**Introduction to Professional Scientific Communication**
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**Lecture – 07**
**Introduction to Scientific Writing**

So, welcome back to this course on professional scientific communication. So, we have been discussing about hypothesis and how; and why Hypothesis is important for executing a very good you know research project? So, our discussion so far, you know was on emphasizing as to why hypothesis is important? And why that is important for the project? And as well as the outcome and so on.

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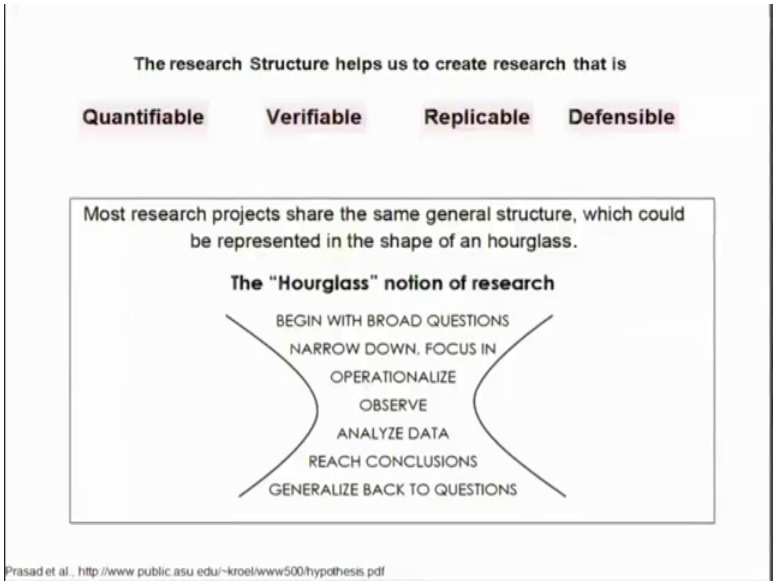


So, now, onwards we are going to look into the very core concept of scientific communication as to how you document your reports? How do you develop your reports? How do you write your reports and so on, so when I spoke about research I mentioned that the any research project you know or the outcome is quantifiable, verifiable, replicable and defensible.

Because, this is possible because, you generate a report which has got all the details therefore, anyone else can read and they can verify that your inference are accurate, and they can redo the experiments and find that, what you have obtained is the same thing

that they are also getting, and then anyone can different your you know outcome because, they are able to get or observe very similar you know outcome.

I also said that, it has a hourglass model notion in research that you brought with you start with broad questions, and you make it focused narrow simple questions and then, you will test these questions and you observe and then obtain data and then conclude and then, we make a generalized statement. And in fact, you know that is how the same concept or same workflow is used, when you develop any reports as well.

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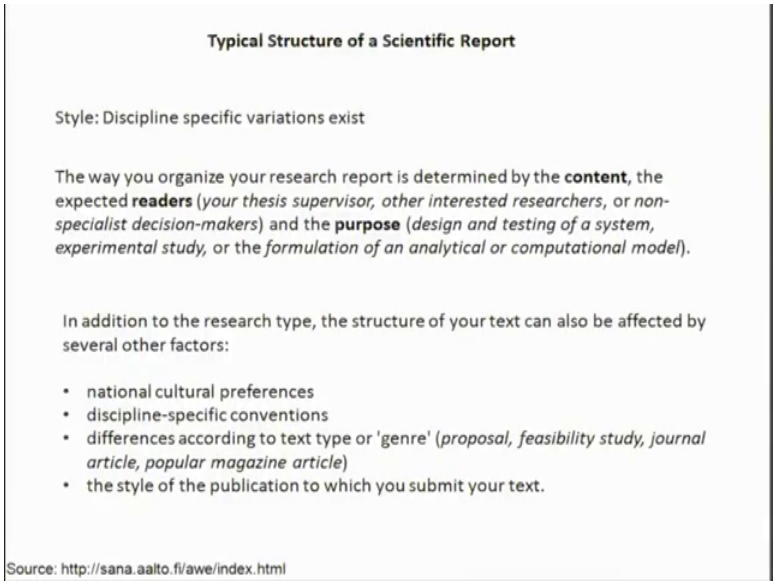


So, let us look into a typical structure of a scientific report. First you should understand that there are discipline specific variations in the way you write scientific report most often biology you know, you infer from something and then you write because, especially in you know molecular biology, and other you cannot really see what is happening.

So, infer from certain experiments, or if you are working on say developmental biology, you see what is happening, but, why it is happening is something very difficult to see. So, you extrapolate as to predict as to what happens therefore, you know if there are changes or if you work on for example, human genetics, you know you look at certain deformities, you look at the family and then you say whether it is recessive dominant and so on.

So, in most of them in such biology you know, you have in direct or indirect evidences to suggest and then therefore, it develop hypothesis. So, there are disciplines specific variations that you need to know there for a given if you switch field you need to understand, that there are you know certain variations that are unique to each discipline

So, the way you organize your research report is determined by the content. So, of the report right and then the expected readers because, you need to know before you when you start your report, for whom you are writing this particular report right? So, the report could be for your supervisors, or it could be for somebody interested in your research, right? Somebody elsewhere wanted to know what you are doing, or in non-specialist's decision maker. For example: somebody in the government would like to know what the outcome of your research.

