BUKTI KORESPONDENSI

International Journal of Learning, Teaching and Educational Research

Active Submissions

Submission complete. Thank you for your interest in publishing with International Journal of Learning, Teaching and Educational Research.

- Active Submissions

e-ISSN: 1694-2116

p-ISSN: 1694-2493

Active Submissions

ACTIVE ARCHIVE

ID	MM-DD SUBMIT	SEC	AUTHORS	TITLE	STATUS
7373	03-07	ART	Wahyudiati	ENHANCING STUDENTS' COMMUNICATION SKILLS AND STEM...	Awaiting assignment

1 - 1 of 1 Items

Start a New Submission

CLICK HERE to go to step one of the five-step submission process.

Refbacks

ALL NEW PUBLISHED IGNORED

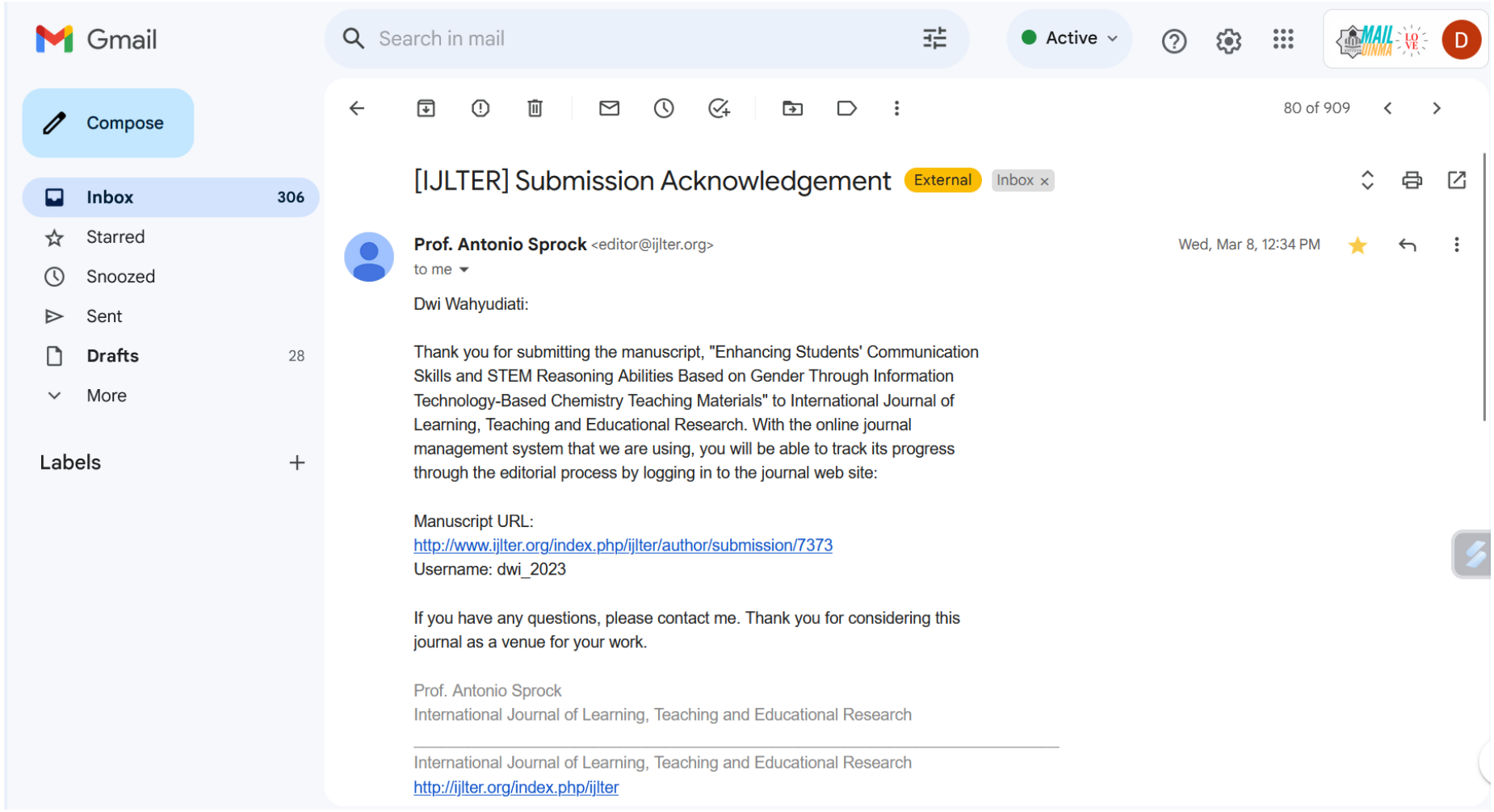
DATE ADDED	HITS	URL	ARTICLE	TITLE	STATUS	ACTION

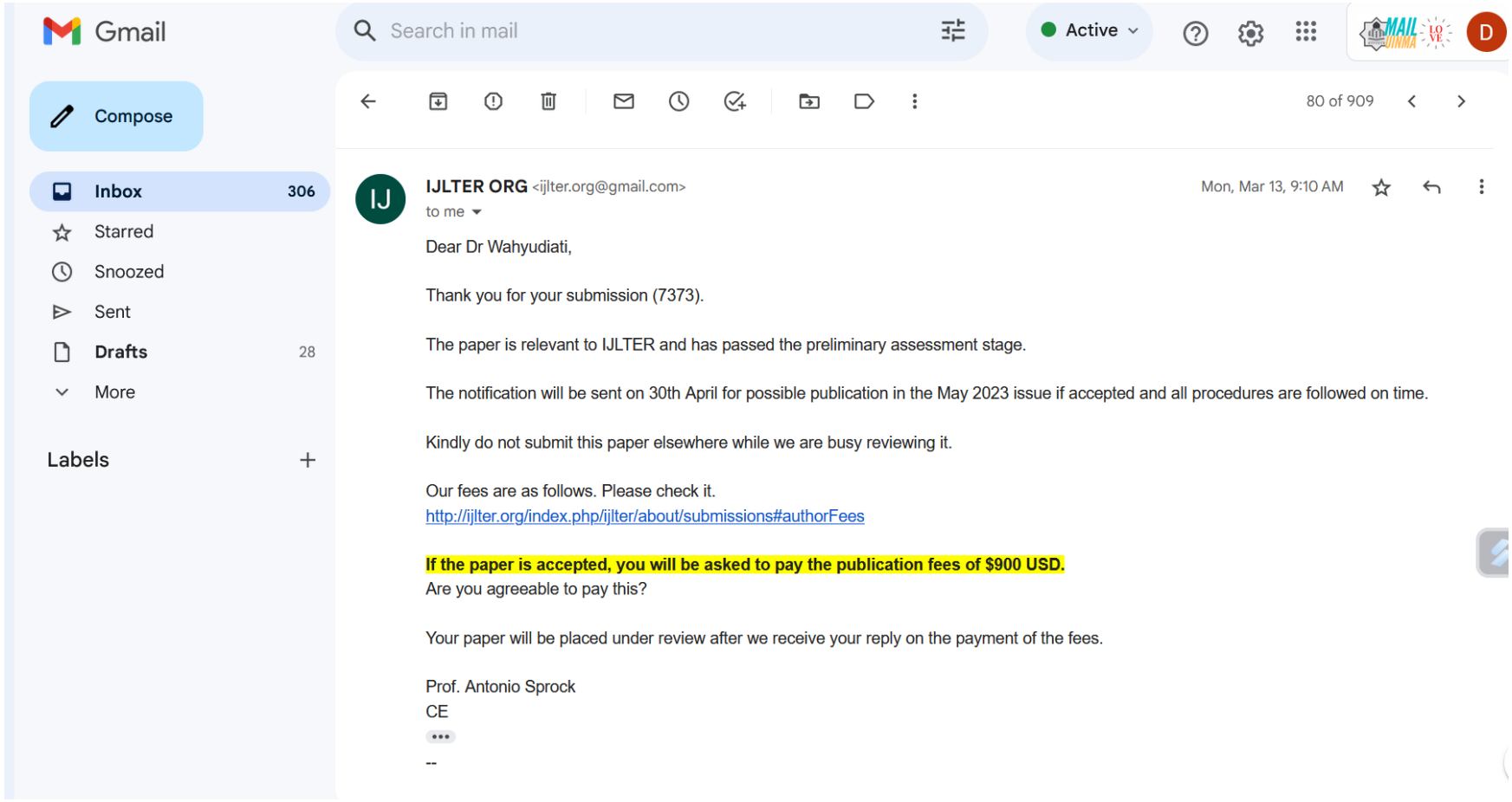
There are currently no refbacks.

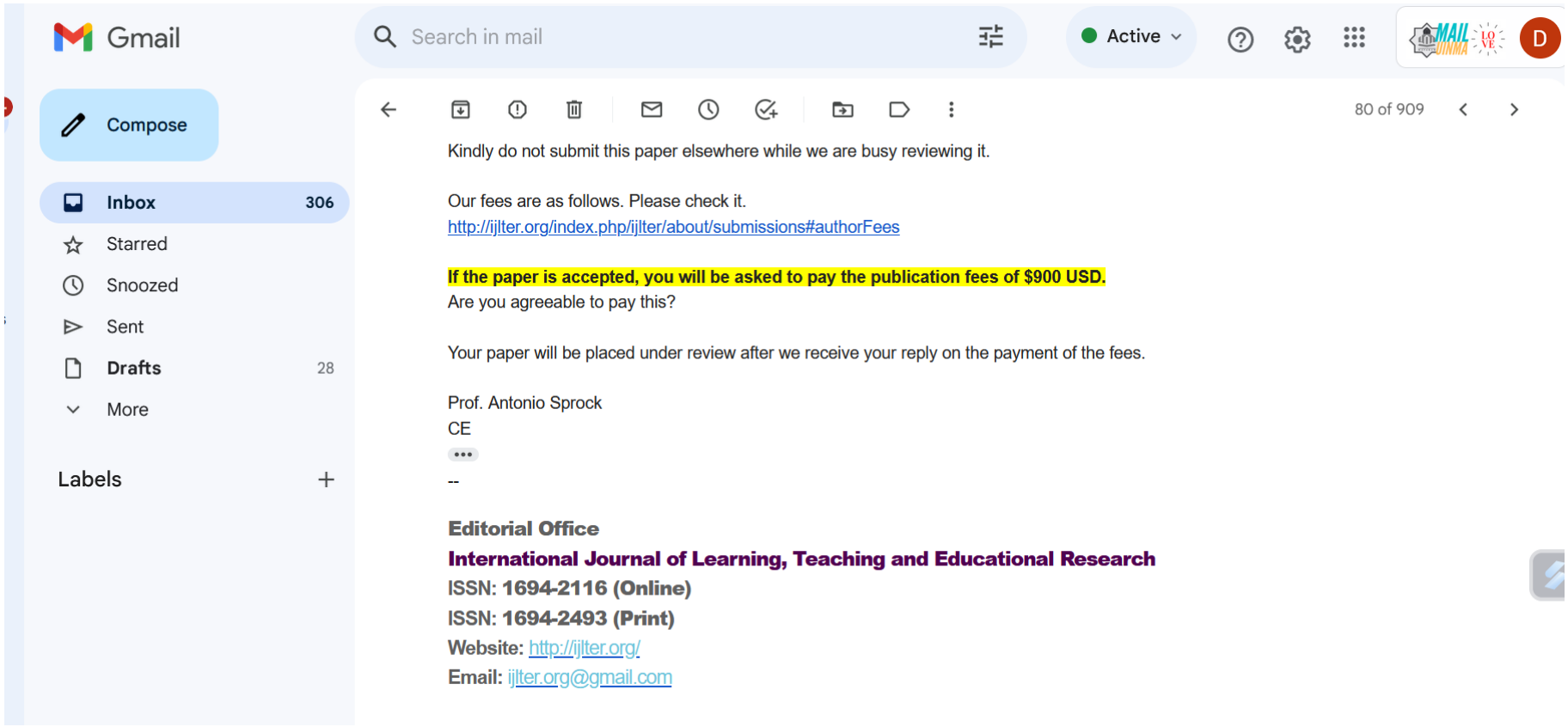
Publish Ignore Delete Select All

e-ISSN: 1694-2116

p-ISSN: 1694-2493


Gmail
Search in mail
Active
Compose
Inbox 306
Starred
Snoozed
Sent
Drafts 28
More
Labels
80 of 909
[IJLTER] Submission Acknowledgement
External
Inbox ×
Prof. Antonio Sprock <editor@ijlter.org>
to me
Wed, Mar 8, 12:34 PM
Dwi Wahyudiati:
Thank you for submitting the manuscript, "Enhancing Students' Communication Skills and STEM Reasoning Abilities Based on Gender Through Information Technology-Based Chemistry Teaching Materials" to International Journal of Learning, Teaching and Educational Research. With the online journal management system that we are using, you will be able to track its progress through the editorial process by logging in to the journal web site:
Manuscript URL:
http://www.ijlter.org/index.php/ijlter/author/submission/7373
Username: dwi_2023
If you have any questions, please contact me. Thank you for considering this journal as a venue for your work.
Prof. Antonio Sprock
International Journal of Learning, Teaching and Educational Research
International Journal of Learning, Teaching and Educational Research
http://ijlter.org/index.php/ijlter


Gmail
Search in mail
Active
Compose
Inbox 306
Starred
Snoozed
Sent
Drafts 28
More
Labels
80 of 909
IJLTER ORG <ijlter.org@gmail.com>
to me
Mon, Mar 13, 9:10 AM
Dear Dr Wahyudiati,
Thank you for your submission (7373).
The paper is relevant to IJLTER and has passed the preliminary assessment stage.
The notification will be sent on 30th April for possible publication in the May 2023 issue if accepted and all procedures are followed on time.
Kindly do not submit this paper elsewhere while we are busy reviewing it.
Our fees are as follows. Please check it.
http://ijlter.org/index.php/ijlter/about/submissions#authorFees
If the paper is accepted, you will be asked to pay the publication fees of $900 USD.
Are you agreeable to pay this?
Your paper will be placed under review after we receive your reply on the payment of the fees.
Prof. Antonio Sprock
CE
--


Gmail
Search in mail
Active
Compose
Inbox 306
Starred
Snoozed
Sent
Drafts 28
More
Labels
80 of 909
Kindly do not submit this paper elsewhere while we are busy reviewing it.
Our fees are as follows. Please check it.
http://ijlter.org/index.php/ijlter/about/submissions#authorFees
If the paper is accepted, you will be asked to pay the publication fees of $900 USD.
Are you agreeable to pay this?
Your paper will be placed under review after we receive your reply on the payment of the fees.
Prof. Antonio Sprock
CE
--
Editorial Office
International Journal of Learning, Teaching and Educational Research
ISSN: 1694-2116 (Online)
ISSN: 1694-2493 (Print)
Website: http://ijlter.org/
Email: ijlter.org@gmail.com

Compose

Inbox 306

Starred

Snoozed

Sent

Drafts 28

More

Labels

80 of 909

ISSN: 1694-2493 (Print)
Website: http://ijlter.org/
Email: ijlter.org@gmail.com

D

Dwi Wahyudiati <dwiwahyudiati@uinmataram.ac.id> Mon, Mar 13, 9:46 AM

to IJLTER

Dear Prof. Antonio Sprock

Thank you for the information and I am willing to continue the process to the review stage and am willing to pay according to the conditions ($900 USD) if my article is accepted for publication. I really hope to be given the opportunity to have my article published in this journal. Hopefully we can immediately get the results of the review from the reviewer for us to immediately revise according to the reviewer's input and suggestions as proof of correspondence. Thank you for the response and approval.

