Lecture 6: Understanding Research Metrics: Author, Journal and Article Level Metrics

Science Communication: Research Productivity and Data Analytics using Open Source Software

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Dear Learners, Welcome to this NPTEL course on Science Communication Research Productivity and Data Analytics using Open Source Software. I am Dr. Neeraj Chaurasia from Central Library, IIT Delhi. The topic for today's lecture is Understanding Research metrics, Author, Journal and Article Level metrics. So, in this lecture I will be talking about measuring the research impact, what we are measuring, why scholarly impact of research is measured, how we measure the impact of research work, and also how research impact can be measured. So, for measuring the research impact, I will be covering the various research metrics, impact assessment tools and techniques which include author level, journal level, article level metrics.

I will also cover some of the major automatic tools in my today's lecture. So, as we know that higher education is increasingly becoming a global business now. Some of the parameters like total number of publications, number of citations, h-index, quality of education, academic reputation and so many other parameters are playing a very important role in branding or ranking of the institutions and for various other purposes also. A good number of points or weightages has been given to these parameters.

All this comes from quality research, its academic and social impact. So, it is very important to measure the impact of research for measuring the impact. It is also important to understand the concept of research metrics and various impact assessment tools, techniques and methods. Research metrics are quantitative tools that help in assessing the quality and impact of research output. They can be used at journal level, article level and researcher level.

Before moving to research metrics in detail, first we need to understand what research impact is. As per Research Council UK, research impact is the demonstrable contribution that excellent research makes to the society and the economy. The impact embraces all

the extremely diverse ways in which research related knowledge and skill benefit individuals, organizations and nations including the academic, economic and societal impact. So, whenever a researcher is doing research, it makes an impact on society, economy and academia. Impact occurs when research generates benefits in addition to building the academic knowledge base.

There are many types of research impact and researchers may have impact across a number of different areas that may be academic impact, cultural impact, economic impact, policy impact, environmental impact or societal impact. When we talk about academic publishing, what are we measuring? We are measuring the quality of journals in which research is published, research impact, researcher impact, article reach, article impact and influence. These are the things which we are measuring. Now, why is scholarly impact of research required? Scholarly impact of research is very much required for strengthening your CV, for getting the job, promotion or getting the tenure. It also helps in showcasing or showing the individual or collective productivity.

For quantifying the research on investment or ROI or research for grant renewals and progress reports, the scholarly impact of research is required. For future funding by illustrating the value of your research, scholarly impact is required. Also, scholarly impact of research is required to identify who is using your research work and confirm that is appropriately credited or not. It helps in finding the collaborators within or outside the discipline. It also helps in benchmarking self-research groups, departments or institutions and it helps in showcasing the research collaborative as well.

How are we measuring? Basically, the impact of researchers on their field or discipline has traditionally been measured using the number of papers they have published, number of citations they have received, number of citations per paper, but these were not found sufficient to measure the research in quality and quantity both. So, various metrics, methods, techniques and indicators were evolved. Research impact is often measured using quantitative methods such as citation counts, H-index, Journal Impact Factor, etc. Currently, there is no one tool or system that completely measures the impact of such publications. Each database or tool uses its own measurement system in dashboard, data and authority files. And it is difficult to use these tools to compare across disciplines that have different research and publication practices.

For measuring the impact of an author, we generally use the number of papers in terms of the quantity, number of citations to somehow find out the quality of publications, average number of citations, H-index in terms of quality and quantity both. For measuring the impact of journals, there are Journal Impact Factor, Citescore, SNIP, SJR and so many other metrics. For measuring the impact of articles, we generally use citation impact and a few other metrics like altmetrics. Now, coming to the research metrics tools and the methods, research metrics are the fundamental tools used across the publishing industry

to measure performance both at journal level and author level. For a long time, the only tool for assessing journal performance was the impact factor.

Now, there are a range of different research metrics available. This basket of metrics is growing every day. It is growing every day from the traditional impact factor to altmetrics, H-index and beyond. Research metrics are measures used to quantify the influence or impact of scholarly work. As discussed, these are quantitative indicators or measures that provide some evidence of impact of research output in any form.