So, when you prepare a report it all depends on to whom you are going to give. So, if it is your supervisor, you do not need to say everything about what was the hypothesis? Why you are done? How you are done? Obviously, your supervisor would know all this you know important elements, all you need to say is what observations you got, what you mean you know in terms of the outcome. What you analyzed, what do you think the outcome really represent, this is what you need to give to him because, the rest you would anyway understand because is anyway working on this problem.

If you are writing to somebody is interested in the result, maybe they do not know all the methodologies that you are using, they may not know exactly what questions that your you asked. Therefore, you need to even provide the hypothesis and some bit of information on the background and so on. But, if you are writing to a policymaker for example, the decision maker some you are working on pollution let us say, and how? For example, industrial pollution may affect a given city, and the city mayor was interested in your research in he asked you ok. Why do not you give me report? I will see what can be done.

Then, you cannot go and explain everything that happens at the level of cell, or what happens in the effluent plant in terms of you know, how the waste material is generated? And so on. You have to talk about you know the impact that it can you know make to the public, and how it can be mitigated? What is you know burden on the city administration in terms of for example, a large number of people are affected it is going to affect their

performance, or if there is a mitigation that you are suggesting what would be the cost involved? These are you know elements decision maker may be looking at. So, certainly you know you have to know to whom you are preparing the report and finally, the purpose.

So, that is purposes design and testing of a system experimental study, all the formulation of an analytical computational model suppose, if you are involved in developing certain software and so on. So, it depends on what kind of a work that you do. So, that is a generic statement. So, in addition to the research type you know depending on what kind of research you do which discipline you work? The structure and text can also be affected by several of the factor. For example, the national cultural preference you talked about, right?

So, if you talk about for example, like I will give some examples, you know if you are looking at you must have most of you must have looked into the Google map. The Google map if you open this are in a Google map from any system that is within India, and you look at India it will show you know the entire Jammu Kashmir as part of India because, that is the political map for all of us who are in India. We believe and we say that is the accurate map because, we are not considered any part of land to any other country.

But, if you open it from the same map, if you open it from elsewhere, you go to us and open it and see then, it may not look identical to the map that you see from when you are within India. The reason is that governments do not allow likewise you know use you must have seen recently. There were some exchange of military a conflict between china and India with regard to a small place near you knows Sikkim. So, these are some of these political maps for example.

So, when you are publishing any report from India you have to use for example, the official map of the Indian government. So, there are likewise you know you need to consider all these things, there are discipline specific conventions, right? So, when you use certain phrases and you assume that this is what you know being meant, when you say something for example. So, therefore, there are disciplines specific you have to understand differences according to the text type or for example, proposal feasibility and journal article. For example, they may say there are some restrictions; they may say that

this is the convention that you have used. So, you need to know a front to whom you are writing? What is the cultural preference? And so on.

So, there are lists of things that you need to understand if it is your thesis then, you have to consult your own institute, university as to what should be the format of the thesis; so the style of the publication to which you submit your text. So, whether you are submitting it as a full-length article, whether you are submitting as a research note or a letter you know then, there is a difference. If it is a letter you may not have very elaborate structuring, it could be a monolith you can know abstract just titled on the content, and research note could have you know subheadings.

So, you need to know you know to which section you are preparing a manuscript therefore, you prepare accordingly. So, you this these are some of the elements that you are to keep in mind, but regardless whether you have formatted your findings accordingly or no?

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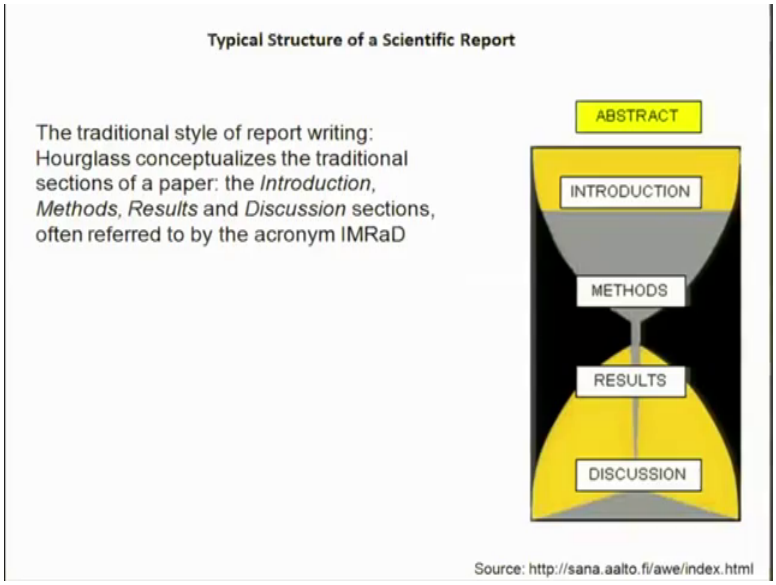


There are some typical structures which you need to keep even when you are making an abstract and you are making a presentation. So, on that is the traditional design that is the traditional style of report writing is the hourglass concept, again something that we discussed when you are you know; executing a research plan. When you are testing and hypothesis again the report you know is very similar to that.