Sincerely
Dr. Dwi Wahyudiati

Sent

Drafts 28

More

Labels

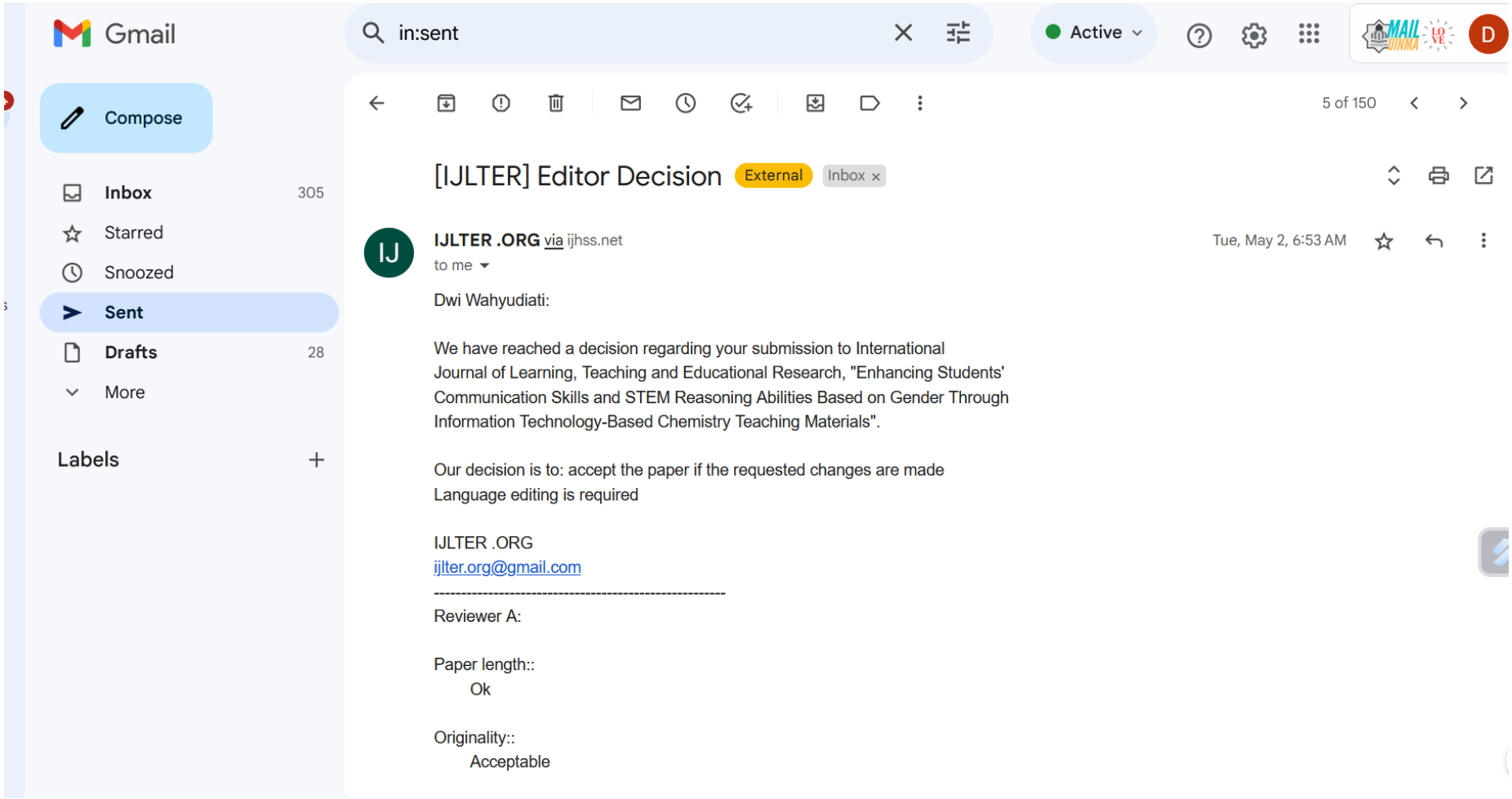
IJ

IJLTER ORG <ijlter.org@gmail.com> Mar 13, 2023, 11:33 PM

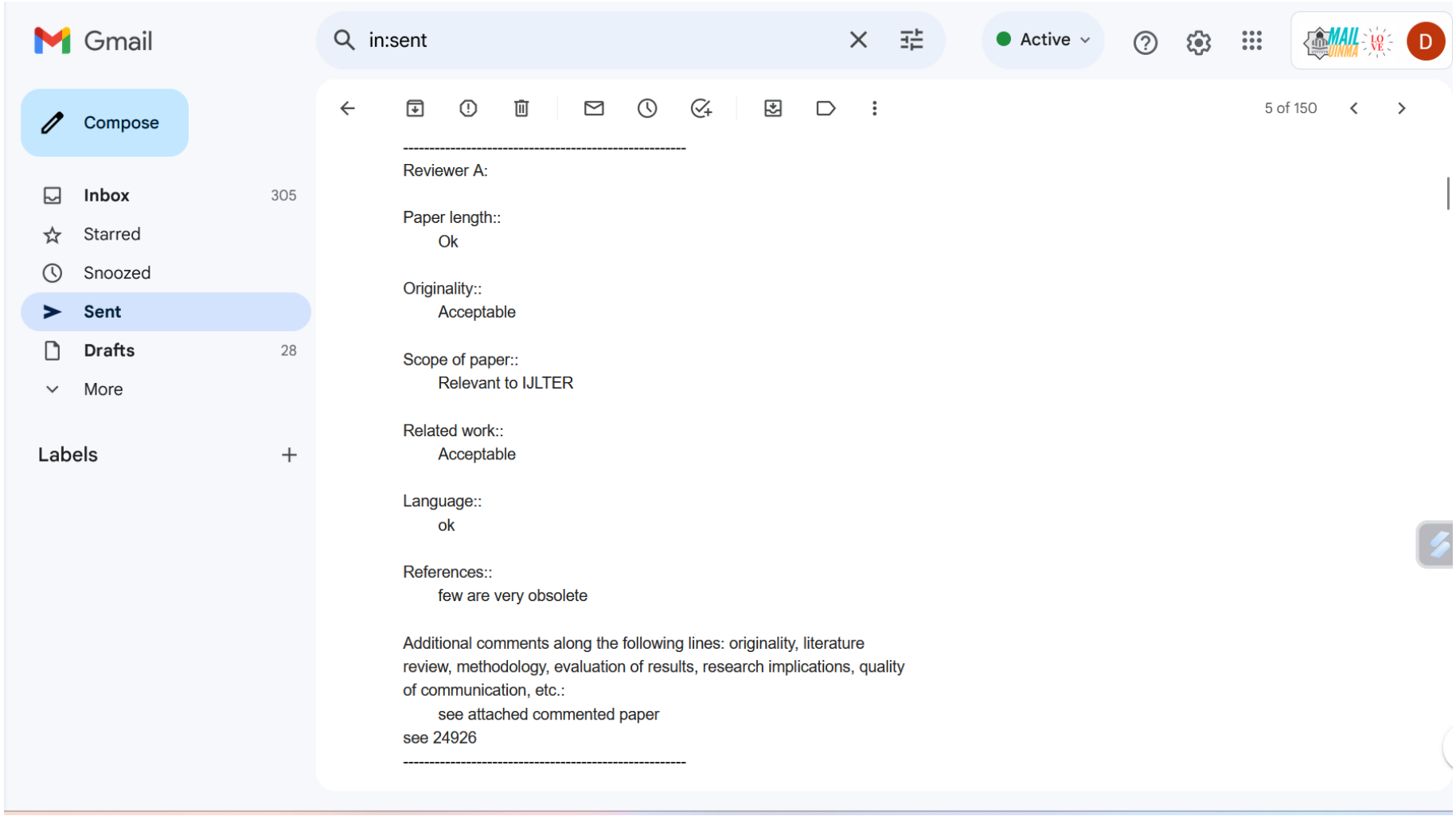
to me

Thank you for your response.
Your paper is now under review.
You will be notified on 30th April 2023.

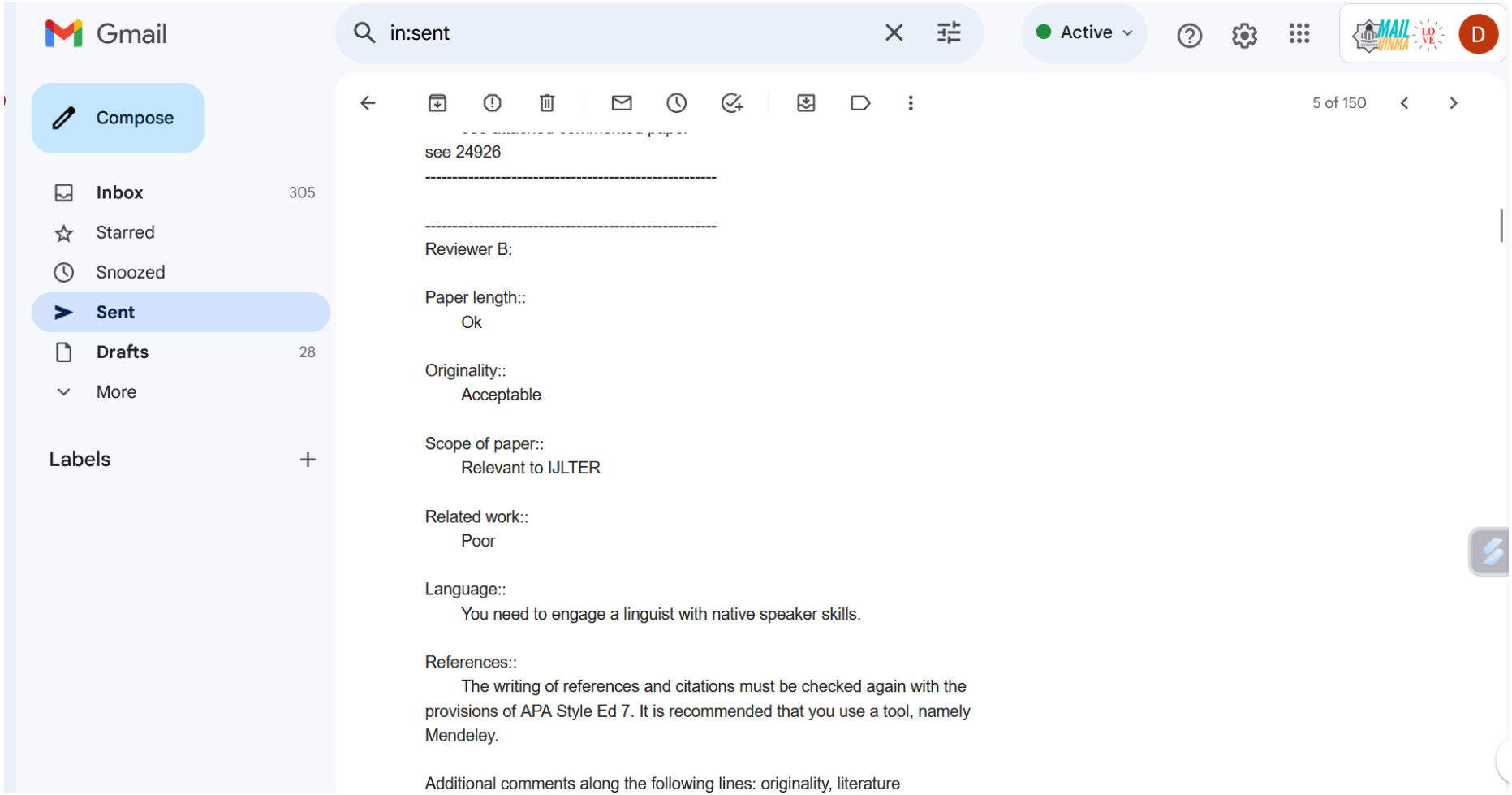
Thank you for your response. | Noted with thanks. | Thank you for the update.


Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
[IJLTER] Editor Decision
External
Inbox ×
IJ
IJLTER .ORG via ijhss.net
to me
Tue, May 2, 6:53 AM
Dwi Wahyudiati:
We have reached a decision regarding your submission to International Journal of Learning, Teaching and Educational Research, "Enhancing Students' Communication Skills and STEM Reasoning Abilities Based on Gender Through Information Technology-Based Chemistry Teaching Materials".
Our decision is to: accept the paper if the requested changes are made
Language editing is required
IJLTER .ORG
ijlter.org@gmail.com

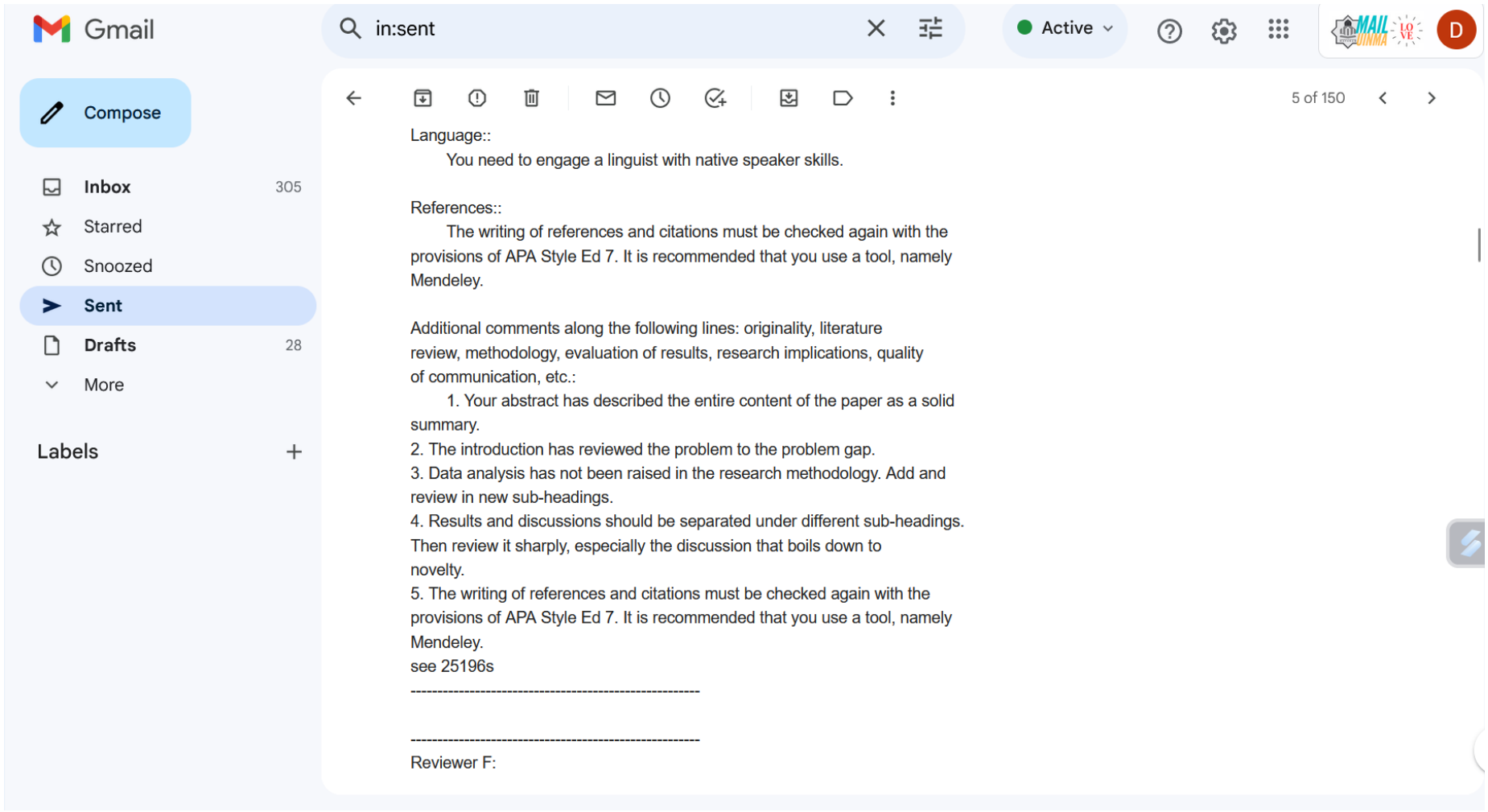
Reviewer A:
Paper length::
Ok
Originality::
Acceptable


Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150

Reviewer A:
Paper length::
Ok
Originality::
Acceptable
Scope of paper::
Relevant to IJLTER
Related work::
Acceptable
Language::
ok
References::
few are very obsolete
Additional comments along the following lines: originality, literature review, methodology, evaluation of results, research implications, quality of communication, etc.:
see attached commented paper
see 24926


Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
see 24926

Reviewer B:
Paper length::
Ok
Originality::
Acceptable
Scope of paper::
Relevant to IJLTER
Related work::
Poor
Language::
You need to engage a linguist with native speaker skills.
References::
The writing of references and citations must be checked again with the provisions of APA Style Ed 7. It is recommended that you use a tool, namely Mendeley.
Additional comments along the following lines: originality, literature



Language::

You need to engage a linguist with native speaker skills.

References::

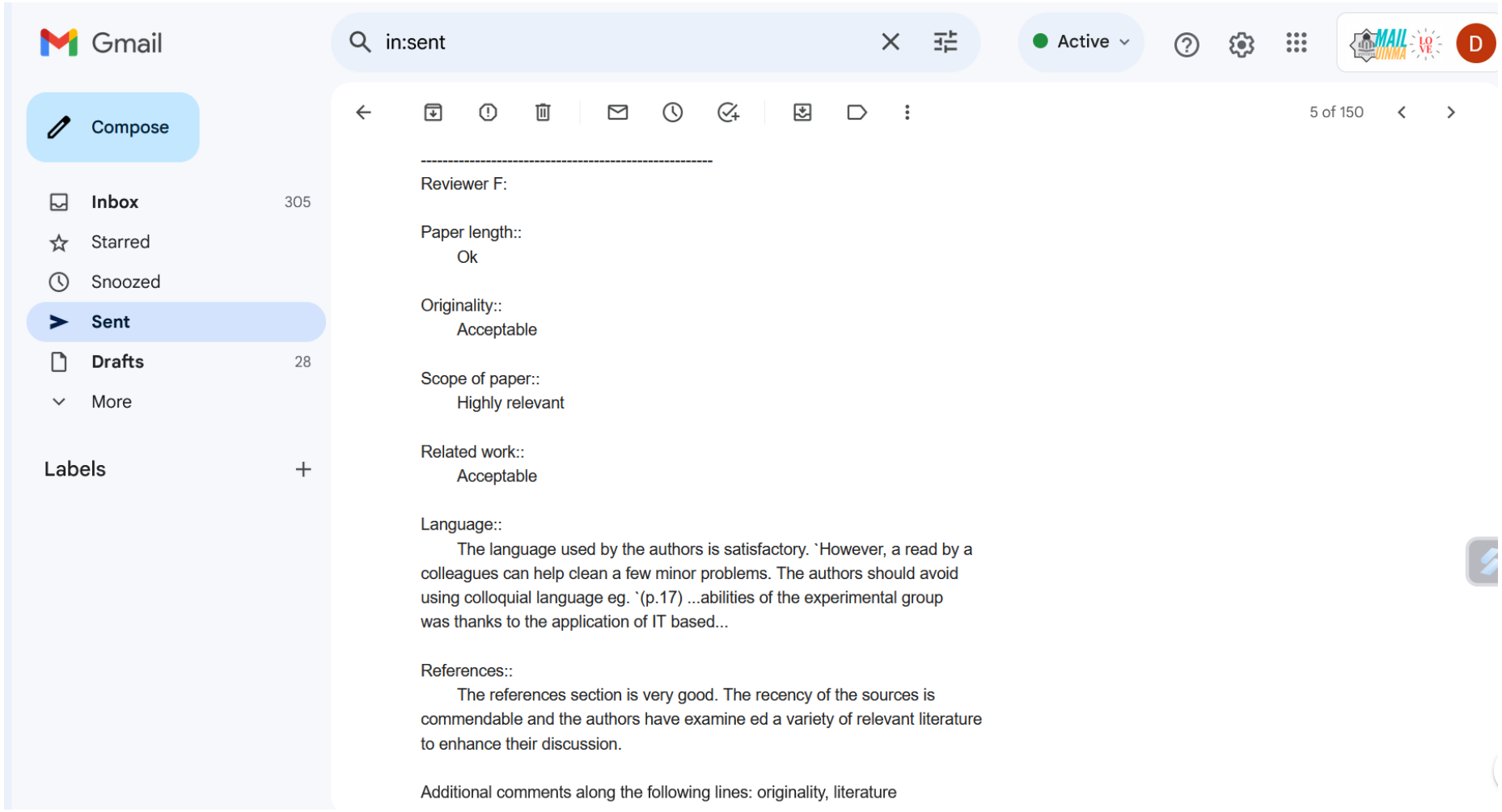
The writing of references and citations must be checked again with the provisions of APA Style Ed 7. It is recommended that you use a tool, namely Mendeley.

Additional comments along the following lines: originality, literature review, methodology, evaluation of results, research implications, quality of communication, etc.:

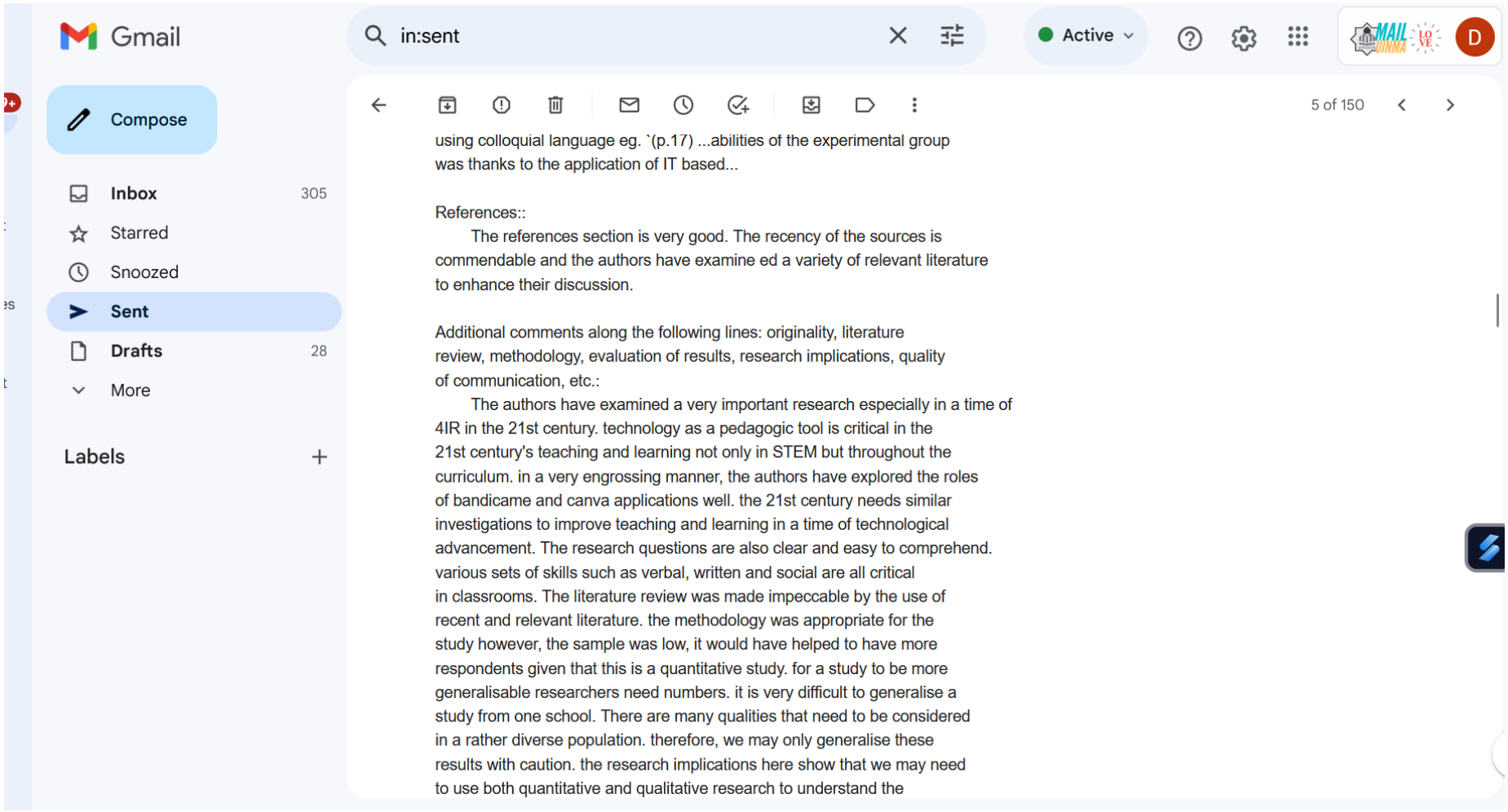
1. Your abstract has described the entire content of the paper as a solid summary.
2. The introduction has reviewed the problem to the problem gap.
3. Data analysis has not been raised in the research methodology. Add and review in new sub-headings.
4. Results and discussions should be separated under different sub-headings. Then review it sharply, especially the discussion that boils down to novelty.
5. The writing of references and citations must be checked again with the provisions of APA Style Ed 7. It is recommended that you use a tool, namely Mendeley.

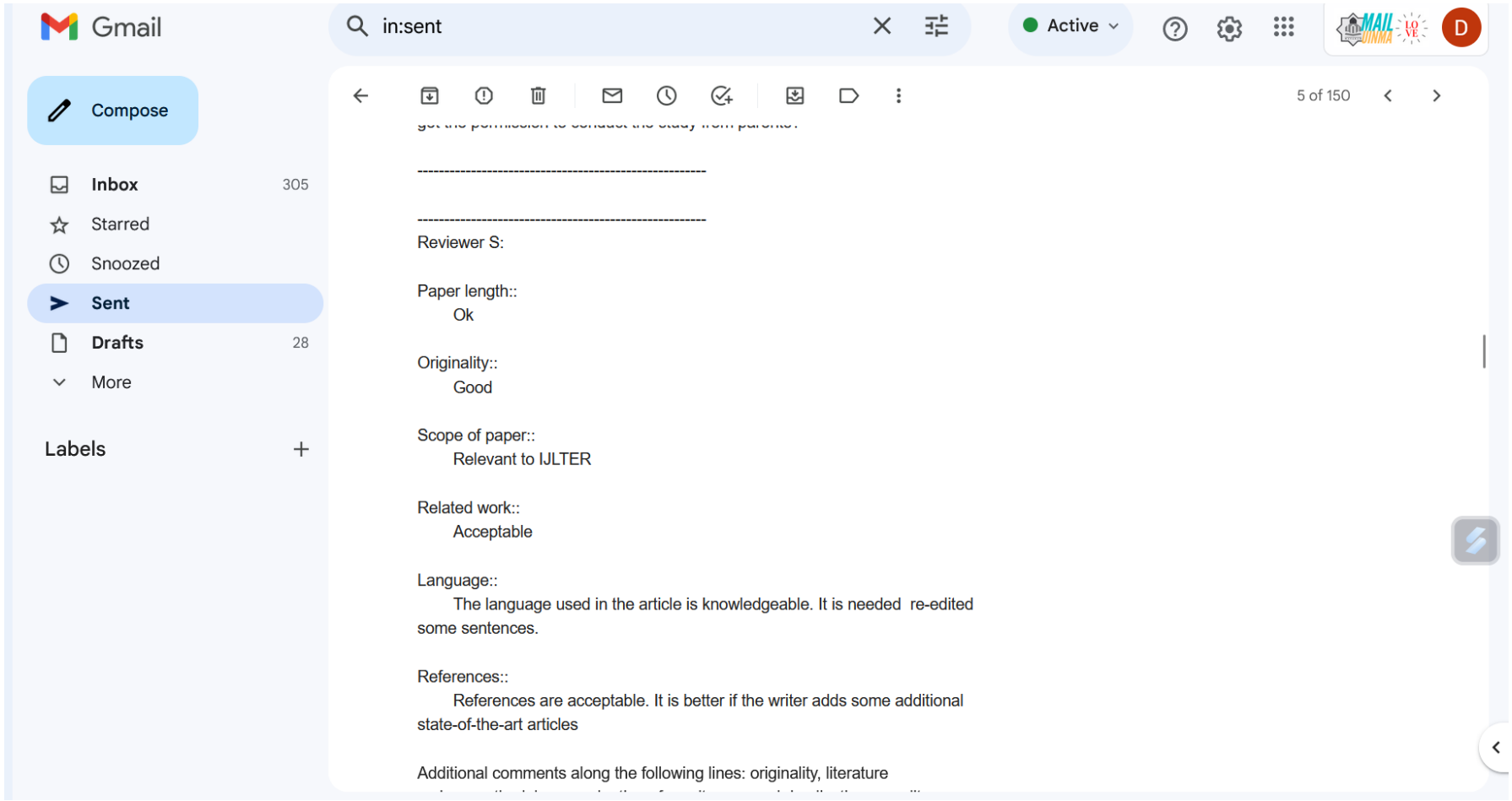
see 25196s

Reviewer F:

