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Types of plagiarism and how to avoid misconduct: Pros and cons of plagiarism detection tools in research writing and publication

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ABSTRACT

The ultimate journey of research and writing is publication. To see one's name listed in the author's byline is an exciting feeling. This exciting feeling of authorship credit is linked with responsibility. The impact of the published work will depend on the dissemination of evidence-based scientific findings to help the health care workers, scientists, and policymakers for the benefit of society. This requires ethical research, to begin with, and publication without misconduct to maintain the integrity and trust in science. Among various misconducts in research writing and publication, plagiarism is a serious scientific misconduct. The issue of plagiarism is a global concern that requires a collective effort from all stakeholders to prevent it and take prompt action if this issue does arise. Adequate teaching and training are necessary to increase awareness right from the early phases of learning; and to develop a culture of ethical research, writing, and publication. Types of plagiarism and its characteristics vary and should be dealt with accordingly, from a warning to definitive punishment for the offense committed. The software available to detect and avoid plagiarism is plenty and should be used taking into consideration their accuracy, usability, and cost.

Key words: misconduct, plagiarism types and tool, research writing publication, software

INTRODUCTION

Plagiarism is a scientific misconduct with consequences. Plagiarism is considered an act of cheating that involves copying others' texts

or ideas and claiming them as one's own without citing the original source.[1,2] The NCBI-National Center for Biotechnology Information, NLM-National Library of Medicine PubMed/MEDLINE in its MeSH-Medical Subject Headings in 1900 replaced the term 'fraud' by 'plagiarism' as "passing off as one's own the work of another without credit".[3] Thus, plagiarism is an act of literary theft, an act of fraud which involves stealing and passing off the ideas or words of another as one's own, or using another's work without crediting the source.[4] This scientific misconduct and academic dishonesty have become a global phenomenon. This is increasingly threatening the trust in science and integrity of the scientific community. The development of computer technology and the internet has made plagiarism effortlessly easy via copy which are plenty and easily available.[5-7] Incidence of plagiarism varies from 20% to 80% and involves a wide range of offenders, students, and faculties, and possibly more common among those with English as Additional Language (EAL). [2,8,9]

METHODS

We performed a comprehensive literature search on plagiarism, types, tools to check and avoid this misconduct. The search methodology included 'PubMed, Google Scholar, Google, Web of Science' till September 2021. The keywords, alone or in combination to retrieve the relevant articles were: plagiarism, types, tools, software, avoid misconduct, research, writing, and publication. Titles and abstracts were chosen for their relevance after scanning the full-text articles. The information was summarized on relevant headings for the review on the topic

to provide an up-to-date summary on plagiarism, its types, and tools available to check the possible misconduct during the preparation and publication of the manuscript.

DISCUSSION

Attitude and awareness for plagiarism

Matching of six or more words or phrases in a sequence to published literature is usually picked up by anti-plagiarism software for a similarity index and is suspected of plagiarism.[10-12] Plagiarism is a global problem.[2,13] Survey of culturally diverse large sample shows that researchers in developing countries are familiar with the concept of plagiarism and its harm, but have an incomplete knowledge, which requires a change in the attitude towards plagiarism.[14] The attitude and understanding are only a part of the story because the socio-demographic factors like age, gender, culture, self-control, and pressure to meet the target are complex issues.[15] A systematic review, conducted to identify and rank the common reasons why students plagiarize, found 11 possible categories among which external values of the student and attitude towards academia and teaching styles were significant factors.[16] Students (in medical schools) have reportedly inadequate awareness of plagiarism.[17,18] Training and workshops targeted at research writing and publications generate awareness and ethical professional development.[19-21] The in-built teaching-learning and training workshops in medical schools need improvement and more input from faculties and academia to raise awareness about plagiarism for ethical research, its publicat-

ions, and evidence-based medical practice.[22]

The complexity of the issue of plagiarism requires awareness at all levels, from undergraduate to postgraduate students, to academia and faculties, and educational institutions to maintain an ethical culture and avoid scientific misconduct. Recognition and addressing plagiarism is a shared responsibility to maintain the integrity of the academic environment to maintain the public trust in science. The reports show plagiarism is not uncommon in Nepal and involves a wide range of offenders in a wide range of misconduct.[23,24]