It falls in two categories, bibliometrics and the other one is altmetrics. Bibliometrics are the traditional citation based metrics. They are based on the citation count, basically counting how many times a publication has been cited in another publication. Altmetrics are the web based metrics. They are used to measure the attention or the interest of scholarly work on various types of online platforms.

This includes social media, research blogs, reference manager softwares, educational sites like Wikipedia, news outlets, online forums and many other online resources. Metrics are available for use at journal level, article level, even at researcher level. However, many other metrics only tell a part of the story and each metric also has its limitations. So, each of these metrics has a specific impact. Using research metrics, you can assert your value, you can benchmark your career progress, you can communicate more effectively and so on.

Now, some of the more common metrics and tools you can use to measure research impact are journal level metrics, author level metrics and article level metrics. Let us talk about journal level metrics in detail. Journal level metrics are used to determine the impact of a journal on a scientific community. It measures the quality of a journal using citation formulas such as impact factor, and helps to track citation patterns within journals and determine which journals are highly cited. There are a number of bibliometric indicators focusing on measuring impact of scholarly journals.

Most of these journal level metrics are calculated from the pool of journals indexed in two citation indexes or two citation databases. These are Web of Science from Clarivate Analytics, and Scopus from Elsevier. You can see in this slide, this is the screenshot from the Web of Science. Using the master journal list option, you can find out all the journals included in Web of Science. Similarly in Scopus, using the option sources, you can find out what journals are indexed in the Scopus database.

Different journal level metrics can be divided into three parts. First one is Clarivate metrics which are based on the Web of Science database. There are Elsevier metrics which are Scopus based and there are some of the metrics from Google Scholar also. When we talk about the Clarivate metrics or Web of Science based metrics, these are

journal level impact factor, five years impact factor, Journal Immediacy Index, Journal Citation Indicators that is also known as JCI.

Let us talk about Clarivate metrics or Web of Science based metrics. The first one is the impact factor. In the early 1960s Irving H. Sher and Eugene Garfield created the Journal Impact Factor to help in selecting the journals for Science Citation Index. Over the period of time, however, it has been adopted as a means of evaluating the quality of research and their work. Journal Impact Factor is the oldest, best known and most widely used measure for assessing the journal performance.

It measures how often the average research article in the journal has been cited or used in other research in any particular year. It attempts to quantify the importance of a particular journal in a field. Journal Impact Factor used to measure importance or rank of a journal by calculating the times its article cited. Journal metrics attempt to quantify the quality and influence of a given journal for comparison purposes. Idea is that more heavily cited journals must be more prestigious and attract higher quality papers.

You can say the higher the Journal Impact Factor, the more influential the journal. JIF is often criticized for having a two short window for analysis which is two years and using JIF, it is difficult to recognize different expectations of citation rates among different disciplines. Now, how is it being calculated? It is very simple. Number of citations to a journal in a given year from articles occurring in the past two years divided by the number of scholarly articles published in a journal in the past two years.

Let us see an example for the year 2022 impact factor. If you want to calculate what we have to do is the number of citations in the current year means 2022 to the papers published in the journal in previous two years. Those are 2020 and 2021. You have to divide those things with the total number of articles published in the journal in the previous two years, that is 2020 and 2021. So, the formula is very simple. Just divide the total number of citations by the total number of articles published in the last two years.

So, you should never directly compare the Journal Impact Factor of two journals with different subject disciplines. Let us talk about the JCR which is the Journal Citation Reports. JCR is an authoritative source for journal level metrics from Clarivate Analytics and it provides an impact factor for a journal. JCR is a quantitative tool for ranking, evaluating, categorizing and comparing the journal. JCR is based on the journal indexes in Web of Science Core Collection, Science Citation Index which is a SCI Expanded and Social Science Citation Index means SSCI. There is no JCR for humanities.