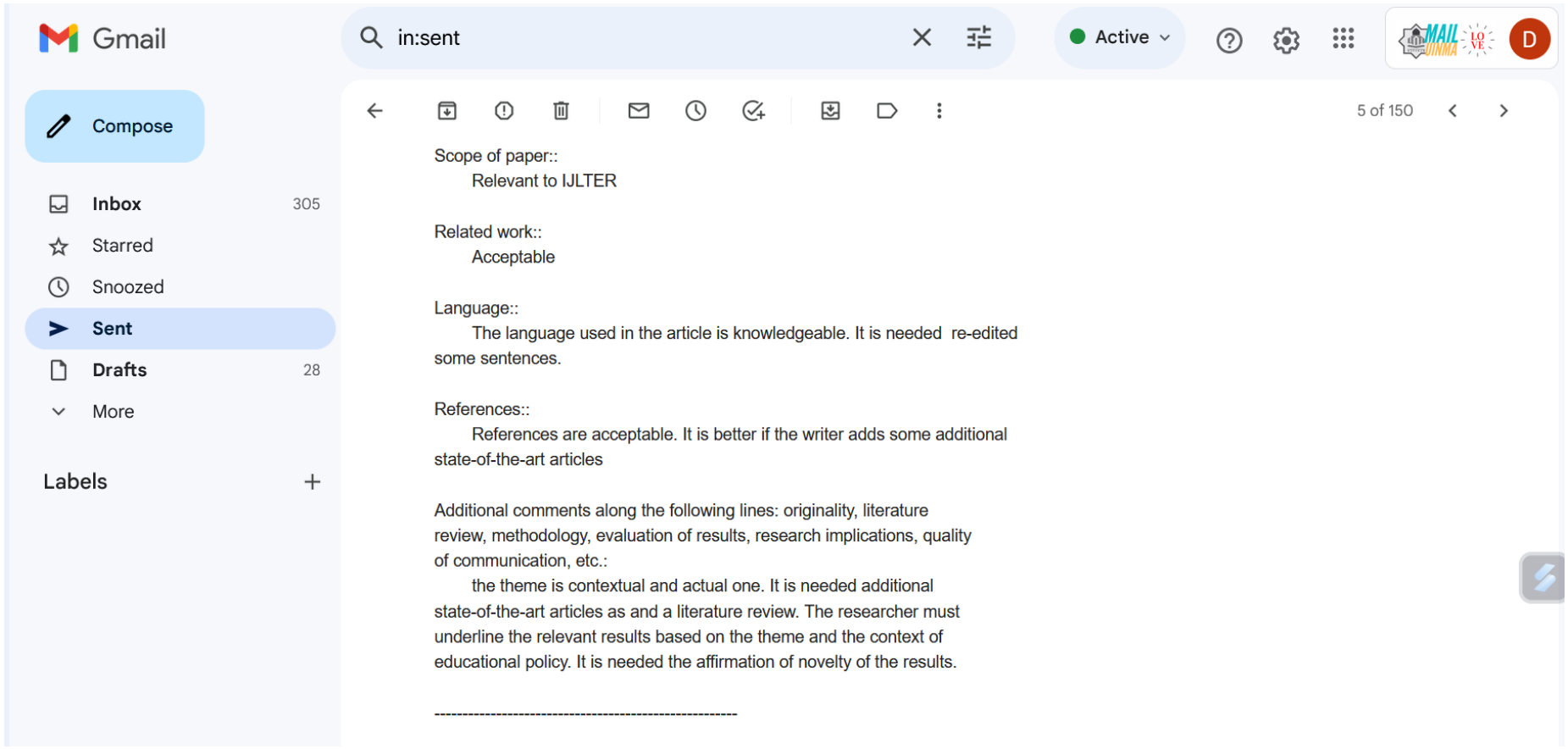

Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150

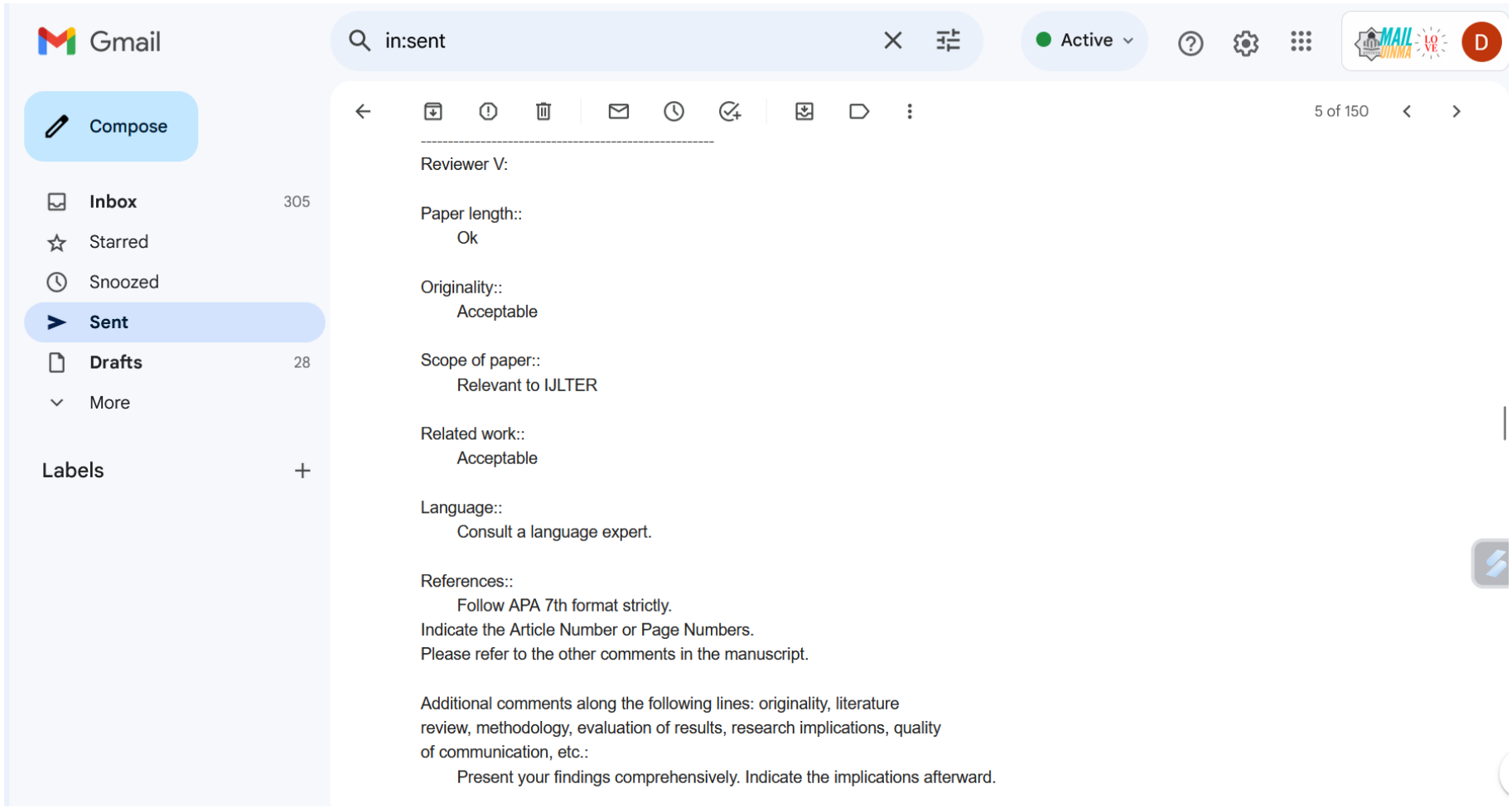
Reviewer F:
Paper length::
Ok
Originality::
Acceptable
Scope of paper::
Highly relevant
Related work::
Acceptable
Language::
The language used by the authors is satisfactory. `However, a read by a colleagues can help clean a few minor problems. The authors should avoid using colloquial language eg. `(p.17) ...abilities of the experimental group was thanks to the application of IT based...
References::
The references section is very good. The recency of the sources is commendable and the authors have examine ed a variety of relevant literature to enhance their discussion.
Additional comments along the following lines: originality, literature


Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
using colloquial language eg. `(p.17) ...abilities of the experimental group was thanks to the application of IT based...
References::
The references section is very good. The recency of the sources is commendable and the authors have examine ed a variety of relevant literature to enhance their discussion.
Additional comments along the following lines: originality, literature review, methodology, evaluation of results, research implications, quality of communication, etc.:
The authors have examined a very important research especially in a time of 4IR in the 21st century. technology as a pedagogic tool is critical in the 21st century's teaching and learning not only in STEM but throughout the curriculum. in a very engrossing manner, the authors have explored the roles of bandicame and canva applications well. the 21st century needs similar investigations to improve teaching and learning in a time of technological advancement. The research questions are also clear and easy to comprehend. various sets of skills such as verbal, written and social are all critical in classrooms. The literature review was made impeccable by the use of recent and relevant literature. the methodology was appropriate for the study however, the sample was low, it would have helped to have more respondents given that this is a quantitative study. for a study to be more generalisable researchers need numbers. it is very difficult to generalise a study from one school. There are many qualities that need to be considered in a rather diverse population. therefore, we may only generalise these results with caution. the research implications here show that we may need to use both quantitative and qualitative research to understand the


Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150

Reviewer S:
Paper length::
Ok
Originality::
Good
Scope of paper::
Relevant to IJLTER
Related work::
Acceptable
Language::
The language used in the article is knowledgeable. It is needed re-edited some sentences.
References::
References are acceptable. It is better if the writer adds some additional state-of-the-art articles
Additional comments along the following lines: originality, literature


Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
Scope of paper::
Relevant to IJLTER
Related work::
Acceptable
Language::
The language used in the article is knowledgeable. It is needed re-edited some sentences.
References::
References are acceptable. It is better if the writer adds some additional state-of-the-art articles
Additional comments along the following lines: originality, literature review, methodology, evaluation of results, research implications, quality of communication, etc.:
the theme is contextual and actual one. It is needed additional state-of-the-art articles as and a literature review. The researcher must underline the relevant results based on the theme and the context of educational policy. It is needed the affirmation of novelty of the results.



Reviewer V:

Paper length::
Ok

Originality::
Acceptable

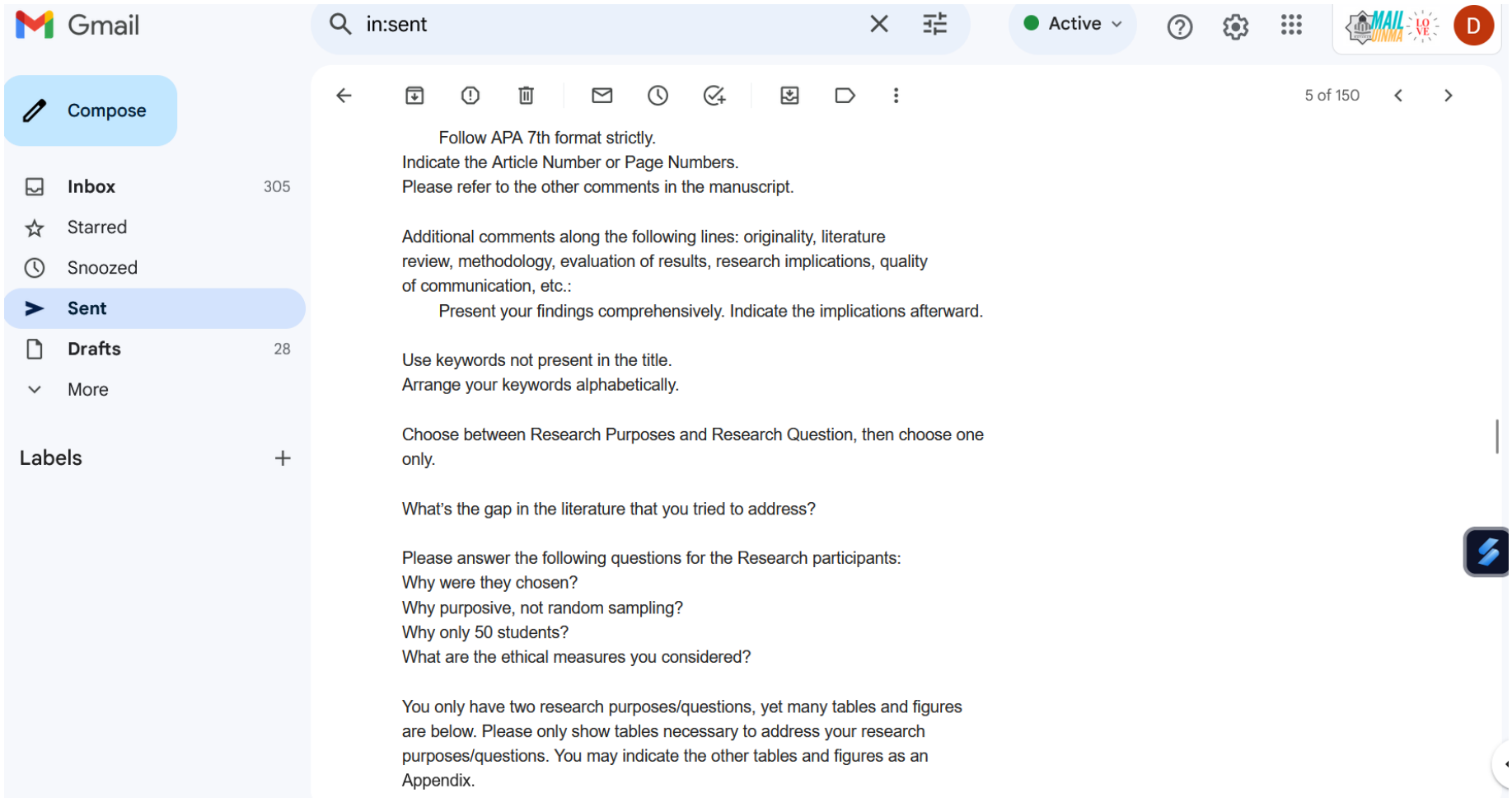
Scope of paper::
Relevant to IJLTER

Related work::
Acceptable

Language::
Consult a language expert.

References::
Follow APA 7th format strictly.
Indicate the Article Number or Page Numbers.
Please refer to the other comments in the manuscript.