The journal editors should be aware and skilled to: recognize misconducts; be familiar with the plagiarism check software tools; seek clarification from authors for suspected plagiarism and other serious misconducts like fabrication and falsification. They should also be ready to take action and reject publication or retract it and/or recommend for academic penalties by relevant bodies based on globally accepted guidelines from Committee on Publication Ethics (COPE), Council of Science Editors (CSE), World Association of Medical Editors (WAME), Open Access Scholarly Publishers Association (OASPA), etc.[25,26] Journals' author guidelines play important role in informing authors on the importance of preventing plagiarism and misconducts.[27]

Common 12-types of plagiarisms, their characteristics, and tools available to check similarity

There are various types of plagiarism in re search writing and publication.[28,29] Two-thir-

ds of the retraction of published articles is due to misconduct, and plagiarism is the main reason identified for retraction.[29] The consequences of plagiarism vary depending on the type, its seriousness, local policies, and the context (repeat offense, during research, or publication). Plagiarism by a student may affect their school grades or may result in expulsion; for faculties, it may affect prestige, career, or job termination; for school and academia, the prestige and its normal operation may suffer due to plagiarism committed by its students and faculties, including the legality of copyright violation.[30-32] Text recycling in research writing sometimes also referred to as "self-plagiarism" is defined by the Text Recycling Research Project (TRRP, http://textrecycling.org/) as "reuse of textual material identical or substantively equivalent in both form and content to the source or the material is not presented in the new document via quotation marks or at least one author of the new document is also an author of the prior document".[33] In Science, Technology, Engineering and Mathematics (STEM) recycling verbatim is common with clearly recognizable wording of the source.[34] Plagiarism is unethical and serious scientific misconduct. It may be committed intentionally which has serious consequences. It includes: cloning/copying of other's work entirely or partly and publishing it as one's work; failing to give credit to someone else's concepts words/phrases without proper citation, or own published work without citation (i.e. self-plagiarism). Unintentional plagiarism is when the person, at the time of writing, did not intentionally plagiarize the work. For example,

not knowing that information (which may not be a piece of common knowledge) he/she used from other's work must be re-written in own words or inappropriately paraphrased and failed to cite or was inappropriately cited (including the wrong citation). All these may happen accidentally[35] or without the intention to copy-paste from the other sources.

To commit plagiarism or to allow it, regardless of the status of the offender, is unacceptable and punishable once the offense is established.[36-41] Types of plagiarism vary with specific characteristics and seriousness, [Table 1].

Various software are available to detect and avoid plagiarism.[11,30,31,42-45] Anti-plagiarism check software should be used, taking into consideration their accuracy, usability, and cost, [Table 2 and Table 3].

Plagiarism check tool/software finds and highlights similarity to other sources and gives a percentage (index) similarity and cannot determine if a paper is plagiarized or not. The writer, reviewer, and editor need to check and determine whether similar/overlapping text constitutes plagiarism or not.

The anti-plagiarism software are plenty, for example, subscription-based paid software [Table 2], and free online tools, [Table 3].

Similarity index and color-coded report provided by plagiarism check software

The maximum similarity percentage or similarity index (i.e. overlap in a document to the text available online) for text match allowed varies around 5-20%; which depends on the type of article, sections of the article, and the journal. Introduction and discussion sections allow a lower range of <5% similarity; result and method sections allow a higher range, but an aggregate

of up to 20% is the usual norm for most journals.[10,12,43]

The software provides a similarity index but not a plagiarism index because no percentage of cheating is ethical. The software provides a color-coded report for matching text, e.g., 0% (blue color) is ideal, 1-24% (green) is considered tolerable, 25% or more intolerable (yellow 25-49%, 50-74% (orange) and red 75-100% (red) are red-flag sign.[43] The human intervention (by authors, reviewers, editors) is required to deal with the 'flagged' similarity index of ≥25% for suspected plagiarism. Putting too much emphasis on 'how similar is too similar', an author should avoid plagiarism by following the universal dictum for citation and not about duplication detectable on software, and so adequate paraphrasing and citation is a must.[12,46,47]

The causes of plagiarism vary, but generally, it's a lack of awareness, inadequate education on scientific misconduct, and the pressure to publish. The ease of copy-paste and the notion that 'it is not always detected' provides a false sense of security for the plagiarist. The varying interpretation and definition combined with lack of policies and leniency in dealing with plagiarism are other reasons for this misconduct. To prevent plagiarism, academia should have clear guidelines and policies for ethical practices, procedures; and also the punishments for misconduct to maintain a healthy research and publication culture.[36,48] The Committee on Publication Ethics (COPE) provides flowcharts[49] for various misconducts and has a flowchart for suspected plagiarism in submitted articles before[50] and after[51] the publication.