So, it all starts with an introduction, wherein you say what is known until now, and then you say what was your the question, that you are asked what was your hypothesis? How you are tested? That is what called methods. Your observations are results and finally, you discuss your results and extrapolate and connect with other findings that are known in the literature. So, this is referred to by the acronym IMRaD that is I for introduction m for methods r for results, and the discussion that is d, right? So, this is how it is it is very similar to the other project you know hourglass that you have seen.

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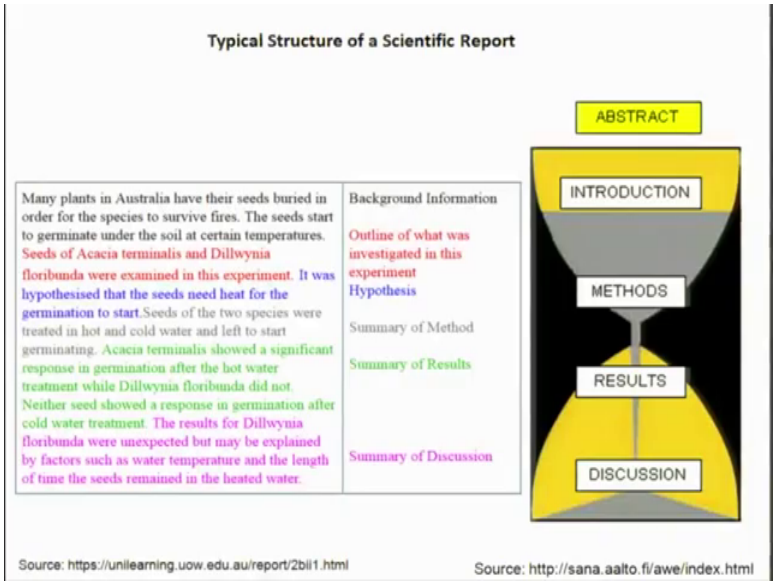


Let us have a look at one of the abstracts; even an abstract would carry all these elements ok. It is just a small one paragraph you will find everything. So, what it is? Introduction is nothing but background information. So, I am (Refer Time: 10:09) copying from one of those you know important links, that talks about how to write research reports and you can see here, the content on the left side that is in the black in a font. It is a background the background is many plants in Australia have their seeds buried in order to for the species to survive fires, right? The seeds start to germinate under the soil at different temperature. So, this is the background outline of what was investigated.

So, you have to say what exactly are you asked? What is that you are tested? That is given in the next section of the introduction that is in the red font. Seeds of a particular plant whatever it is, where I examined in the experiment as to how possibly they survived, right? So, that is the hypothesis. Next is hypothesis it was hypothesized that the

seeds meet heat for the germination to start. So, because, just after the fire possibly they germinate the fire is possibly the trigger test, the hypothesis it is testable in a lab you can tests.

So, that is the summary of the method meaning how did you do that? How did you test your hypothesis?. Seats are the seeds of the 2 species that mentioned were treated in hot and cold water and left to start germinating you are mimicking in the fire you know condition in the wild, and you are testing whether it happens here. Now, the summary of of the results what you found you know your particular one of the 2 you know plant seed, that they have looked at showed a significant respond in germination after the hot water treatment whereas, the other did not, right?

So, one of them show that the fire possibly could be the trigger, after just after the fire they may you know survive, right? Neither seed showed the response in germination after cold water treatment because, that did not really elicit theory you know signaling to the seed to germinate. So, that is the summary and result. Now, you give what is called a discussion? So, this is the observation you got what do you really mean by? It can you extrapolate can you sort of think aloud and say something.

The results of one other plant were unexpected, but may be explained by factors such as water, temperature and the length of the tank the seed remained in the dead water. Because you need to know only one of the 2 trees you know seeds of the 2 trees responded to the heat, the other one did not. You know, why the other one did not?. He did not go in your hypothesis they are saying that possibly one has to you know treat it a little longer maybe that also would trigger and so on. So, this is extrapolation you say something that you are not it tested, but, you say this is a possibility.

So, this is the typical structure of any report, what it shown is about 253, 100 words small section. But, the report could be 100 pages it could be 40 pages but, pretty much having all the detail but, exactly very similar you know kind of organization.

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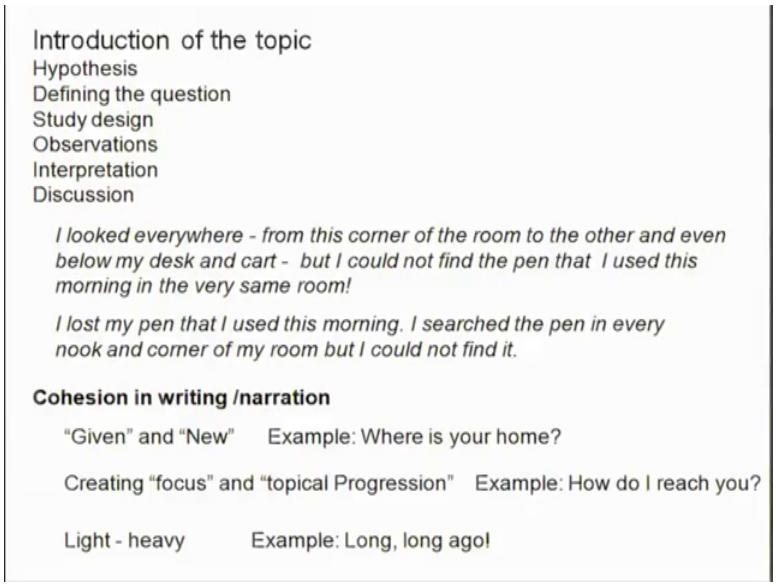