Additional comments along the following lines: originality, literature review, methodology, evaluation of results, research implications, quality of communication, etc.:
Present your findings comprehensively. Indicate the implications afterward.


Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
Follow APA 7th format strictly.
Indicate the Article Number or Page Numbers.
Please refer to the other comments in the manuscript.
Additional comments along the following lines: originality, literature review, methodology, evaluation of results, research implications, quality of communication, etc.:
Present your findings comprehensively. Indicate the implications afterward.
Use keywords not present in the title.
Arrange your keywords alphabetically.
Choose between Research Purposes and Research Question, then choose one only.
What's the gap in the literature that you tried to address?
Please answer the following questions for the Research participants:
Why were they chosen?
Why purposive, not random sampling?
Why only 50 students?
What are the ethical measures you considered?
You only have two research purposes/questions, yet many tables and figures are below. Please only show tables necessary to address your research purposes/questions. You may indicate the other tables and figures as an Appendix.

Gmail

in:sent

Active

Compose

Inbox 305

Starred

Snoozed

Sent

Drafts 28

More

Labels

5 of 150

Why were they chosen?
Why purposive, not random sampling?
Why only 50 students?
What are the ethical measures you considered?

You only have two research purposes/questions, yet many tables and figures are below. Please only show tables necessary to address your research purposes/questions. You may indicate the other tables and figures as an Appendix.

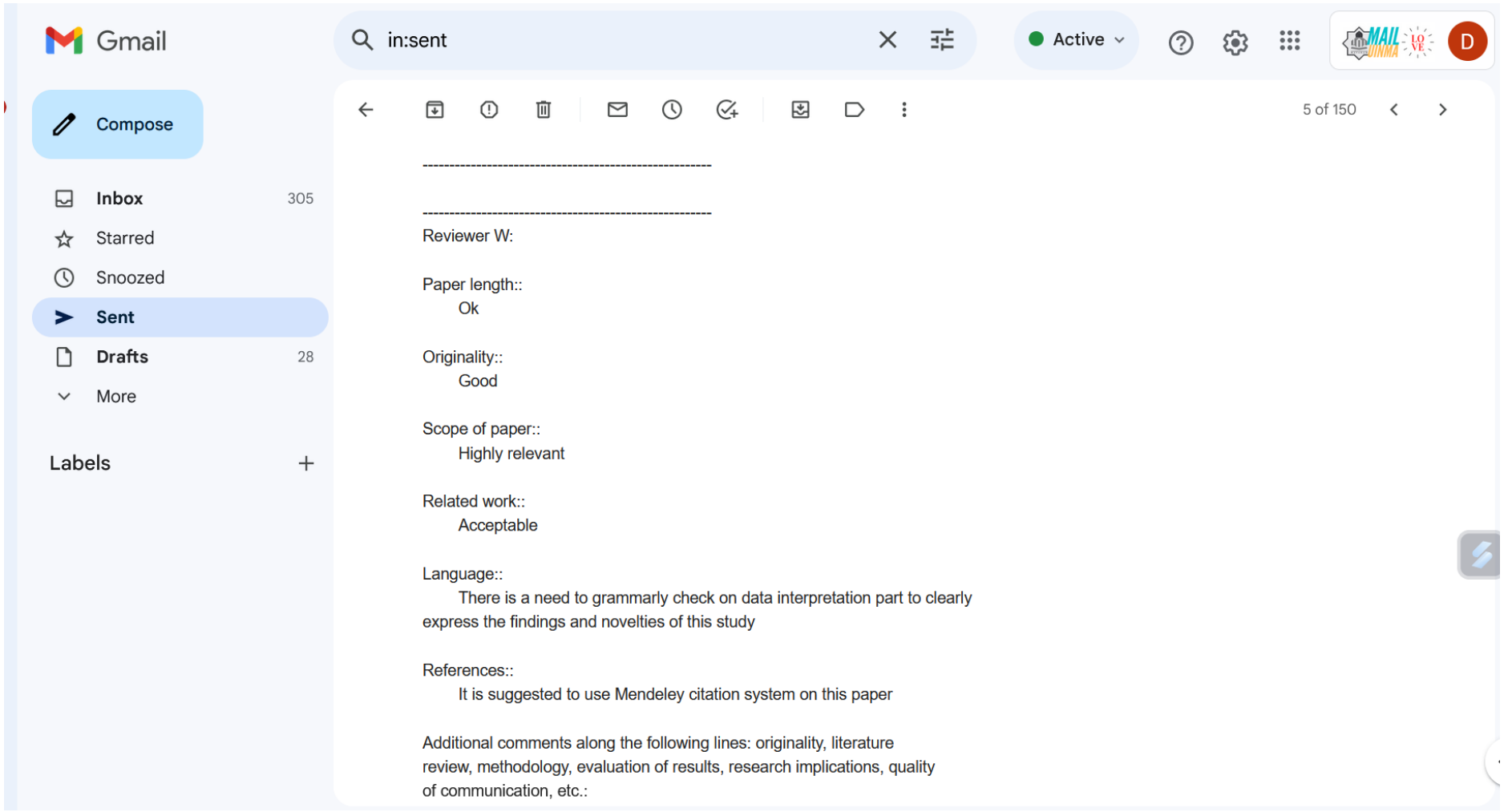
The Figure label is written below the Figure.

Please follow the APA format in presenting your results.

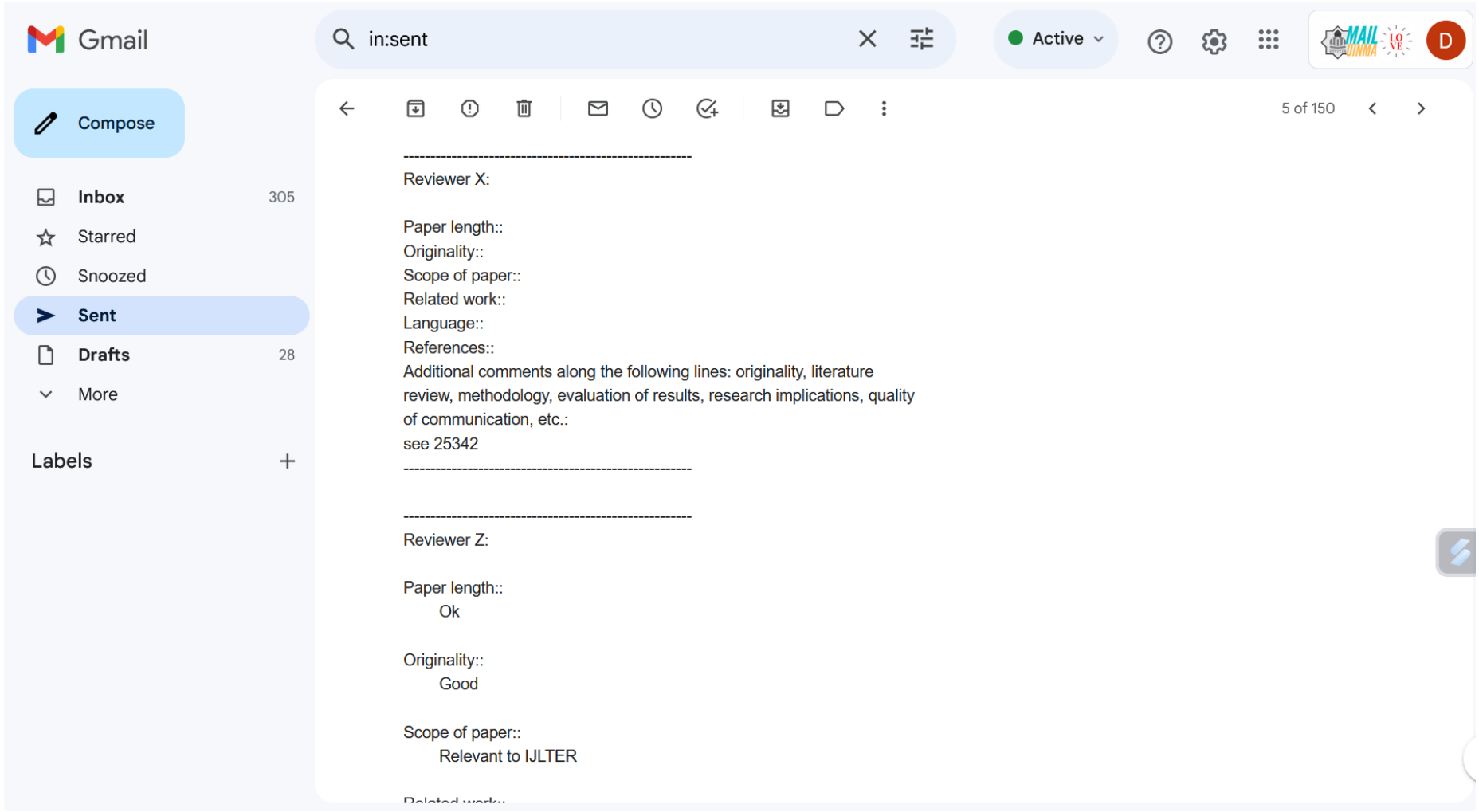
Please update your citations. Review studies and literature from 2018 onwards.

Kindly revise your conclusion (see comments in the manuscript)

There should be no citations in the Conclusion and Recommendations.