Table-1: Twelve types of common plagiarism of varying severity [10,13,25,28-32,40,42]

SN	Type of plagiarism	Characteristics	Severity
1	Direct plagiarism or ctrl-c or templating or complete plagiarism or cloning	Extremes of intellectual theft of copy and publish others work as own	Serious
2	Self-plagiarism or duplication or recycling plagiarism	Reuse or repetition of own previous work without citation	Moderate
3	Error-404 or invalid source plagiarism	Use of false citation or non-existent or inaccurate sources	Moderate
4	Remix plagiarism, mash, mosaic, patchwork plagiarism	Rephrasing, combining, and mixing sentences from one or more sources	Serious
5	Replication or duplication or shotgunning plagiarism	Dual or multiple submission of a manuscript to multiple journals	Serious
6	Colluding, cartelling, or unethical collaborative plagiarism	A group of researchers cites each other's works to promote themselves	Moderate
7	Secondary sources plagiarism	Data from a secondary source (meta or systematic review) is used without citing it, giving a false impression of the review by cherry-picking references	Moderate
8	Paraphrasing plagiarism	Change words or phrases here and there as your idea without citing	Serious
9	Verbatim plagiarism	Use of quotation marks to copy other's ideas without citation	Serious
10	Aggregator or stitching sources plagiarism	The paper contains no original work and is copy-pasted with a citation from sources	Moderate
11	Salami slicing plagiarism	Publishing several papers from the same data-set instead of one study	Serious
12	Picture and/or figure manipulation	copying image or manipulating it to present as original work	Serious

Overcoming the limitation of plagiarism check software

Most electronic software, paid or free, identify the text-similarity match of submitted documents to the database of published articles and documents and may explain partly why plagiarism persists, e.g. there

have been papers published (mostly in open access journals requiring article processing charges- APC) after using plagiarism check software, and retracted later.[9,43] The editorial explanation from the journal Reumatismo reads "To our readers: With deep regrets, we inform that the article pain in systemic sclerosis, which has been published in Reumatismo contains verbatim text plagiarized from another paper, that was not picked up in the peer-review process despite increasingly employing sophisticated software to detect plagiarism".[52]

The academics and editors need to be aware that software not only does not always catch a recycled text, but it's also difficult to interpret the report of plagiarism check; and false report occurs due to common phrases, names of institutions, text translated from non-English publications which may go undetected by software. Also, a level of similarity match that is considered 'acceptable' or 'not acceptable' needs further scrutiny by a human.[53] Deciding to filter out papers to publish or reject on the similarity index at face value is not always appropriate. Use of additional software and diligence of manual scrutiny by reading and reviewing the manuscript is necessary.[53,54]

Plagiarism detection is a complex process. It cannot solely rely upon quantitative measures provided for text similarity index reports by anti-plagiarism software. One of the reasons could be that most of the anti-plagiarism check software rely on a database of publications mostly in the English language. Even the powerful and paid anti-plagiarism tool may miss out on the processed and recycled text, and also similarity index has a poor correlation to plagiarism.[55,56]

Assessment by readers is important as anti-plagiarism software may not always be relied upon to detect intellectual theft that can be spotted by readers and authors from non-English and not

widely circulated journals.[57] Misappropriation of ideas, methods, and images may be easily missed by over-reliance on 'similarity index' reported by anti-plagiarism software.[52,57] Customized antiplagiarism software in University learning was found helpful to raise awareness, detect and avoid plagiarism in various teaching-learning activities.[58] Analysis of a survey of journal editors by the Asia-Pacific Association of Medical Editors (APAME) found plagiarism in 75% (out of 46 journal responses) followed by duplicate publication in 58% among other misconducts.[55] This survey emphasized that there is a definite need to strengthen the ethical culture of researchers and reviewers, and anti-plagiarism check software can improve plagiarism detection.