Let us see, some of those important you know tips with regard to how do you write? We talked about some of those the very first section that is introduction of the topic and then, you talk about hypothesis you talk about defining the question, and you are going to say how you design the study observation interpretation discussions. So, we need to know how you write.

So, let us not go into each one of the sections and look into some of those you know important tips as to how do you frame a sentence, right? So, there are 2 different sentences given here, when you read you will understand which one really mean you know feel good as you know good writing. I looked everywhere from this corner of the room to the other and even below my desk and caught. And I say this you do not understand why I am saying this? But, I could not find the pen now you understood I am searching for a pen, and I used this morning in the very soon same room meaning, I used it in the morning the same room, but now, you do not have. So, this is the message.

The second statement is I lost my pen, that I used this morning which makes it very clear that, the pen is no longer with me I used it this morning until then it was there, I searched the pen in every nook and corner of my room, but I could not find it. I tried my best I could not find. So, if you look in these 2 both the sentences are grammatically correct, you do not find any big problem with regard to how this you know sentences frame, but

one conveys the meaning immediately other one it takes time, meaning the second one clearly tells the very first go that I am looking for the pen and I lost it, right?

So, that is what important you need to have cohesion in writing on narration, when it comes to scientific writing because, unless I understand every sentence. I am unable to you know follow what you wish to do because, this becomes extremely difficult. Because, these are complex topic that you are going to explain and only those who are interested are going to read and therefore, you need to make it as easy as possible.

So, some of those you know tips that are given here. For example, when you talk about writing every sentence should have for example, given and new in the sense you know. The first part of the sentence something that is already introduced to you. The second part of the sentence is something that is new to you, right? So, it is very similar to somebody asking you where your home is.

So, you if somebody is act for example, I live in a different part of the city and you live in different part of the city, I never been to your home if I ask you where is your home? If you tell you know I am in say Shastri Nagar. So, I still it does not make any sense to you because, I know you are on the other side of the city. But, still it does not make any sense to me because, it does not tell again where is your home, but you may want to say that you do you know that particular movie theater, and there is an adjacent lane and then over there I live.

So, then you are going to bring in an element which is the movie theater, which I may be aware of or you can say this is a mall which I may be aware of then, from there you narrate and tell where you are. So, then it easy for me to understand, it is very similar philosophy is used when you construct a sentence, we will see little later with examples.

The second important element is creating focus and topical progression. It is like you know somebody's asking for example, you said where is your home? If I do not know where your home is and now, you are told where it is? But, I am asking how to reach your home? Then, you can tell you come to the movie theater from there you go straight and you will find another mall from there you take a right turn, and you will find a tall house with red colored paint next to that there is a small house, that is my home.

So, these are ways by which you narrate this is called as topical progression that is very, very essential for you to keep the reader interested in what you are writing. So, that needs to be you know really attended to. The third and the important aspect when you write introduction is you know the light and heavy. Every time when you introduce something you are always start with some light statement meaning, it is not loaded with information and then, progressively you should make it convey whatever you wish to convey.

It is important thing is that you must have seen the traditional grandma story. It starts with very simple you know thing long long ago there lived a king. So, you do not really need to know much about it then, she will narrate this king ruled a country called x y z and go on it she builds the story. So, this is what it is you start with something very light I feel good about it and bring complexity gradually, that makes it easier for the reader to read what you write when you introduce any topic.

So, you will see how to do. So, there are examples I am going to discuss today but, what I recommend is that you know there is this particular page is you know it is a web-based learning portal. There are large number examples given most of the concept that I am going to discuss today or based on this harm line portal.

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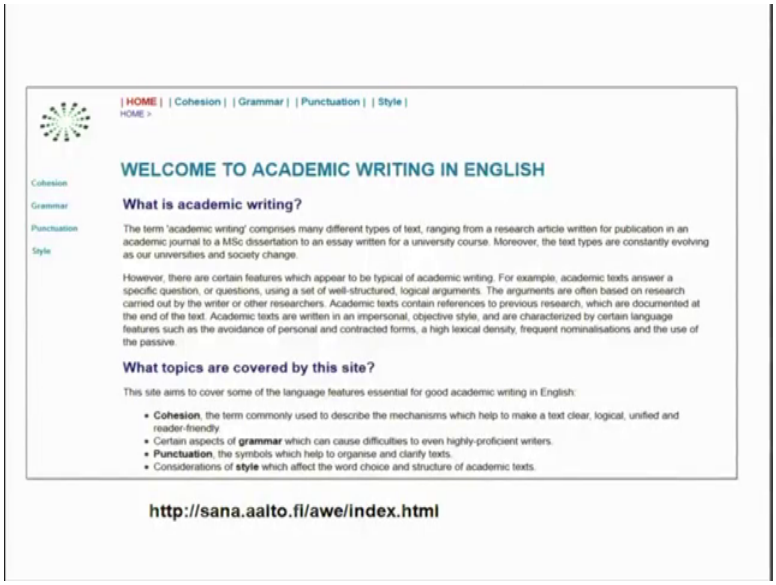

So, I suggest that you guys go through this and there are exercises that you can do also, and which would really help you to learn better. I am going to show some of these examples.