We should keep in mind that a journal may advertise its impact factor on its website but this claim should be verified through JCR. This is a screenshot from Web of Science. You can see at the right side corner JCR is there along with the other products from Clarivate

Analytics. In the JCR you can use different options for searching. You can use the title or the ISSN number or any other option for finding out the information about the journal.

JCR is a subscription based product from Clarivate Analytics. But previous years JCR can be found through various open access platforms like ResearchGate. So, if you do not subscribe to the JCR you can find out all JCR from different sources. Let us talk about the JIF quartile. Journals quartile ranking is determined by comparing a journal to others in its JCR category based on the impact factor score. So, basically the quartiles are segregated or differentiate based on the impact factor of different journals.

Each subject category of journals is divided into four quartiles: Q1, Q2, Q3 and Q4. So, Q1 contains the top 25 of journals in the list whereas, Q2 is occupied by journals in the 25 to 50 percent group, Q3 contains journals in the 50 percent to 75 percent group, and Q4 is occupied by journals in the 75 to 100 percent group. If a journal falls in Q1 it means the journal performs better than at least 75 percent of journals in the category based on its impact factor score.

Let us talk about the Journal Immediacy Index. Journal Immediacy Index is the average number of citations to the articles from the current year divided by the total number of articles from the current year. It indicates how quickly articles in a journal are cited during the current year. So, it is a very important index. So, if you want to calculate the Journal Immediacy Index for 2023, what you have to do is to count the citations in 2023 to the items published in 2023, and divide them by the total number of items published in 2023. So, this is how this Journal Immediacy Index can be calculated.

Now, let us talk about this 5-years impact factor. This is also a very important metric for journals. It indicates how much the journal being cited during the most recent 5 full years. For the calculation of this, citations to the articles from the most recent full 5 years divided by the total number of articles from the most recent 5 full years. For example, for the year 2014, 5 years impact factor for NEJM which is the New England Journal of Medicine is 54.39. So, how is it calculated? What you have to do is you just take the citations which start from 2009, 2010, 2011, 2012 and 2013 in the year 2014 and divide the total number of papers which are published since 2009 to 2013. So, you will be able to find the 5 years impact factor of the journal. Now, let us talk about this Journal Citation Indicator which is the new metrics from Clarivate Analytics. JCI is a new way from the year 2021 from Clarivate Analytics to measure the citation impact of journal recent publications using a field normalized calculation. It provides a single journal level metrics that can be easily interpreted and compared across the discipline.

It is based on the journal citation performance across 3 full years of citation data rather than a single year's snapshot of a journal's performance across the previous 2 years. JCI focuses entirely on the articles and reviews. Journal Citation Indicator is calculated for all

the journals in the Web of Science Core Collection and published in JCR. It is the average category normalized citation impact which is known as CNCI of citable items published by journals over a recent 3-years period because it is normalized, it allows comparison across the disciplines. For example, 2023 JCI will be calculated for the journals that published citable items those are research papers classified as articles or reviews in the Web of Science in 2020, 2021 and 2023 and 2022 counting all the citations they received from any document index between 2020 and 2021.

JCI there are various indicators in JCI. What is the meaning of those indicators? A journal with an indicator of 1 received the average citation count in its category. A Journal Citation Indicator above 1.0 means that the journal performs better than average with 2.0 indicating the journal performance twice as well as average and 0.5 indicates that the journal performs half as well as the average.

So, the journal that received a JCI score of 2.5 performed 2.5 times better than average. So, these are some of the indicators in JCI. Now what is the difference between Journal Citation Indicators and Journal Impact Factor. You should know because this JCI is a new metric from Clarivate Analytics. So, what is the difference in both JCI is designed to complement the JIF which is the original and long standing metrics for the journal evaluation.

In addition to normalization there are several key differences between JCI and JIF. For example, JCI is calculating 3 years of publication, contrast with the 2 years window of employed for the JIF. This 3 years calculation enables JCI to be as current as possible while also allowing more time for publications to acquire citations. Also JIF calculation is based on the citations made in the current year while the JCI counts citations from any time period following publications up to the end of current year. So, this is the difference in both the indicators.

