the designer about this significant improvement from the old to the new you need quantitative data. So, quantitative studies usually involve large numbers of users.

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So, both type of the studies be it quantitative or be it qualitative need to follow basic rules for good experiment design, by making sure that your studies are externally valid and internally valid. So, what do we mean by external validity? By external validity we mean that participants are representative of the target audience of your main population of your main customers.

And the study conditions reflect how the task is done in the wild, in the wild means in the actual situation where your representative users will work right. Internal validity on the other hand means that the experimental setup does not favor one condition you have two conditions, one is the old application old site and you want to compare that with the newly redesigned site.

So, internal validity means that your experiment should not be designed in a way that it is only favoring the new one and not the old one, each one should have a chance to get favored successfully you know. So, for example, if design A is tested in the morning and design B is tested in the afternoon it is possible that, fatigue can play a role in how participants used design B.

So, what is the way out? Change the way. One day you use design A in the morning and ask people to test and then design B in the evening. The next day you have design B in the morning and then design A in the evening. This way you ensure that internal validity is addressed.

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Some of the most popular quantitative research are quantitative usability testing which is often known as benchmarking, web analytics or app analytics. A B testing alpha beta testing or multivariate testing, card sorting, which we have already discussed in our last module, tree testing already discussed. Surveys and questionnaires, clustering qualitative comments somewhat discussed we have also discussed about this, desirability studies and eye tracking testing.

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Let us start with discussing the first one which is quantitative usability testing which is often called as benchmark. Now, quantitative usability testing is often used in tracking usability over the period of use; that means, time.

And it is compared with the competitors of the product, it is a it is a behavioral method of study; that means, the focus is on what people do. And the context of use is task based, so

a task is given and then it is compared. So, quantitative usability testing is focused on collecting metrics like time on task or success rates.

Once these metrics are collected with a relatively large number of samples around say 30 or 35 participants it can be used to track the progress of the products usability over time or compare it to the usability of your competitors' products.

That means, the focus is on how the usability is evolving as new design solutions or new designs are being introduced into the product. And every time this is being compared with the competitors in a way, so that you know definitively what is being improved and where it is being improved.

And remember the number of participant size that is required is relatively high you require at least 30 to 35 participants I have seen, in studies where they have used more than 100 participants. And it depends on the nature of the application nature of the product nature of the task complexity of the task so on and so forth.

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The next one is web analytics it is often also called as app analytics. It is used to detect or prioritize problems, it is also used to monitor performance. It is something that you can see in live situations, how your customers are coming to your application, what they are doing, where they are clicking, whether there is a goal conversion or not. Everything can be observed by you.

It is a behavioral type of method because you observe what people have done, that means what they do and therefore, it is a behavioral type of study. And the context of this is live

it is a live your product is running your product is already there right and you get on these data's as your users are using in the product. So, analytics plays a major role now in the industry to tell us, how the interfaces or the interface elements are performing based on the requirements of the customers or your users.

They describe what people are doing with your live product; that means, the interface the application, where they are going, what they are clicking on, what features they use, where they come from and on which pages they decide to leave the site or the application. These are so vital information because this tells you about their frustrations at what page they are leaving and where they are going, where the entire traffic is being directed.

This will tell you, in fact actually accurately that the issues here are the issues with your application. This information can support a wide variety of user experience activities; that means, in particular it can help the designers; that means, you monitor the performance of the various concepts.

Say for example, you want to add a widget, you want to add a particular feature a new way of conceiving the task or a micro interaction technique in the application. And there is a new something new that has been incorporated at the site.

Now, your data analytics data would tell you whether you would see a jump in the traffic because of these introductions. Or whether people are getting confused and leaving without completing the task, the new design even attempting to completing or use the new design and leaving it; these are vital insights. So, these helps you to monitor the performance of various contents like the UIs or the features in your product and identify, what does not work.

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The next one is a very interesting type which is known as the A B testing. It is already we had discussed it about in the early slides remember we discussed about comparing the newly redesigned UI with the old one right.

The same thing here is what we call as A B testing alpha beta testing or it is also called as a split half testing. Now, it is used when your intention is to compare two design options you have design A and design B you want to compare. It can happen if you have multiple concepts or it may also happen that you have the new concept and the old concept and you want to see how your new concept is being performing.

Type of method it is a behavioral type of method because the focus is on what people do and the context of use is live. That means, for the same product for the same site or the application you have some features that are given to some participants or actual users and some are given and the old one is retained for few.