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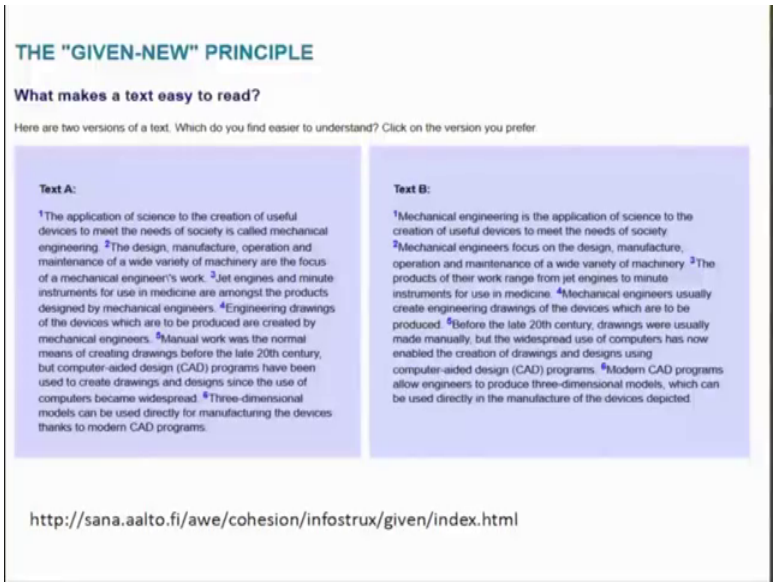


So, what you need to do is that you need to take some time and read these 2 paragraphs. The one that is shown on the left side which is text A and the one that is shown on the right side that is text B; You can pause the video and read it for some time and then ask the question, which one is you know is better? Which one you feel that it makes your reading more interesting and more lively, and in conveys the meaning better than the other one?

So, you can take time and do. If you have done that you would say most often that the text B is better, we are going to dissect as to why the right-side text B is better than text A because, it followed all those principles they just now we explained, that is always given and new, there is a topical progression there is a light and then, followed by heavy thing that is introduced.

Let us see, some of those let us see what is the problem with text A here, that would help you to understand, why text B is better?

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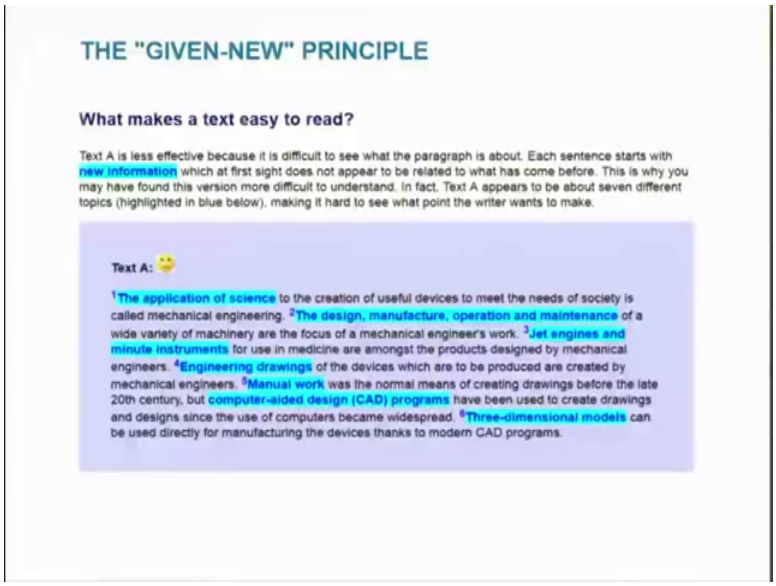


So, what makes a text easy to read text A is less effective because, it is difficult to see what the paragraph is about. When you read anything, you should quickly understand what you are discussing about. Remember I gave you a sentence that I looked here and there searched from this corner to that corner and you get to find the pen I lost, the pen in the morning. So, until I complete the sentence I am unable to convey to you what my whole narration is about. So, exactly that could be one of the problems.

So, each sentence starts with new information for every time you scratch your brain as to or your head as to what does it mean? Which at first sight does not appear to be related to what has come before; when you know read it second time or when you about to complete then, you feel that is related. This is why you may have found this version more difficult to understand. In fact, text here appears to be about sound different topics highlighted in blue color, what you can see here.

The application of science the design manufacture operation maintenance all this you know or something new that is being introduced at the beginning of the sentence, which makes it very, very difficult to understand from the readers of point of view.