The "Trojan Citation" is used to comply with the citation requirement where the main source is cited for minor information but the major part of the manuscript is copied with a slight modification of the content from another published article which often requires the expert human intervention to detect plagiarism.[54]

Managing translational plagiarism

Plagiarism check tools utilize methods and measures to detect textual plagiarism based on text similarity index and do not provide in-depth information that requires manual interpretation of labor-intensive work for the reviewers and editors.[59] Managing 'translational plagiarism' adds to the hardship for journal editors, for example, translated non-English references or articles from original sources which are usually not detected by plagiarism screening tool.[60,61] In such a situation, an online translation tool, e.g. Google Translate can be of help to first translate and then use plagiarism check tools. A further check for "textual overlap, erroneous referencing, typographical errors, publication

Table-2: Common 12-types of paid plagiarism check software[30,31,42-45]

S.N.	Plagiarism Check Tools	Features
1	Turnitin	Since 1997, proprietary, popularly used, computes a given document for detailed similarities, originally developed for students work, suitable for academic plagiarism check
2	iThenticate	Since 2004, proprietary, popular academic plagiarism check tool for researchers and publishers (not suitable for students classwork)
3	PlagScan	Since 2008, limited access, submissions are checked against (public) online documents, a (private) shared repository, and the user's own (private) repository
4	PlagTracker	Since 2011, freemium, less useful for academic purposes
5	Quetext	Since 2015, freemium
6	Copyscape	Since 2004, freemium, targeted at website managers
7	Grammarly	Freemium, checks ProQuest databases and (public) web pages (free version only for grammar check)
8	HelioBLAST	Requires subscription, check against abstract and titles in Medline/PubMed, free version limited to 1,000 words
9	Urkund	Online plagiarism detection, easy, the entire process is automated by sending the document by email to receive the report
10	Plagiarism Detector	A standalone computer desktop application runs only on Windows
11	Viper	In English, scans over 10 billion online sources including websites, journals, and news; simple, fast, and effective low-cost alternative
12	Plagiarism Scanner	runs against Internet resources- websites, digital databases, and online libraries

Freemium: limited basic services free, advanced features require payment

Table-3: Common 12-types of free online plagiarism check tools[11,44,45]

SN	Plagiarism Check Tools	Features
1	Plagiarisma	One of the best free plagiarism tools; in multiple languages; no word limit per search, supports TXT, RTF, MS Word, PPTX, XLS, PDF, EPUB, FB2, and ODT
2	SearchEngineReports.net	Free plagiarism check up to 2000 words per search; can paste the text for check or by entering a URL, or files upload; view matched results; download plagiarized report; also check grammar
3	Quetext	Support file format- Txt, PDF, Doc, Docx; 5-free checks per month; Basic check Free (Pro paid version)
4	Dupli Checker	Feature include: Plagiarism checker, API (Application Programming Interface) and Plugin; Grammar checker; Support file format -Txt, Doc, Docx, RTF, ODT, Htm, Html; 1000 words limit per search
5	SmallSEOTools	Plagiarism checker API and Plugin; Available on Google Play, MacStore, and App Store; Download the plagiarism report; Support file format - Txt, Doc, Docx, PDF, Tex; 1000 words limit per search
6	Plagiarismdetector.net	Feature include: URL/File uploading; Download PDF reports; Support file format - Txt, Doc, Docx; 1000 words per search (Deep search feature- paid version)
7	PREPOSTSEO	plagiarism checking of up to 1000 words for free (deep Search paid version); supports multiple files uploading; supports APIs to integrate the tool with application
8	PlagTracker	fast plagiarism checks for free; easy plagiarism reports; also fix grammar errors and does proofread- suitable for publishers to verify that the content is original before publishing
9	EduBirdie	free online plagiarism checker for content or upload documents stored on local drives
10	Plagiarism Checker	SeeSources.com is also an online plagiarism detection tool. It resembles Plagium and many other free online tools, but here you can also load documents in MS Word, HTML, and Text format.
11	Plagium	Plagium is a very simple online plagiarism detection tool. You just have to paste your original text, And Plagium will search for redundancies over the web. There are many free,
12	See Sources	SeeSources.com is also an online plagiarism detection tool. It resembles Plagium and many other free online tools, but here you can also load documents in MS Word, HTML, and Text format.

year, publication media, and relationships between authors" is necessary to deal with the possible plagiarism.[62]

It is common to find good research from non-English journals being translated and published in English language journals which may not be easy to detect for the stolen work using plagiarism check software.[13] The translational work of the predatory editing services and medical writing companies may use copy-paste and combine texts, data or figures to steal others' work violating the ethics of research writing and publication to sell the manuscript and authorship for money.[63] There are profit-oriented Paper Mills, often illegal organizations, which produce scientific papers on-demand and sell the articles.[64-66] Authors should be vigilant to seek service from authentic commercial medical writers/writing companies and follow their recommendation and guidelines, for example, International Society for Medical Publication Professionals (ISMPP), European Medical Writers Association (EMWA), American Medical Writers Association (AMWA), Australasian Medical Writers Association (AMWA), Indian Medical Writers Association (IMWA), and Chinese Medical Writers Community (CMWC) to name a few which provide a forum for professional services.[67,68] Ultimately, it is the author's responsibility to do ethical research writing and publication and to not take shortcuts to avoid misconduct.