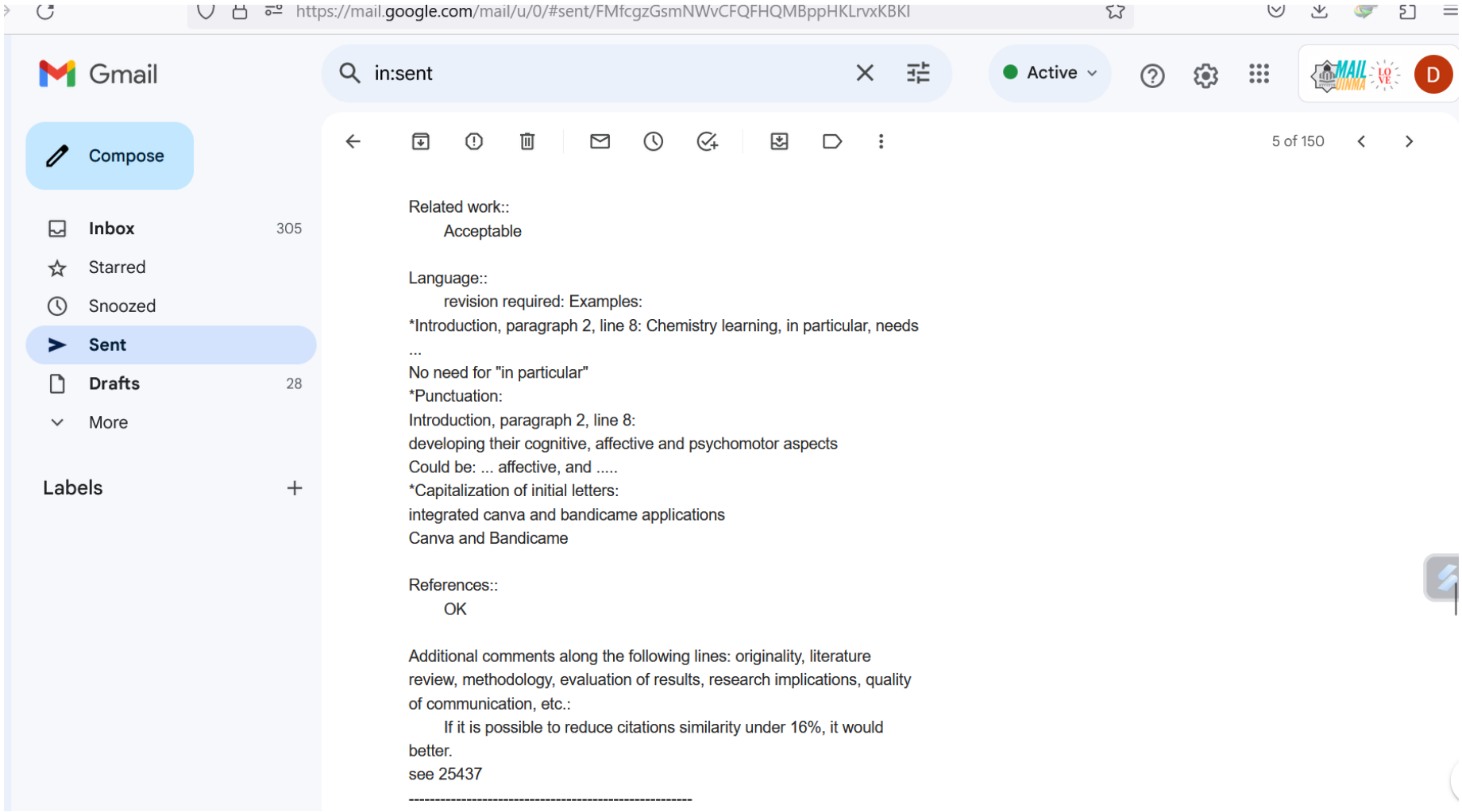

Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150

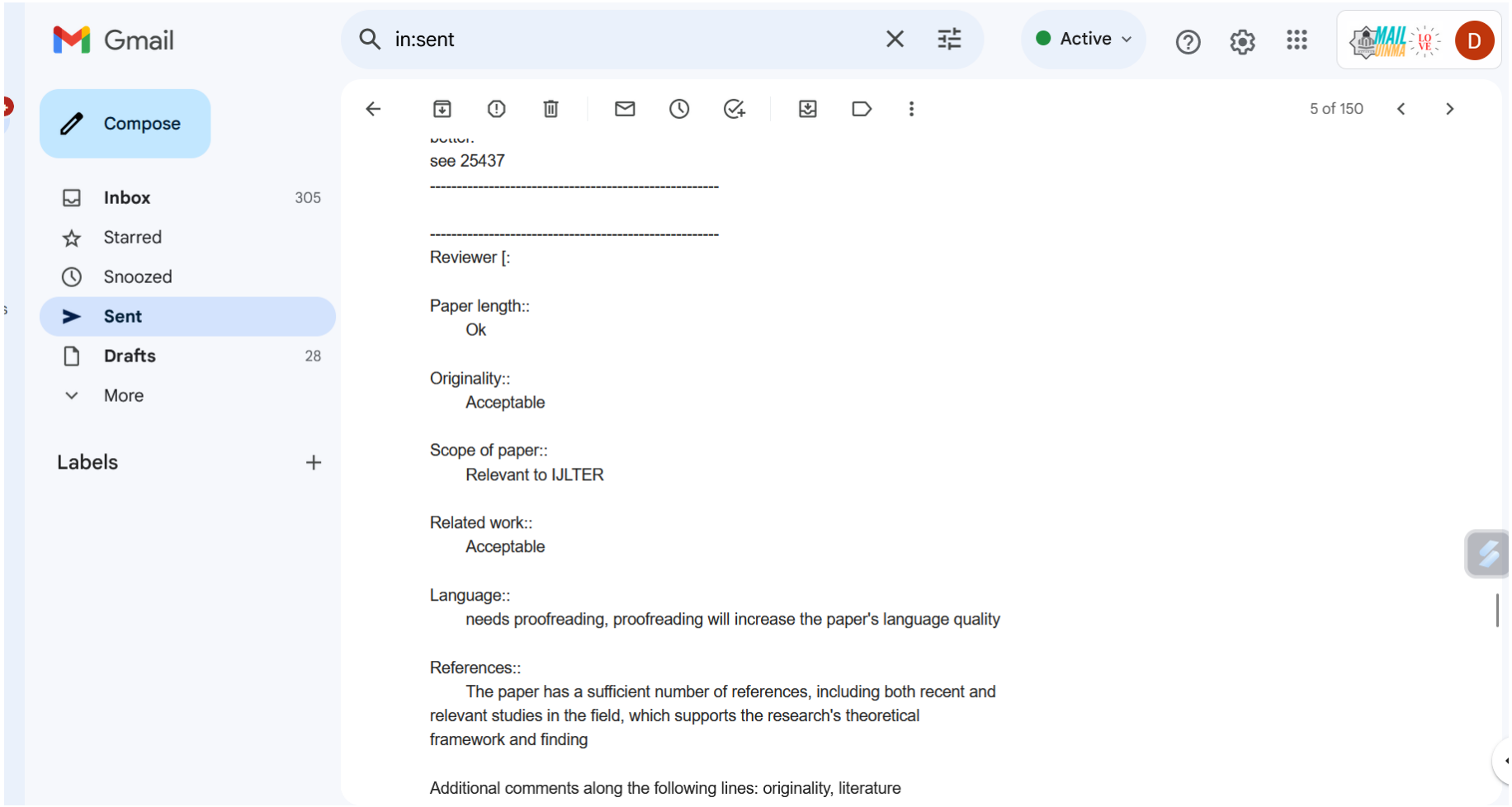
Reviewer W:
Paper length::
Ok
Originality::
Good
Scope of paper::
Highly relevant
Related work::
Acceptable
Language::
There is a need to grammarly check on data interpretation part to clearly express the findings and novelties of this study
References::
It is suggested to use Mendeley citation system on this paper
Additional comments along the following lines: originality, literature review, methodology, evaluation of results, research implications, quality of communication, etc.:


Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150

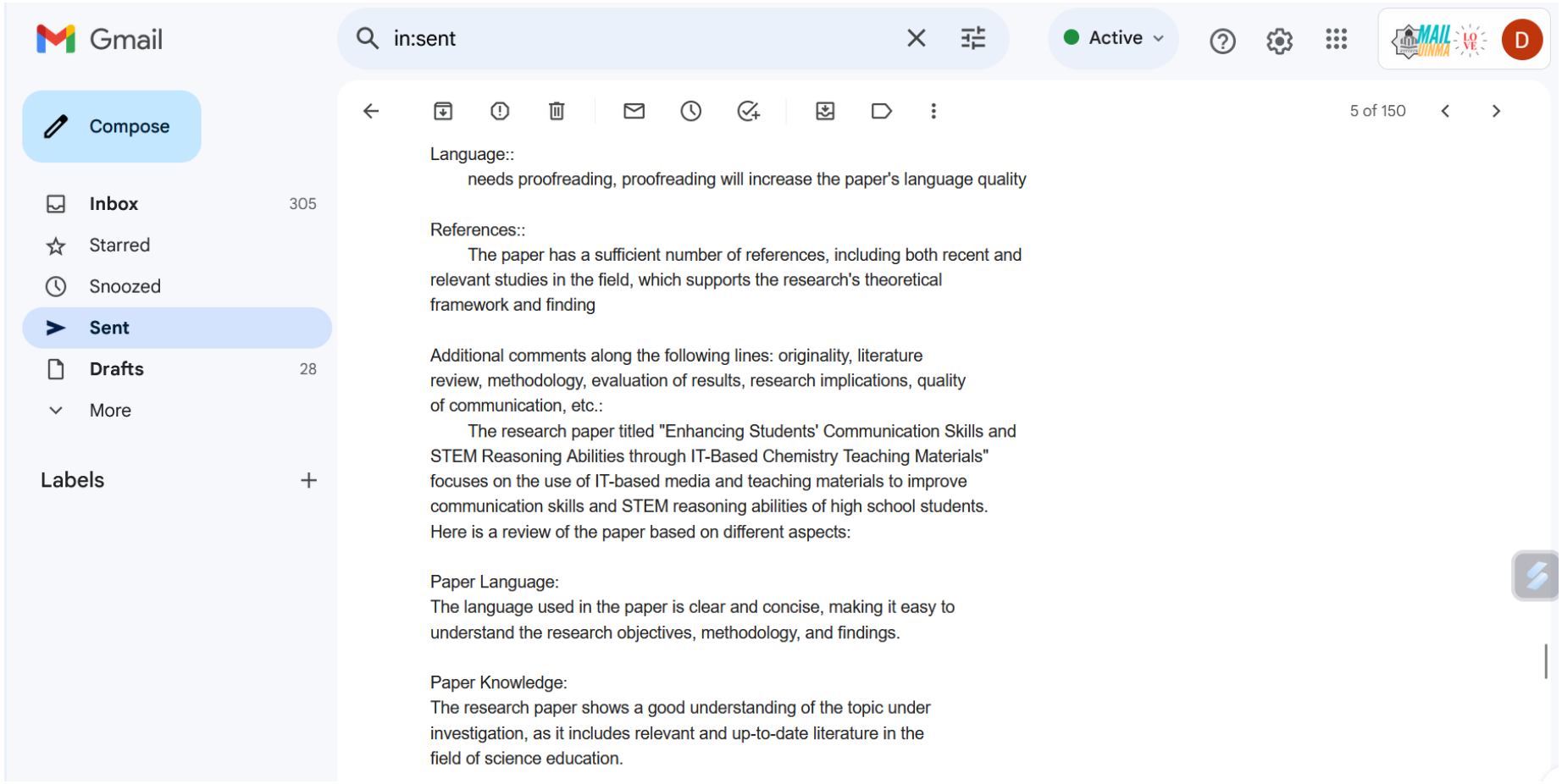
Reviewer X:
Paper length::
Originality::
Scope of paper::
Related work::
Language::
References::
Additional comments along the following lines: originality, literature review, methodology, evaluation of results, research implications, quality of communication, etc.:
see 25342

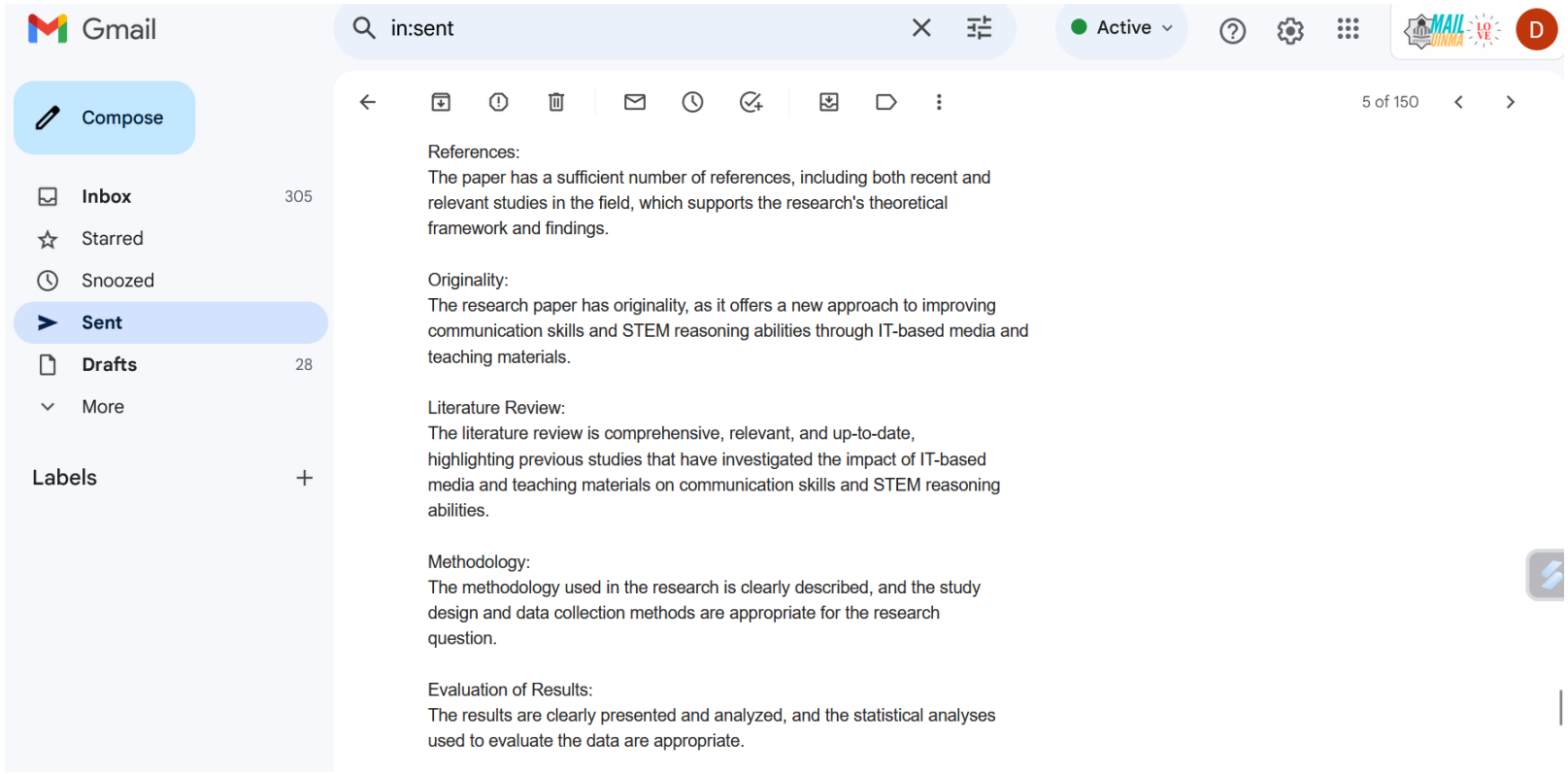
Reviewer Z:
Paper length::
Ok
Originality::
Good
Scope of paper::
Relevant to IJLTER

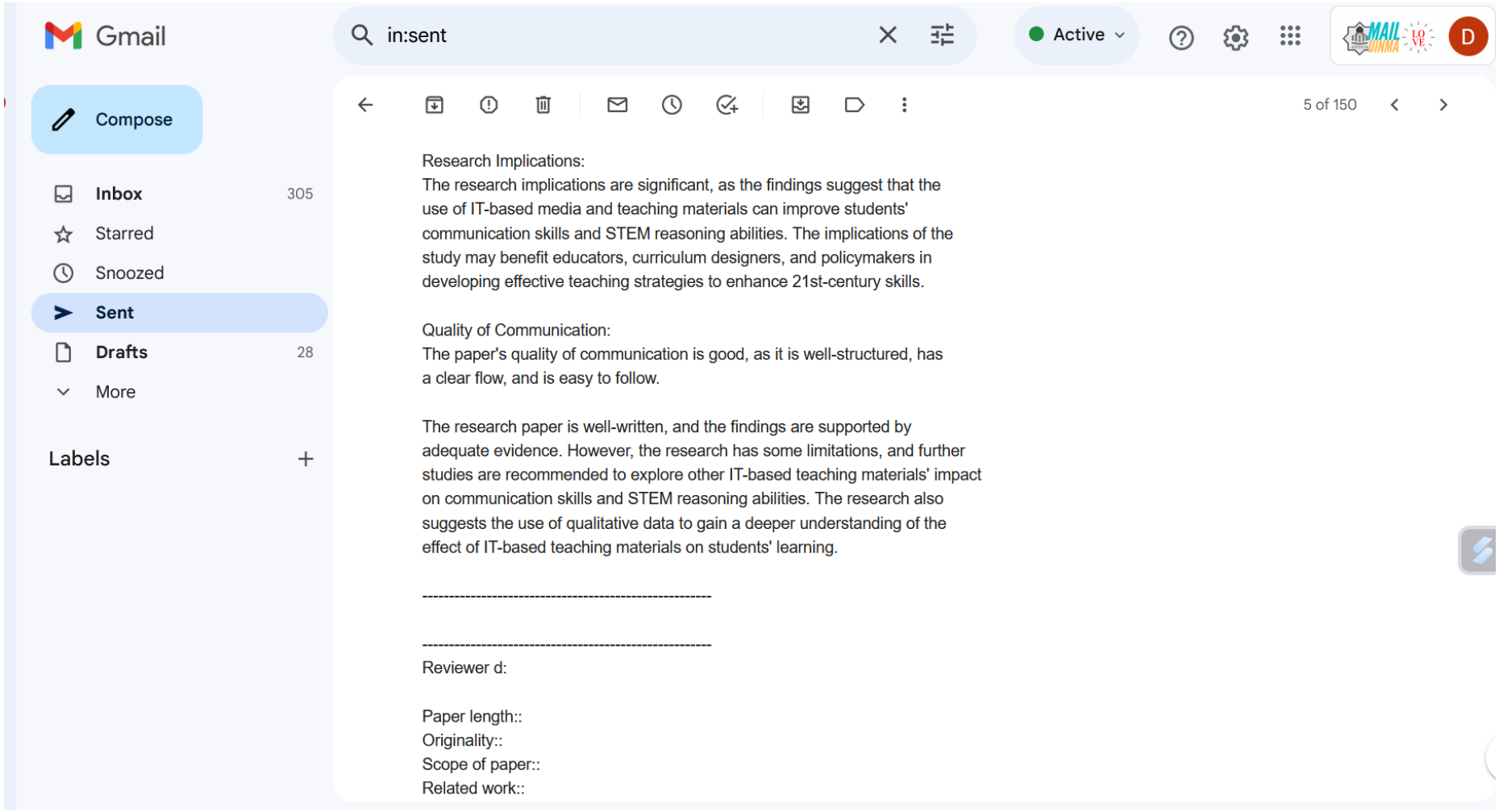

https://mail.google.com/mail/u/0/#sent/FMfcgzGsmNWvCFQFHQMBppHKLrvxKBKI
Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
Related work::
Acceptable
Language::
revision required: Examples:
*Introduction, paragraph 2, line 8: Chemistry learning, in particular, needs
...
No need for "in particular"
*Punctuation:
Introduction, paragraph 2, line 8:
developing their cognitive, affective and psychomotor aspects
Could be: ... affective, and .....
*Capitalization of initial letters:
integrated canva and bandicame applications
Canva and Bandicame
References::
OK
Additional comments along the following lines: originality, literature review, methodology, evaluation of results, research implications, quality of communication, etc.:
If it is possible to reduce citations similarity under 16%, it would better.
see 25437


Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
see 25437

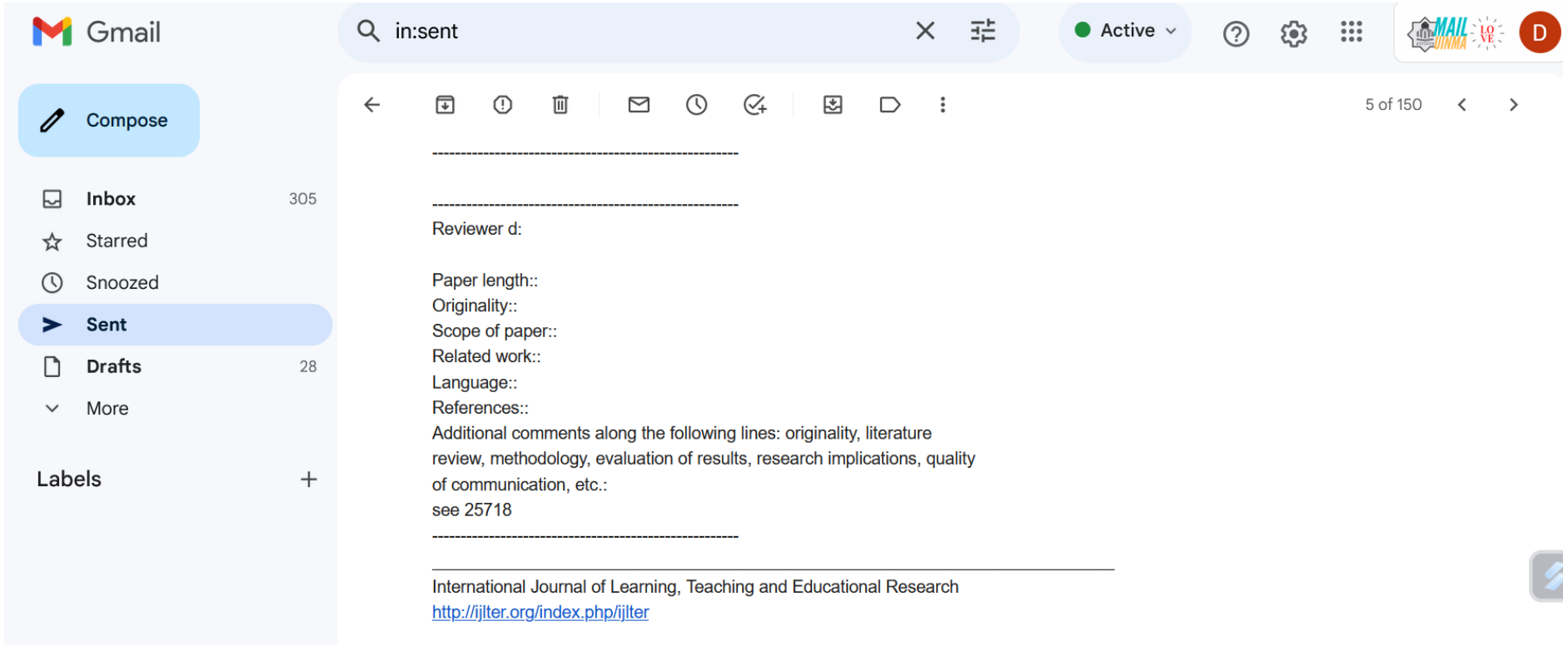
Reviewer [:
Paper length::
Ok
Originality::
Acceptable
Scope of paper::
Relevant to IJLTER
Related work::
Acceptable
Language::
needs proofreading, proofreading will increase the paper's language quality
References::
The paper has a sufficient number of references, including both recent and relevant studies in the field, which supports the research's theoretical framework and finding
Additional comments along the following lines: originality, literature


Gmail
in:sent
Active
D
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
Language::
needs proofreading, proofreading will increase the paper's language quality
References::
The paper has a sufficient number of references, including both recent and relevant studies in the field, which supports the research's theoretical framework and finding
Additional comments along the following lines: originality, literature review, methodology, evaluation of results, research implications, quality of communication, etc.:
The research paper titled "Enhancing Students' Communication Skills and STEM Reasoning Abilities through IT-Based Chemistry Teaching Materials" focuses on the use of IT-based media and teaching materials to improve communication skills and STEM reasoning abilities of high school students. Here is a review of the paper based on different aspects:
Paper Language:
The language used in the paper is clear and concise, making it easy to understand the research objectives, methodology, and findings.
Paper Knowledge:
The research paper shows a good understanding of the topic under investigation, as it includes relevant and up-to-date literature in the field of science education.


Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
References:
The paper has a sufficient number of references, including both recent and relevant studies in the field, which supports the research's theoretical framework and findings.
Originality:
The research paper has originality, as it offers a new approach to improving communication skills and STEM reasoning abilities through IT-based media and teaching materials.
Literature Review:
The literature review is comprehensive, relevant, and up-to-date, highlighting previous studies that have investigated the impact of IT-based media and teaching materials on communication skills and STEM reasoning abilities.
Methodology:
The methodology used in the research is clearly described, and the study design and data collection methods are appropriate for the research question.
Evaluation of Results:
The results are clearly presented and analyzed, and the statistical analyses used to evaluate the data are appropriate.

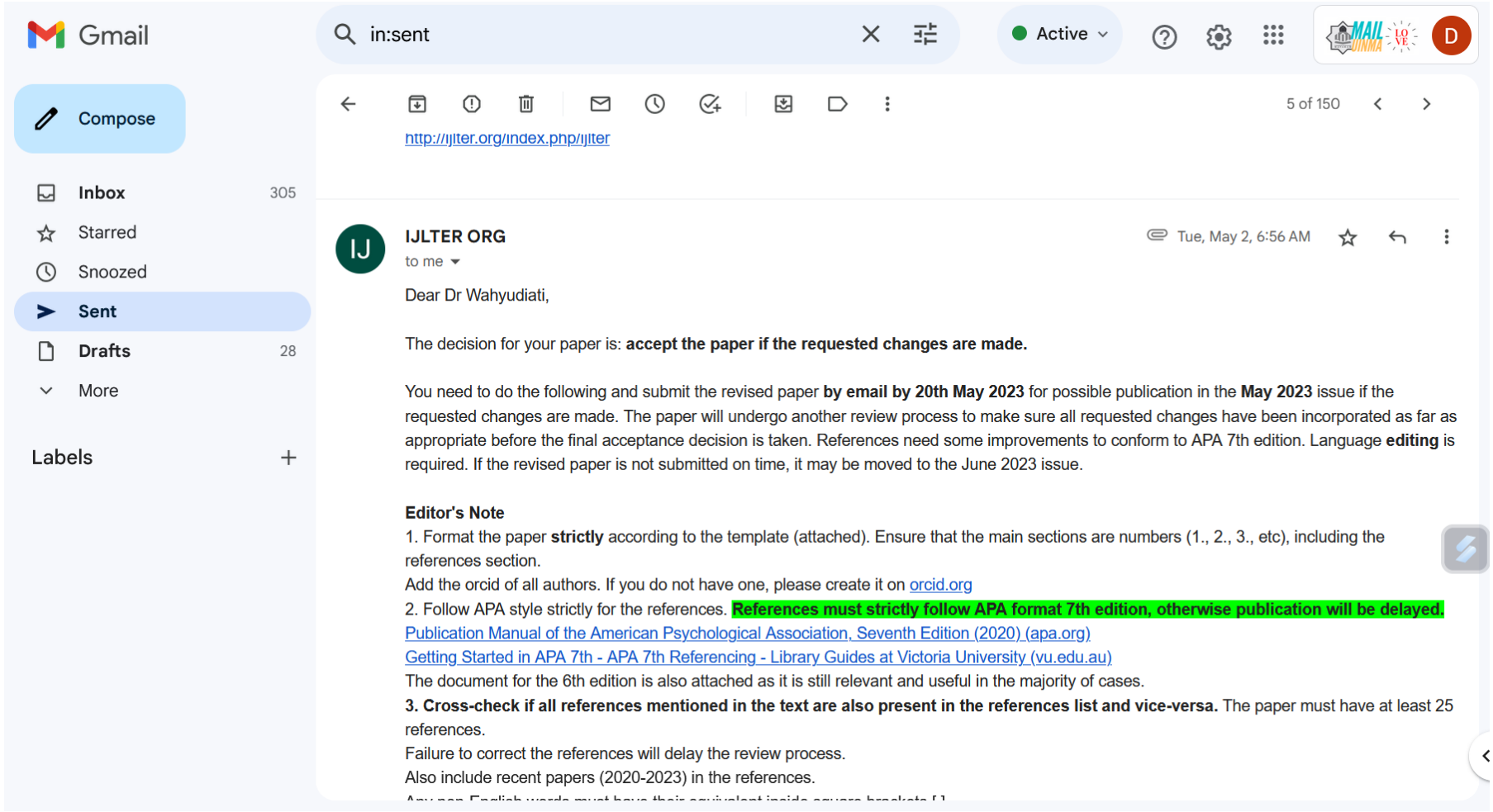

Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
Research Implications:
The research implications are significant, as the findings suggest that the use of IT-based media and teaching materials can improve students' communication skills and STEM reasoning abilities. The implications of the study may benefit educators, curriculum designers, and policymakers in developing effective teaching strategies to enhance 21st-century skills.
Quality of Communication:
The paper's quality of communication is good, as it is well-structured, has a clear flow, and is easy to follow.
The research paper is well-written, and the findings are supported by adequate evidence. However, the research has some limitations, and further studies are recommended to explore other IT-based teaching materials' impact on communication skills and STEM reasoning abilities. The research also suggests the use of qualitative data to gain a deeper understanding of the effect of IT-based teaching materials on students' learning.

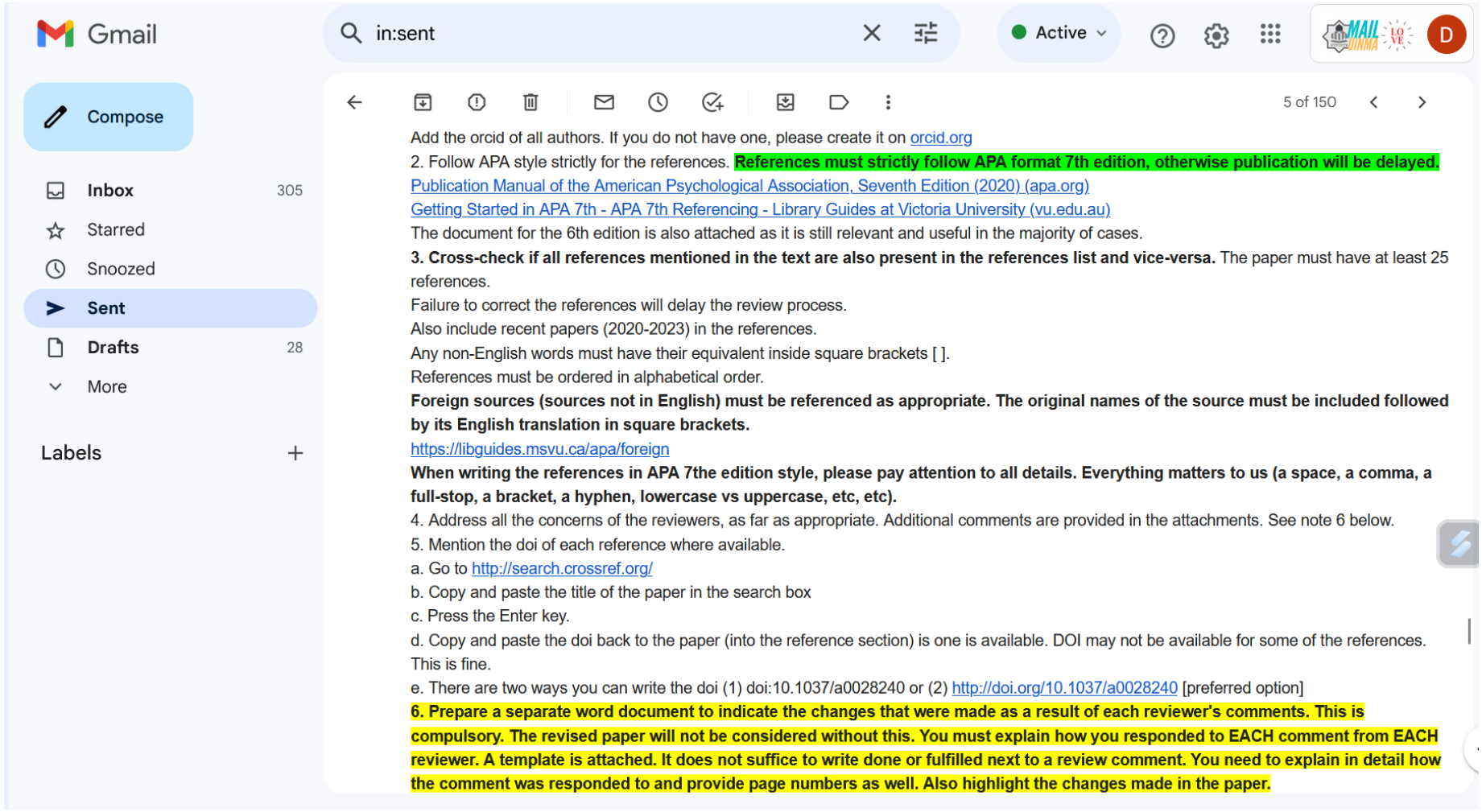
Reviewer d:
Paper length::
Originality::
Scope of paper::
Related work::