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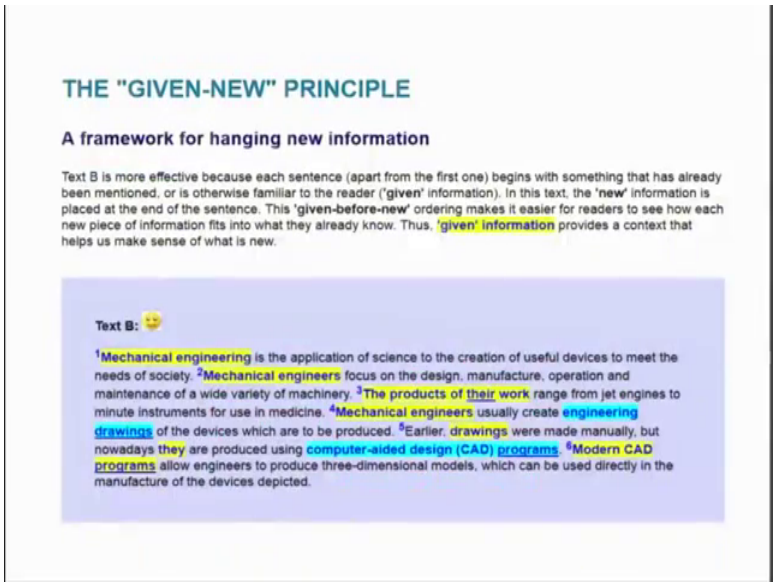


But, if you if you rewrite the same concept whatever has been told in text A same thing has been told in text B. But, with the principle that we described that is given and new. So, meaning you starts the sentence with something that possibly you may know or majority of the readers might know, and then introduce a new concept in the second part of the sentence. The second part of the sentence becomes now given because, you understood what it is and now, you can use that has the given and build the concept.

Mechanical engineering is the application of science to the creation of useful devices to meet the need of the society. Because, mechanical engineering there is term most of us would have heard about that sounds you know kind of familiar, and then you explain what it is. Mechanical engineers are easy because, anyone who practices mechanical engineering is engineer.

The product of their work when I say there we know it is mechanical engineers and then, you say that they create what is called as engineering drawings now, we are introducing something new and for the devices which are to be produced earlier drawings then, you say that very similar, but you know but they are made manually. But now, you have you know computer-based drawing diagrams or computer aided designs what is called a cad and so on.

So, you can see that as you introduce every sentence has got something that was already known to you, and then you bring in something new therefore, it is much easier for you

to follow as a reader. So, this is an important element not only when you write even when you speak, if you can always start with something that the readers might know the audience might know, and then develop from there is much, much easier for the audience to follow.

For example, if you are as you know is research student doing some project work. Somebody is asking you a limb and not connected to any research lab not enough research profession ask you what you are working on? Let me say that you know I work on a disease, I do not work on the disease per se, but I try to understand the gene that is involved in the disease as to what is a function of the gene. So, that is my project.

Now, if some third person asked me as to what I am working on, if I give this answer how it would sound like? I work on a gene called epmta, if I say this the person will not understand anything because, epmta does not make any sense, even if I work on a gene called epmta does not make any sense because, you may wonder why is he working? On this looks like useless I have not heard about anything. There is no problem this guy says he works on a disease, but he says something he works.

But, rather you say in a different way you start from a conversation that you can relate to, you say I work on your neurological disease. This is something that he would be able to understand, and then you say this disease is caused by defect in a gene called epmta. Now, he understands ok. There is a defect now I am trying to understand the function of the gene therefore, I can now tell when you are defect in this gene what possibly may go wrong in the disease it makes an impact.

So, you need to know how to relate the new and the given in which sequence it should come, you do not follow you do not follow it in your conversation it might make it very difficult for people to follow that is something again introduced here. It is shown here for example, every sentence you have beginning with word or statement which is already given I have been told, mechanical engineering you expect most of them to know.

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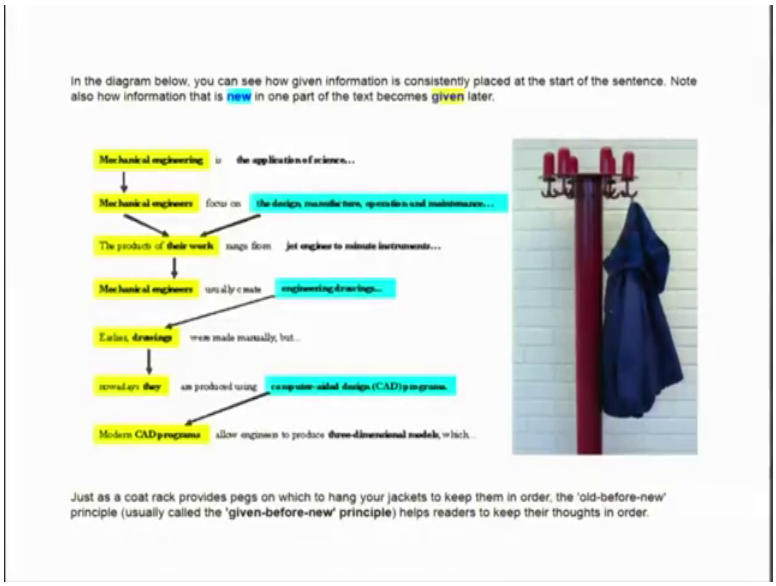


Now, second sentence starts with mechanical engineers and understood that the engineers who practice this profession. Because, they focus on and then you follow it with knew that is the engineers focus on design, manufacture, operation whatever it is that is showing the blue, and then you say the products of their work is that is the product and then, and so on.