Now let us talk about the Elsevier metrics which are based on the Scopus database. Some of these are CiteScore, Citation Tracker, SJR which is also known as SciMago Journal Ranking, SNIP which is the Source Normalized Impact Per Paper. So, CiteScore metrics introduced in 2016 - a family of 8 indicators to analyze the publication influence of serial titles. CiteScore metrics offer more robust, timely and accurate indicators of a serial title's impact. CiteScore calculates the average number of citations received in a calendar year by all the items published in that journal in preceding 3 years. It counts all the documents since they all have the potential to attract citations. So, we may say that the CiteScore is independent of document classification. Articles in Press are also included in the calculation of CiteScore. For example, the year 2019 CiteScore counts the citation received in 2016 up to the 2019 to the articles, reviews, conference papers, book chapters and data papers published during 2016 to 2019 and divides this by the number of these documents published during 2016 to 2019.

So, this calculation is also very simple. What you have to do is the number of citations to the document published during 2016 to 2019 and divide by the number of documents published in 2016 to 2019. So, you will get the CiteScore. The 4 years CiteScore time window provides a robust assessment of citations to papers after their publications. Also, a 4 year publication window is a good fit for all subject areas and it is long enough to capture the citation peak of most disciplines. So, you can find out the CiteScore or any other metrics on the journal page like in this slide you can see this journal has all kinds of metrics on their homepage. You can also find out the CiteScore metrics or CiteScore in Scopus database for all the journals which are covered in Scopus.

Now, the next one is the CiteScore Tracker. CiteScore Tracker helps to see how a title CiteScore is building each month. It provides a current review of how a journal is performing during the course of the year. CiteScore Tracker calculated in the same way as CiteScore, but for the current year rather than the previous complete years. Calculation is updated every month.

Now, the SJR indicator which is also known as SciMago Journal Ranking which is from Elsevier is a very important metric. It is a prestige metric for journals, book series and conference proceedings that weights the value of citations based on the subject field, quality and reputation of sources. SJR indicator gives weightage to the citations, also from where the citations are coming from. Citations from more prestigious journals means the journal with higher JCR weighted more than the citations from less prestigious journals which are having the lower SJR. So, prestige is basically based on the citations from where those are coming from.

Citations from important journals will count as more than one citation. A citation from a less important journal will count less than one citation. SJR uses a three-years citation window and is calculated based on the scope of sources. To raise the SJR ranking, one needs to be published in a more reputed journal, which is the only way to increase SJR. The formula for calculation of SJR is what you have to do is the average number of weighted citations received in a year divided by the number of documents published in the previous three years. So, this is how you can calculate the SJR. SJR is freely available and you can access it. This is a screenshot from SJR and you can find out the country wise or journal wise ranking from the SJR. And currently India is at level 7. If you see the country wise metrics or SJR. Now, let us talk about the SNIP which is Source Normalized Impact per Paper. It measures contextual citation impact by taking differences in the disciplinary characteristics into the count.

This can be used to compare journals in different fields. SNIP normalizes for differences in citation behavior between subject fields. SNIP weighted citation based on the total number of citations in the subject field. The calculation is based on the citations from subject fields in which citations are less likely to be weighted more. Number of citations

in the present year to the publication in the past three years normalizes to correct the differences between sub-scientific fields. SNIP therefore measures the contextual citation impact, and enables direct comparison of journals in different subject fields. So, using SNIP you can compare two journals in different fields. What you have to do is journal citation count per paper to be divided by the citation potential in its subject field. You can find out the SNIP or SJR or CITEScore in any of the journal pages.