So, two different live versions it can be between the old one and the new one or between a new concept A versus new concept B. So, two different live versions of the same user interface are created and then each version is shown to different target audiences or users to see which versions are performing the best and while you can club it.

Now, this alpha beta testing is many a time clubbed with web analytics to interpret the data of whether people are accepting the new or people which one is accepting concept A or concept B. So, it can be tied up with the analytics and this kind of metrices can be extract in order to compare between the two designs multivariate testing is almost similar the difference lies that testing several design elements.

So, you know we are not only testing one concept. So, you have one UI and you have one concept one feature and in the other concept it does not have or you have a different feature and you are comparing these two that is a A B testing.

In a multivariate testing you not only have one feature, but you have many features right. For example, your test could involve different button labels typography placement on the page. So, different new introductions are being tested simultaneously. So, it is one versus many in A B testing you are only comparing one while in multivariate. So, multi multiple variations multivariate means multiple variations.

In multivariate the focus is on how different features new features that have been incorporated in the site are affecting the performance right. That is in short about A B testing or multivariate testing.

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And we have already discussed about card sorting in our requirement analysis phase 2 module. Its use is to determine information architecture labels and structures. It is attitudinal in nature because, what people say you are asking people how they would like to club things together and therefore, the focus is on more on attitudes.

The context of use it is not there is no product you are just trying to understand how people are clubbing information. Now, why we say that it is quantitative in nature? The answer is here. So, this method gives you the opportunity to get into the users' mental model right of the information space. What terminology do they use? How do they logically group these concepts together?

Now, quantitative analysis of the percentage of participants, who created similar groupings here we are talking about pattern see we are talking about percentage patterns. And therefore, quantitative aspect is coming into play, can help us these percentage of users identifying similar things or similar groupings can help us establish which categorization approach would be understandable to most of the users.

That means, we are trying to understand the dominant grouping of information across our target audience using of the samples obviously. Because we are focusing on the percentage therefore, this technique is being may primarily call as a quantitative way. This is it has also a qualitative aspect to it I cannot say no to that. But finally, it is about identifying the dominant pattern and that can only be identified if you identify the amount of percentage your samples are framing similar groups or using similar groups.

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The next one is tree testing we have discussed this technique also in detail in last module. Now, tree testing is used to evaluate information architecture hierarchies. So, there is a qualitative aspect to it as well.

And the method of is behavioral, what people do? We are asking the people to complete a task to identify certain things the example that we have discussed in the last module if you remember that, we have asked them to identify look at an information and tell us what did they mean by that or how to do that activity or how to establish a business. There is an task given to them.

The context is task based although they are not using the product, but they are using the hierarchy to complete a task a task that is given by the designer. So, quantitative analysis

of the tree test results will show whether people were able to find the right path to this item in the information architecture. And how many again this is very important every time we discuss remember the focus is to identify the dominant pattern.

The focus is to identify the dominant pattern, because you are not designing for one two people you are designing for a target audience. And majority of the target audience should feel comfortable with the insights that you have identified, it should match their own. And therefore, the percentage is important percentage is so important here.

So, quantitative analysis of tree test results will show whether people were able to find the right path to this item in the information hierarchy and how many participants picked the wrong category again percentage. This method is useful in identifying if an information architecture structure, labels and placements agree with people expectations. Because, why and how the focus is on identifying the dominant percentage of the dominant patterns right.

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We will now move on to surveys and questionnaires. As we have been discussing during the initial modules about various tools and techniques of asking questions, asking conducting surveys questionnaire surveys. The use of this technique is to gather information about your users. Their attitudes and their behaviors though the type of method is attitudinal.

Because it is a survey and you are asking them to respond you are not actually observing them to complete a task or do the task. So, the focus is on what they say and what they write in your survey. The context of use can be any right.

So, they can produce combination of quantitative and qualitative data, ratings proportions of answers for each choice in a multiple choice question proportions so important aspect as well as open ended responses similarly proportions can be identified there as well. And you can even turn qualitative responses to a survey into a numerical data and how do you do that? You do that using a scale.

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I have taken an example figure from the Norman Nielsen group, which says that for example, you have an app and you say that this app is. So, 1 stands for easy to use and 5 stands for difficult to use and you ask the person to rate. So, he may whether click here or here or here or here or here whatever it may be, what you see here are the qualitative states this is easy this is difficult. So, from easy you move towards difficult right.

So, these are called semantic differential scales that we have discussed earlier and these are rating scales and each radio buttons stands for a numerical value. So, respondents can choose easy to use which is 1 or difficult to use which is 5 or a value in between. This is how you convert a qualitative response into a quantitative data.