You will find that everywhere the sentence starts with the given which is already introduced, and then bring in something new therefore, the reader can understand well this is also called as what is called as coat track. This is namely the westerners use this because; in tropical countries like India you do not often use or always use the coat. So, you have is a hook on the circular disk you can hang this, you can count which is the oldest used one which is a new one. So, you can keep washing it and changing it.

So, that is new old order and so, oldest and so on. So, that is the kinds of you know principle that is simply followed to write a small paragraph by which you can appreciate better.

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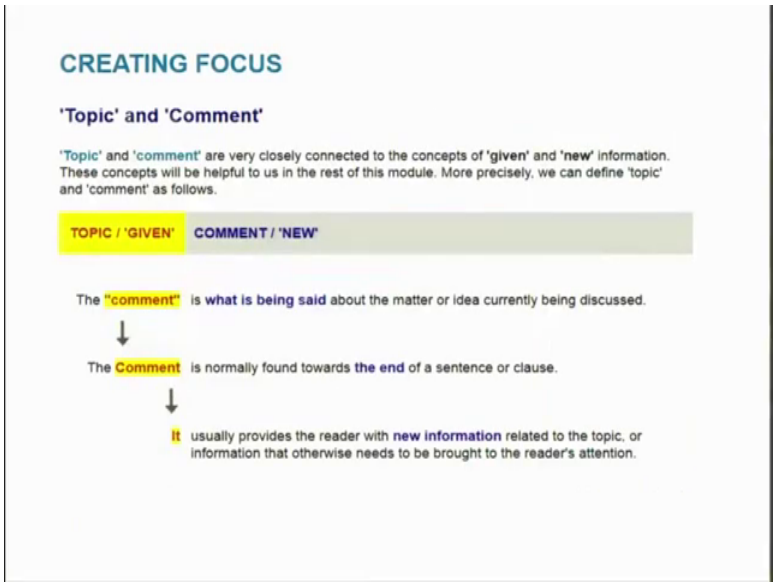


The second aspect is to create focus the focuses is to make sure that a given abstract, you know you are you know driving or helping the reader to go to the complexity therefore, you know exactly watch the topic you are introducing to that.

So, it is very similar to the given and new except that the topic comes first, and you know a part of it you know the comment comes later and for example, you talk comment itself as something then, the comment is what being said for example, the topic about the matter or idea currently being discussed. The comment is normally found towards the end of the sentence or clause because, that becomes new and then you introduce.

So, the again there are large number of exercises that you can do if you open the portal that I have mentioned. You want to go and look at read and try it out you can understand better more on that because, basically I am going to narrate the same thing. I will give you some more you know few topics, that is one more important aspect is that when you introduce any complex ideas, you have to first introduce what is called as a light.

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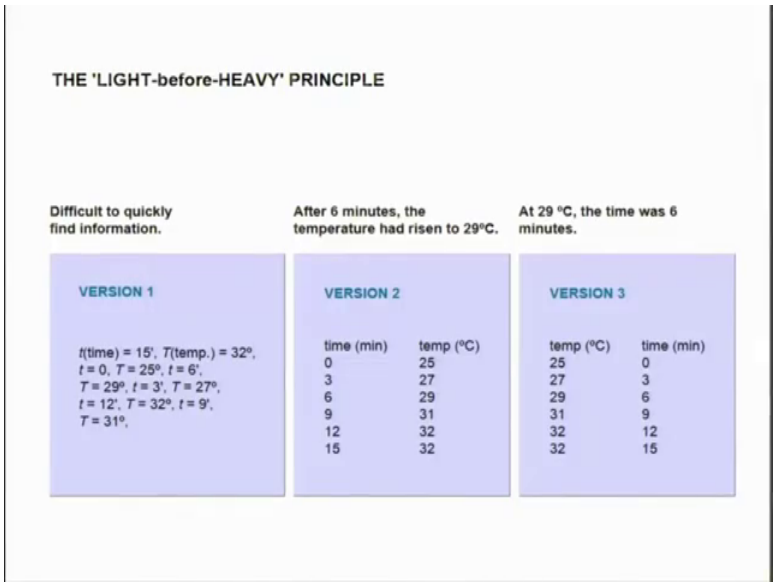


Which is not that heavy to begin with, but gradually you can introduce more difficult or complex problems we can introduce therefore, the reader will be glued to your; whatever you write.

For example, there are 2 tape 3 tables that are shown here. Now, if you read or analyze or look at each of the table and you will find one among the 3 is much easier to follow than the other, right? So, which one you can take time and read most of us will say the second one is better because, we all follow the convention left to right. The left is something that is given the right is something that is new.

So, you can see that inversion 2 there is a time, you know time point 0 3 6 9 12 15. These are minutes they can understand somebody tabulated some data at different time points which is progressive, and with time you find that temperature is increasing.