Now, another important metric is FWCI which is Field Weighted Citation Impact. FWCI takes into account the differences in research behavior across the discipline. FWCI is the ratio of citations actually received by the articles published in a journal and the average number of citations received by all other similar publications indexed in the Scopus database. Similar publications are those publications in the Scopus database that have the same publication year, publication type and discipline. FWCI value answers the question of whether a journal is cited above or below the global average in its particular field. FWCI of 1 indicates that the publication has been cited at world average for the similar publications. Similarly, FWCI of greater than 1 indicates that the publication has been cited more than would be expected based on the world average for similar publications. For example, a score of 1.44 means that the output has been cited 44 percent more times than the expected. FWCI of less than 1 indicates that the publications have been cited less than would be expected based on the world average for similar publications. For example, a score of 0.85 means 15 percent less cited than the world average. So, FWCI refers to the citations received in the year of publications plus the following 3 years.

FWCI can be used to directly compare or benchmark the performance of an article against the articles because it is normalized. It is calculated using the data from the Scopus database. FWCI is a unique metric that is only available by a Scopus, SciVel and it is calculated based on the publications indexed in Scopus after 1996. For calculating FWCI, what we have to do is the citations received by the publications in the publication year plus the following 3 years divided by the expected number of citations per publication received in the same time by similar publications. So, this is how this FWCI can be calculated. You can find out the FWCI on individual journal pages and calculation can be done as described.

Now, let us talk about some of the journal metrics from Google Scholar. Google Scholar has adopted the H-index method of impact for publications and H5 variations for a complete 5 years calendar for journals. You can find out Google Scholar metrics on the Google Scholar page. What is the H-index of journals? A more recent journal metric that was designed to create a simple way to represent the quality of a journal.

Ideally, a method that is more reflective of the majority of papers published in a journal instead of potentially few highly cited papers in the journal. The H-index is the number of papers published in a journal that have been cited at least H times. For example, if a

journal has published 20 papers that each paper has been cited at least 20 times, then the journal's h-index is 20. Similarly, a publication with 5 articles cited by respectively 17, 9, 6, 3 and 2 has the H-index of 3 because 5 articles have received at least 5 citations. So, this is how this H-index of a journal can be calculated.

Now, what is H5-index? H5-index is another metric from Google Scholar. H5-index is the H-index of articles published in the last 5 complete years. Now, what is H5-index? H5-index is the H-index of articles published in the last 5 complete years. A publication that had 5 articles but only 3 had at least 5 citations or more would be H5 of 3. This metric is based on the articles published by a journal over 5 calendar years. For example, H5-index of 60 means that the journal has published 60 articles in the previous 5 years that have at least 60 or more citations each.

The limitations of Google Scholar metrics is that Google Scholar metrics displays the top 20 journals for each subject category. Additionally, there is no historical data. So, this is the limitation of Google Scholar journal metrics.

The next one is the author level metrics. Author level metrics are used to track how often an author's work is cited. It helps in demonstration of the reach and impact of an author's work. Also, author level metrics helps to track the work of colleagues and identify potential collaborators for collaborations in the projects. There are a number of author level metrics which includes H-index, I10-index, G-index, M-index, author impact factor and so on.

Let us understand these metrics in detail. So, the first one is H-index which is the best known and most widely used metrics. H-index was proposed by J.E. Hirsch who was a physicist in the year 2005. It is an index to quantify the individual scientific research output. H-index measures both quality and somehow the quantity of an author's papers. It also measures the quality and sustainability of scientific output as well as to some extent the diversity of scientific research.

H-index measures both the productivity and impact of publications. It is the metric that measures impact of an author's scholarly output and performance. It compares publications to citations to measure quantity and quality both. So, how can you define H-index? A scholar with an index of H has published H-papers each of which has been cited in other papers at least H times. So, this is the simple definition of H-index.

You can see in the slide the interpretation of H-index. This author has published a number of papers, but his 20 papers have received at least 20 citations. So, his H-index is 20. Again in this slide you can see the author has published 6 papers and he has an index of 6 because his 6 papers have received at least 6 citations. So, from where can you find this H-index? There are a number of sources for finding out H-index. You can find out the

H-index from the Web of Science, you can find out from Scopus, and also from Google Scholar.

H-index is the lifetime achievement, and it always increases with your citations and will only increase if it never decreases. It is meaningful when you compare H-index within the same discipline. This simple calculation of H-index is if you want to calculate it manually. To manually calculate the H-index what you have to do is, organize the articles in descending order based on the number of times they have cited where both the rows are matching that would be the H-index of the author.