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The next one is clustering qualitative data. Now, when I say clustering qualitative data what comes in your mind first, do you remember something any technique that we had discussed about? Can you remember about protocol analysis the techniques that we have discussed? What we do with open codes actual codes? Do you remember something?

So, the use of these techniques is to identify important themes. Do you remember something now? We are focusing on themes in qualitative data. The type of method is attitudinal in nature what people say and the context of use can be any. So, this technique is less of data collection methodology and it is a more of what analysis approach because you have the transcribed data. Now, you are trying to collect or combine the themes to come up with major themes.

So, it is more of a analysis approach. So, it involves grouping observations from a qualitative study based on common themes. If you have a lot of observations you can have a lot of observational data you have lot of transcribed data, you can count the number of instances; that means, the frequency. Here we are talking about what again frequency see frequency is so important, because the focus is on identifying dominant pattern right.

So, you can count on the number of instances when a particular theme is mentioned. So, from qualitative, now we are counting the frequencies a particular theme is mentioned. This method can identify the prevalence see to it prevalence and frequency of a specific theme or situation. These would allow us to convert even qualitative data into theme based data and then tell us, what is the frequency of the dominant theme across our participants that we have observed.

The next one is desirability studies. Now, the use of desirability studies is often carried out to identify attributes, associated to your product or brands. It is an attitudinal again because we depend on what people say and it is a task based it is used in task-based scenario. Now, these studies desirability studies attempt to quantify and measure some quality of a product quality aspects of it.

It wants to measure the quality of the product such as the aesthetic appeal you know, brand strength you know tone of the voice so on and so forth and these studies can be customized depending on the research questions. So, the focus is on research if we want to see whether a change in a particular feature in the UI will change in the aesthetic appeal of the product or not we go for this kind of studies.

They generally involve first exposing the participants to the product and then asking them to describe the design by selecting options from a list of descriptive words. With the large sample size that is representative of the population trends start to emerge. Again, here what you finally, focus on is the frequency across the samples of the chosen word.

So, what is important here? If you think for a moment across all the techniques that we are discussing. The focus be it qualitative or quantitative, the focus is always on trying to understand the dominant pattern.

The important aspect of performance or experiences that our participants are feeling and important in terms of number. If you are asking 10 people the focus should be how many of them confirm to a particular thing. If the number is less for example, in 10 if 3 people are saying this 3 people are saying this 4 people are saying this increase the numbers.

And as you increase the numbers you would see the variations start emerging. One factor will become dominant the other becoming smaller lesser and lesser dominant. And it is at that point of time we realize that this is the factor that is dominant across our actual users or representative users. So, that is what we are trying to find out from our samples.

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And finally, the one that is extensively used now and it is a highly precision based study is the eye tracking testing study. We will have a demonstration of the eye tracking device in this module and you would see how eye tracking studies helps us to interpret the quality of the interface.

Its use is carried out to determine which user interface elements are distracting findable or discoverable. Its cost is very high the equipment cost is very high and it is very difficult to collect because it has to call in participants they have to be a situation an experimental set up where they will be have to be called in all the instruments has to be fitted.

So, there is a chance of error being there. Difficulty of analysis is also high. It is a behavioral study because we collect data on based on what people do and it is a task-based study.

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So, eye tracking studies require special equipment and this equipment costs are really high and these equipments tracks users eyes their pupils as they move across in an interface while they are performing a task.

When many participants say 30 or 35 or more than that perform the same task through an interface, meaningful trends we start looking at trends, then emerge where they are focusing, where their pupils are focused. Where they are moving from which elements have attracted their most they are mostly concentrated in and then you can tell with some reliability which elements of the page will attract people's attention.

The focus is on attracting people's attention through your movement of the pupils whether they are dilated or not how many times you have gazed into that feature of the interface. So, eye tracking can help you identify which interface and content elements need to be emphasized or deemphasized to enable users to reach their goals.

Because see the moment when the user perceives that ok this is the feature I need to use this and then I need to move ahead before that whatever distractions are there you would be able to understand that if you conduct a eye tracking study and you can manipulate those designs in order to ensure, that the focus of your users does not get distracted.

And they remain ever concentrated in their journey of task completion. Though being a very costly study eye tracking helps us, in understanding where people are concentrating and which are the elements that are being attended by our participants.

In the subsequent module after this you will see a demonstration of the eye tracking device that we have. Two of my research scholars Rahul Jetti and Nandita would demonstrate the working of eye tracking device, the parameters that it measures, how are those parameters extracted, how the entire experiment is conducted they will demonstrate it in detail.