So, it becomes easier for me to understand in short time without really scratching my head whereas, other 2 are complicated difficult to understand though it is exactly the same data, but presented in a very different way. Which makes it very obvious that, you may want to say the same thing, but saying it in a way that the reader can understand help you to convey, what you want to convey without losing out the importance of the content, right?

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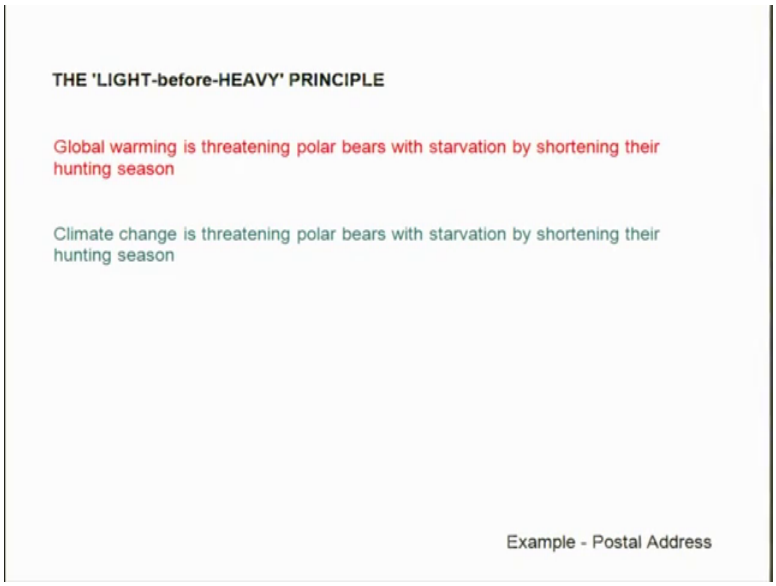


So, this is again one last example for example, in with regard to Light-before-Heavy principle. The first sentence says global warming is threatening polar bears with starvation, by shortening their hunting season because, it becomes pretty hot they do not get much of their prey therefore, they may die. The same thing has been said in the second statement.

Climate change is threatening polar bears with starvation by shortening their hunting seasons. The question is which one of the 2 sentences follow the heavy sorry the Light-before-Heavy principle? Which would make it easier for the reader; you know that it is the first one is going to be difficult because; you start with the statement called global warming. For example; I am not aware about global warming what does it mean?

Now, I am not going to follow anything else, right? Because, it is a more of a technical term you talked about how the atmospheric temperature changes with time, right? That is what global warming. So, if I am not aware about that particular 2 word I am not going to follow the rest although I can follow the rest of the thing which are very simpler, but if I use the second sentence, climate change I understand it is a common term, anybody can understand that is threatening the polar bears with starvation by shortening their hunting you know season now, it is able to make easy for me to follow it, right?

So, this is the convention an example is postal you know address, you know when you get any envelope courier to you whether it is application or magazine whatever it is there

is an address. The address has got if of course, your name it has got your door number, it has got street it has got city, it has got pin code it has got state it has got country. It really helps people to deliver because, the first time when it was posted elsewhere they are going to look at to which country should go, it comes to that country then, going to look at which state it should go and which city should go, which street you should go. So, it is easier for people to bring in. So, it is therefore, it is called as light and heavy.

So, if you remember this you know in your brain when you write anything, you will be able to implement that makes it much more easier, and I would recommend that you visit this particular site it has got beautiful contents anybody can you know go and then read and then, try out the exercise which would really help you to learn there is one more link that is given that is Scitable, which is from the nature group again it is going to talk about how to write you know scientific reports and so on.

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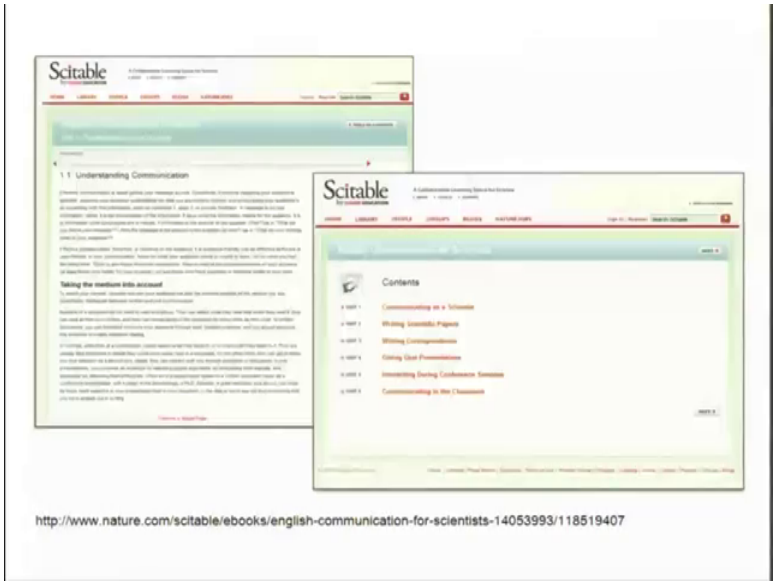


This is something there and which something, that we are going to see in the next class.