This is the screenshot of Scopus. You can see this author has this H-index of 52. He has published 269 papers which have received more than 10,000 citations, but his 52 papers have received 52 citations. So, that is why his H-index is 52. So, in Scopus and Web of Science it is automatically calculated, and will give you the author's H-index as per the Scopus. The author Willet Walter has 319 H-index which is the maximum H-index in Scopus.

Similarly, in the Web of Science also you can find the H-index of a particular author. Again, you can see the H-index in Google Scholar along with the I10-index and other metrics Google Scholar will give you the H-index also for the author. As per the Google Scholar, Ronald C. Kessler has the maximum H-index. So, now the question comes: what is the best H-index? So, as per J.E. Hirsch, after 20 years of research an index of 20 is good, 40 is outstanding and 60 is truly exceptional. The advantage of H-index is that it combines productivity, the number of papers they have published and impact the number of citations in a single number.

Now, G-index is another author level metric. G-index was coined by Leo Egghe in 2006 which is an improvement of H-index. It is an index which quantifies productivity in science based on the publication record. G-index assists the H-index and gives more credit to the most highly cited papers. G-index is the unique largest number that the top articles received together with at least G square citations. G-index is calculated by ranking a set of articles in decreasing order of the number of citations that occur. Limitation of the G-index is that it is not as widely accepted as the H-index. This slide shows how this G-index is calculated. So, in this slide you can see the H-index is 5 and G-index is 7.

Now, what is I10-index? I10-index was introduced in 2011 by Google and it is the number of publications with at least 10 citations. If I10-index is 2, then what does it mean? It means that 2 of the research papers have 10 or more citations each. I10-index is very simple, free and straightforward to calculate, but it is only available in Google Scholar.

Now, let us talk about M-index. M-index is another variant of H-index that displays H-index per paper since first publication. The H-index tends to increase with the career length and M-index can be used in a situation where H-index is a shortcoming, such as comparing researchers within a field, but with very different career lengths. In that case, M-index may be very useful. M-index is inherently assumes unbroken research activities since the first publication. It helps to normalize between those at the earliest stage and their career. M-index is the H-index divided by the times, which means years between the first and most recent publications. For calculating this M-index, what you have to do is take the researchers H-index and divide by the number of years since their first publication. So, you will find the value of M.

Now, what is the author's impact factor? Author impact factor is the extension of impact factor to the authors. Author impact factor is capable of capturing trends and variations of impacts of the scientific output of scholars in time. So, how is it being calculated? Suppose, you want to calculate the author impact factor for 2023, what you have to do is, you have to take the citations in 2023 to the articles he or she has published in 2022 and 2021, and divide by total number of articles he or she has published in 2022 and 2021. So, using this formula, you will be able to find the author's impact factor.

We need to understand that all these metrics have some of the limitations, which we need to consider. Some of those are like in case of impact factor, impact factor or H-index are depending upon the citations. Citations count can be affected in a number of ways. There is no single comprehensive source. There is 35 to 40 percent overlap in two major citation databases, i.e., Web of Science and Scopus. Publication dates or years, frequency of journals may affect the results. Research measures across the discipline may also differ. As we have discussed earlier also, impact factor was never meant to be used as a quality measure for researchers.

Distribution in citations is highly skewed. One obvious limitation of impact factor calculation is that the resulting value can be easily thrown off by just one or a few highly cited papers. So, it does not necessarily reflect the quality of each individual paper that is published in the journal. So, these are the limitations of the impact factor. It also takes at least three years worth of data to calculate.

So, new journals need to wait at least three years for receiving or for earning the impact factor. So, this is also one of the limitations. The coverage also has limitations. Now, what are the limitations of H-index? You cannot compare the productivity of younger researchers with experienced scholars. You cannot compare scholars working in different fields or disciplines. Different databases give different H-index scores depending upon the coverage, etc. So, these are the limitations of H-index.