Avoid plagiarism through educational initiatives

Educational initiatives combined with the use of modern technology like an anti-plagiarism check can help avoid plagiarism and increase the awareness to maintain a culture of ethical research and publication, [Table 4].

A study comparing three groups of students over 15 years during three different periods found an increased understanding of and reduction in plagiarism.[71] The study on attitudes towards plagiarism among faculty members in Egypt recommended the development of an academic integrity policy, implementation of a training program on plagiarism, and dissemination of knowledge to increase the awareness for academic integrity.[72]

Live examples of 'cloning' plagiarism in the context of Nepal

The retraction notice by Bali Medical Journal (Oct 2017) reads: "Several critical errors have been found in this article (DOI:10.15562/bmj.v2i3.52). We found that the authors copied most of the data from: https://www.ncbi.nlm.nih.gov/pubmed/23016472 (2011). The authors changed the sample size from 735 to 635 in their study, but the percentage of each type of thyroid dysfunction is still same like the original paper".[73] The journal blacklisted the authors and the university claimed proceeded for further action to fire the involved plagiarists.[74] Also, one of the coauthors in the above-cloned article had another article retracted due to plagiarism.[75]

Another instance of cloned articles "Use of antibiotic prophylaxis in low-risk laparoscopic cholecystectomy is unnecessary: A clinical trial" published in PJMHS/PJS[76] was copied from the original-work[77] "Routine use of antibiotic prophylaxis in low-risk laparoscopic cholecystectomy is unnecessary: A randomized clinical trial".

Issue of plagiarism has been increasingly surfacing in Nepal, including the highest authority of the University (the Vice Chancellor)[78], and faculties[79]: Seven barred from research after plagiarism, duplications in eleven papers.

Table 4. Twelve educational tips to avoid plagiarism using the anti-plagiarism software[12,43,69,70]

S.N.	Educational tips
1.	Training for awareness and skill development to understand the meaning of the sentence
2.	Training for awareness and skill development to write in own words to convey the actual meaning
3.	Acknowledge and cite the sources for idea, text, and diagrams
4.	Use quotation marks when using exact phrases or sentences from other sources and cite the source
5.	Training for awareness and skill development to keep the sources in the correct context
6.	Training for awareness and skill development to paraphrase and summarize
7.	Training for awareness and skill development of critical analysis and interpretation
8.	Training for awareness and skill development of referencing and citation
9.	Training for awareness and skill development to properly acknowledge the source
10.	Education and skill development to monitor, detect and respond to possible plagiarism
11.	Learn to interpret and intervene for intolerable similarity index of anti-plagiarism check software
12.	When in doubt cite, and check manuscript with anti-plagiarism software before submission

WAY FORWARD

Plagiarism has no boundary and is a global issue. It's an unethical behavior of cheating and copying others' ideas and texts, which may be legally punishable due to copyright infringement. Some of the common reasons for plagiarism include: lack of knowledge, insufficient technique or resources on ideas to avoid plagiarism while summarizing and paraphrasing, the greediness of authors to increase the number of publications, and pressure to publish.

Together with citation of the source (including one's earlier publication to avoid self-plagiarism or text recycling), some of the important steps to avoid plagiarism are to follow the basic rules: to always paraphrase, summarize in own words, quote "…", cite, and use plagiarism check tools. Continued education, detection, and appropriate action policy for the misconduct are important measures to prevent plagiarism. Awareness

of scientific misconduct and its consequences helps prevent plagiarism at all levels, from students, academics, authors, reviewers, editors to academia. The vast amount of easily available information on the internet must be appropriately paraphrased and cited, and plagiarism check software used as needed, to help avoid this global phenomenon that has damaged the trust in science. To avoid plagiarism, all factual information of research requires citation (e.g., earth's population is in billions), unlike the common knowledge (e.g., the earth is round) which may not be cited.

The journal editors and peer reviewers must be vigilant for suspected plagiarism and ready to take appropriate action with a simple warning to definitive punishment depending on the seriousness of the misconduct. The teaching and training workshop embedded in the school curriculum with continued education, starting from the early stages of students' learning time, is necessary to develop a culture of ethical research writing and publications to avoid plagiarism and other misconduct.

CONFLICT OF INTEREST

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