Measuring the impact of articles using the citation analysis, there are few limitations or which we need to consider. Once the article is published, different online tools keep track of the number of times they have cited. Number of citations is useful, but it should not only be the criteria for evaluating the impact of the author.

We need to see that there are different studies that show that articles in the medical field are cited the most. Science articles also tend to have a high citation rate. Humanities and social science articles are cited the least. Many articles are never cited. Self-citations may affect the total number of citations required, and some articles are cited soon after the original publications. Others may not be cited for the future or others may not be cited for 5 or 10 years. So, these are some of the limitations which we need to consider using these matrices.

Now, let us talk about article level metrics. Article level metrics are used to quantify the impact of published articles, how published papers are being discussed and shared. Article level metrics process uses various sources of information, one is altmetrics.

So, what is altmetrics? Altmetrics is an alternative to the traditional citation metrics. They can include peer reviews, citations on Wikipedia and in public policy documents, discussions on research blogs, media coverage, bookmarks on reference managers like it may be Mendeley, or any other reference managers and mentions in the social media networks such as Twitter, and all. Therefore, the data for calculating the altmetrics is sourced from the web, and can give insights into the research output activity across various platforms as soon as the article is published. Article level metrics allow you to measure the impact of your research before it starts receiving the citations. Altmetrics use the DOI of such papers to monitor and aggregate its coverage across the internet. Altmetrics coined by Jason Priem in 2010. He defined, altmetrics are meant to complement, not totally replace these traditional measures such as citation count, journal prestige, or impact factor and h-index. Altmetrics as a subset of webometrics he defines like that. Simply altmetrics are metrics beyond the traditional metrics. Why do we use altmetrics? Because traditional measures of impact are inadequate. Citations are only a small part of the scholarly ecosystem, and only represent one type of impact. Most research includes journal articles that are now available in a network environment. So, we need to see what is going on in the electronic environment. So, that is why this altmetrics is very very important. Altmetrics will provide a more complete picture of the reach and impact of research and scholarship. So, that is why this altmetrics is playing a very important role. Also for measuring the researchers and research work, altmetrics can help in this regard. To demonstrate the value of academic as well as the non-academic engagements and societal value, altmetrics can play an important role in finding out that.

To understand and join the public conversation what is the impact or what is the views of the public on a particular topic. We can find out what we think using the altmetrics tools.

Find out the research gaps and the interest is also very important to see and also to discover non-traditional research output. So, that is why these altmetrics tools are very important.

Using various altmetrics tools we can find out how many times someone has downloaded my article, who is reading my work, has it been covered by news outlets or who is commenting on my work, how it is being shared, which countries are looking at my work and so on.

There are so many things which can be found out using altmetrics tools. Now, altmetrics data is aggregated from many sources. There are a number of sources from where this altmetrics data can be aggregated. So, that may be Github or Mendeley or PLOS, and so many other databases, or Figshare, or Slideshare, Wikipedia, and all. There are a number of altmetrics tools and some of them are like Altmetric.com, ImpactStory, PLOS Article Level Metrics, PlumX Metrics, ReaderMeter, ScienceCard, PaperCritic, Crowdometer, and all.

So, there are some of the altmetrics tools, which can be used to find out the altmetric score of particular research or any share. What is Altmetric.com? Altmetric was born as a London-based startup founded by Euan Adie in 2011. Their Mission was to make article level metrics easy. Individual users and libraries can use Altmetric.com with a free account, a commercial license is required in case of publishers or funders or the institutions. Altmetric score is a quantitative measure of quality and quantity of attention that the scholarly article has received through social media.

This is the screenshot you can see you can find out the Altmetric score using this website. Another one is the ImpactStory. It is an open source web based altmetric tool. ImpactStory uses the ORCID to find the data and import scholarly work. It aggregates impact data from many sources from Mendeley to Github to Twitter and many more sources that can be displayed in a single point. Users create collections of materials through the online identifiers such as Google Scholar, DOIs and PubMed IDs, etc. ImpactStory uses more than a dozen of APIs to search for metrics. The ImpactStory account can be synchronized with ORCID to update automatically when new content is published. Scholars need to enter the information about the articles such as DOI to generate an ImpactStory.

Another important article level metrics is PLOS Article Level Metrics. PLOS is a non-profit open access publisher empowering research to accelerate the progress in science and medicine by leading a transformation in research communication. It is a project started in 2009 and PLoS article level metrics track the usage of citations and social media activity for all PLoS articles. These metrics comprise data points that capture the ways in which research articles are read, saved, shared or commented or

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cited. PLOS has begun to track impact metrics beyond just citation count. It has developed software that will track the number of times an article is shared using social network tools such as Facebook, Mendeley and some of the other social media websites.

Next one is ScienceCard. ScienceCard is an alternative tool for websites which collects metrics automatically in different ways such as citations, download counts, and altmetric in different disciplines for a particular researcher by a unique author identifier.

Next one is ReaderMeter. ReaderMeter is a cloud computing and mashup visualization author level metrics and it is based on the consumption of scientific contents by a large population of readers. Readership data is obtained by a Mendeley API, and analyzing readership data can help discover areas of real-time impact that may not be visible to traditional citation based metrics or measurements.

Crowdometer also provides a web-enable service which displays Tweets linking to scientific articles and allows users to add semantic information for betterment of digital services among users. The results of such crowdsourcing efforts can be displayed in real time. PaperCritic is also one of the altmetric tools, which offers to researchers a process of monitoring all types of feedback about their research work in exhaustive, expeditiously and pinpointedly. Apart from this, it also allows every researcher to easily review the research work of others in relevant fields or subfields.

Another important tool is PlumX metrics. PlumX measures the individual works of a research scholar. It was founded by Andrea Michalek and Mike Buschman in late 2011. PlumX is a tool to harvest metrics from various online sources and an impact dashboard for measuring research output. PlumX provides both altmetric and traditional metrics. It divides the type of interaction into the five categories which include citations, usage, captures, mention and social media. It is integrated into Elsevier products like Scopus, ScienceDirect, SciVel and Pure. It is a subscription based product, and it is available only via subscription. So, in all the products from Elsevier you will find the sign of PlumX metrics and it will give you the complete data on those five components.

You can go to the particular journal website or particular journal page, you will find out these kinds of Altmetric scores. So, several publishers are providing such information to the readers including Frontier, Nature Publishing, Springer Nature, Elsevier, ResearchGate. So, now journals have this Altmetric score on their website, or publishers' website, or individual journal page.

Now, what is an Altmetric score and why is it important? Altmetric data can help researchers to understand how their research is being interacted with by the public, government, policymakers and other researchers. Altmetric scores are measures used to gauge on online consumption, perception of research papers within the non-scientific community. With these outsourced data, public reactions can be effectively captured and

analyzed by the experts within the short period. Altmetric score for the research output provides an indicator of the amount of attention that it has received.

The score is derived from the automatic algorithm, and represents a weighted count of amount of attention picked from research output. Altmetric scores can be gathered immediately as you publish your research work. So, now at the end I would like to summarize that research metrics do not replace the traditional ways of accessing the research impact. For example, peer review, research funding, practical application and so on, simply provide this additional data to make impact assessment more accurate and meaningful. Research metrics must be considered in context; any direct comparison should be made carefully. The researcher's field of study as well as career length of researcher will greatly affect the citations and attention the work receives. Research metrics are not universal; they are limited to the datasets from various platforms from which they are drawn. Citations count in various citation databases may differ, and different metrics track different data. And always include the source of any impact metrics you are reporting. I would like to quote Albert Einstein. He rightly said that "Not everything that counts can be measured. Not everything that can be measured counts". The practical part of all these metrics will be covered by some of the other colleagues.

At the end I would like to express my sincere thanks to various internet sources and also authors of those internet sources used to prepare this talk. The presentation is mainly prepared to create an awareness among learners in the field. So, I would like to acknowledge all those sources. Thank you very much once again for becoming a part of this NPTEL program. Thank you very much.