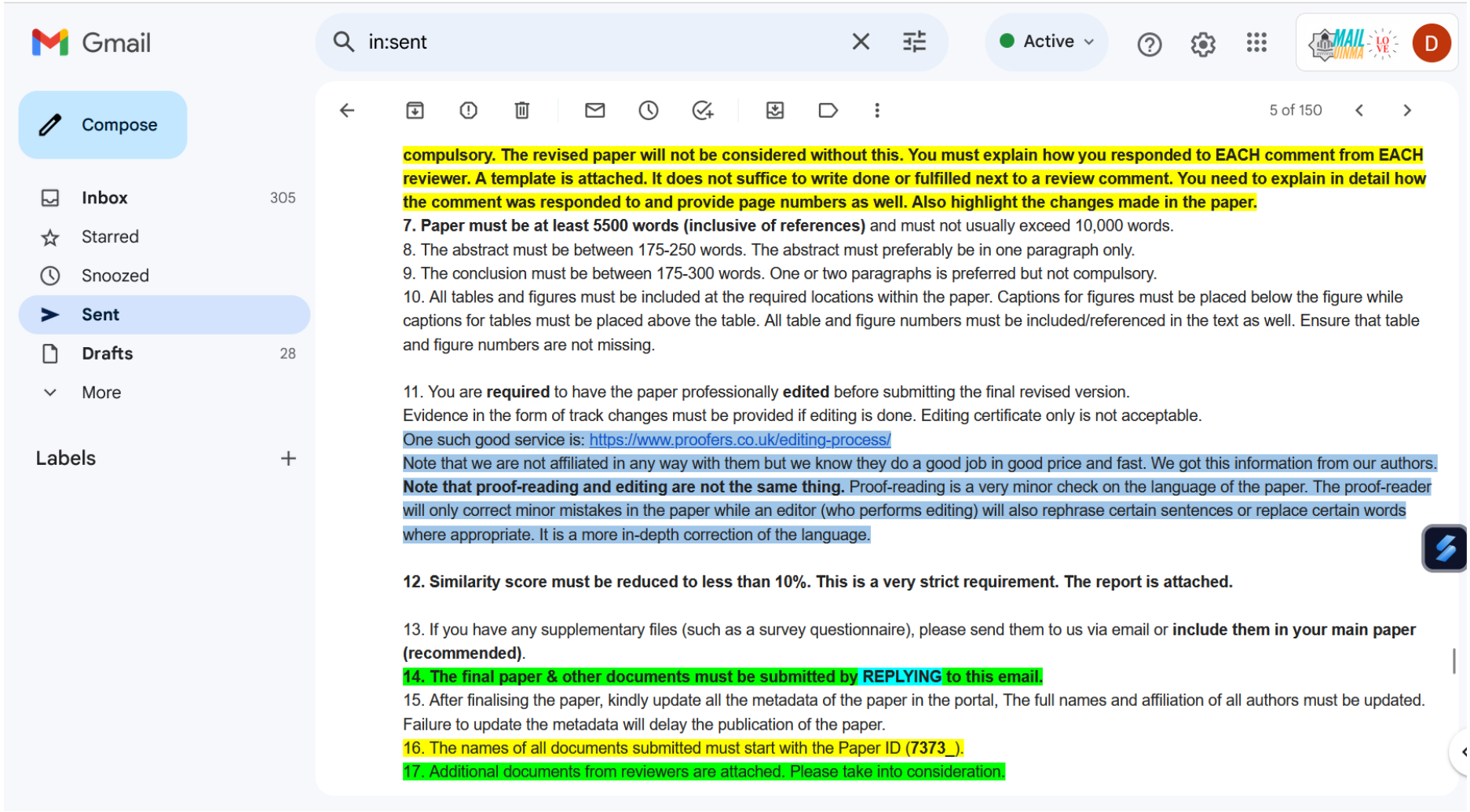


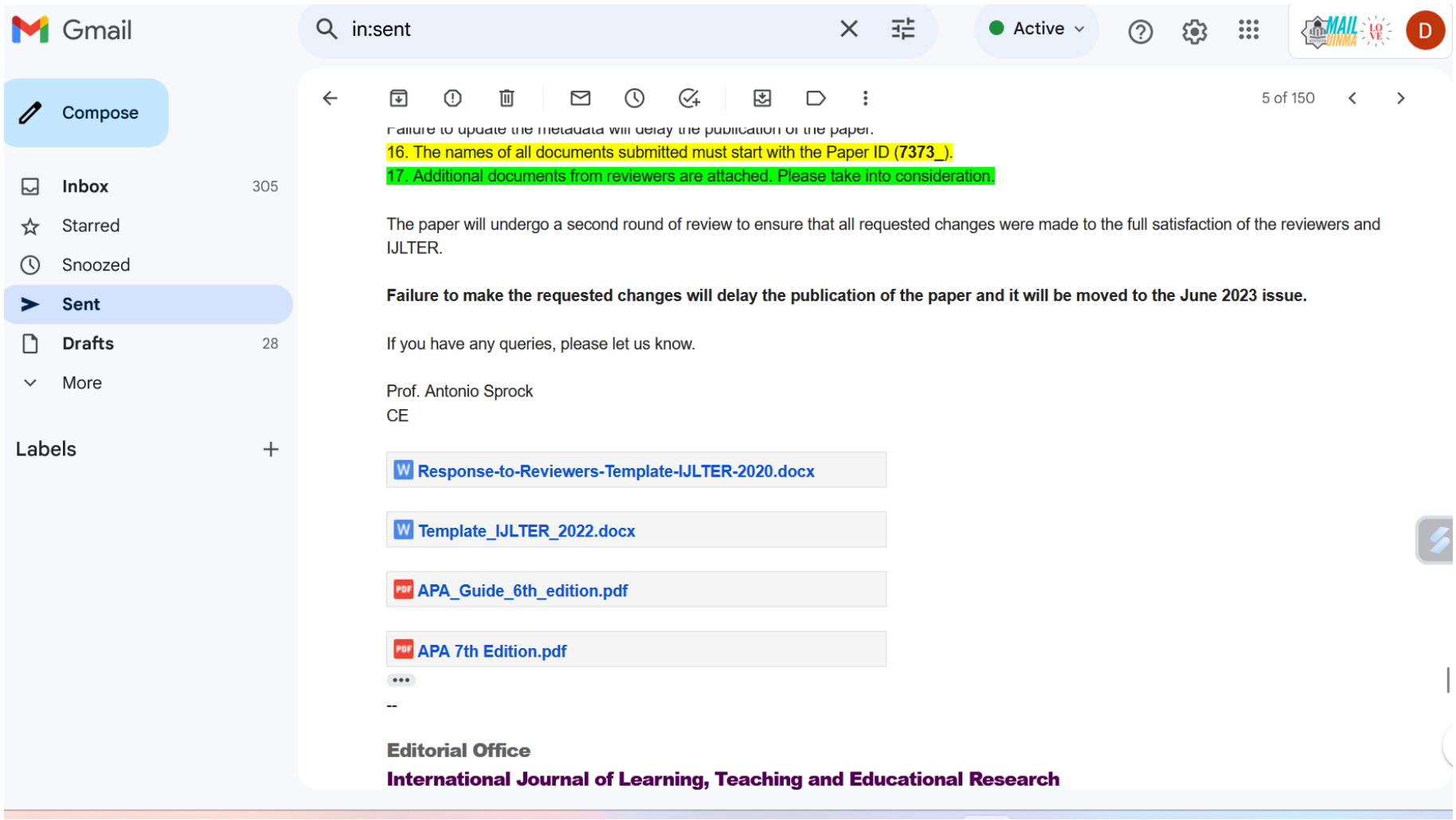
Reviewer d:

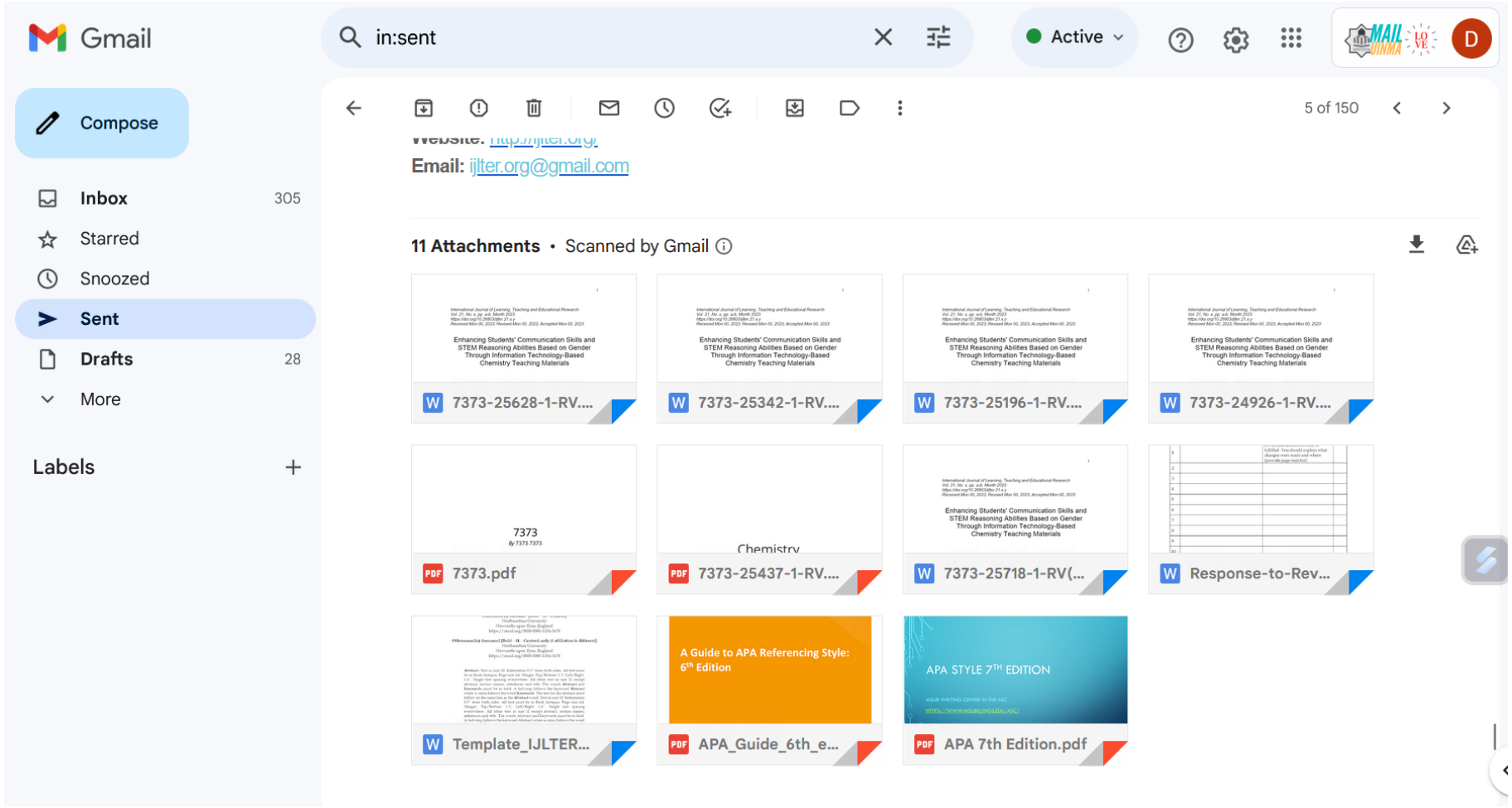
Paper length::
Originality::
Scope of paper::
Related work::
Language::
References::
Additional comments along the following lines: originality, literature review, methodology, evaluation of results, research implications, quality of communication, etc.:
see 25718

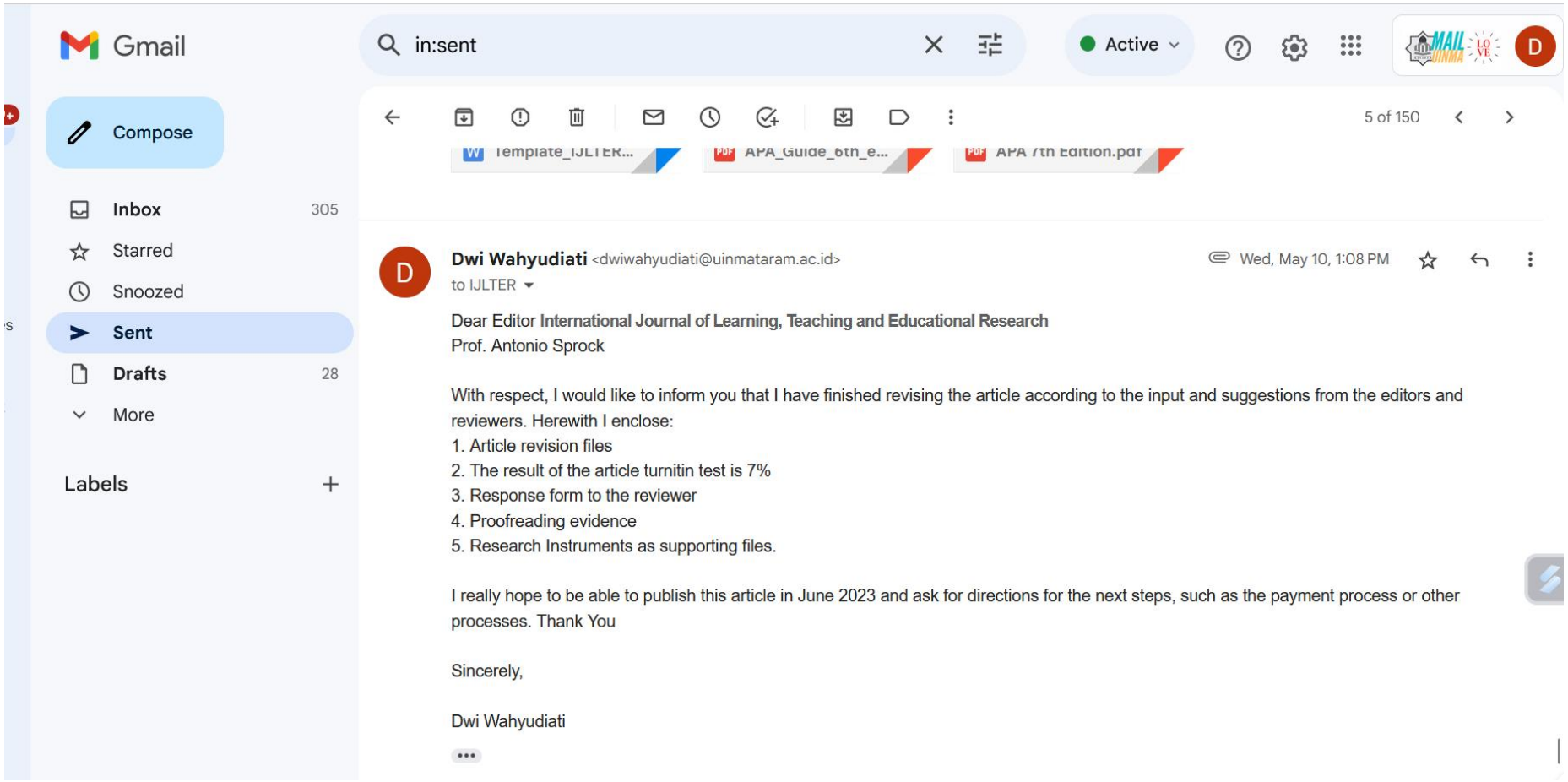

Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
http://ijlter.org/index.php/ijlter
IJ
IJLTER ORG
to me
Tue, May 2, 6:56 AM
Dear Dr Wahyudiati,
The decision for your paper is: accept the paper if the requested changes are made.
You need to do the following and submit the revised paper by email by 20th May 2023 for possible publication in the May 2023 issue if the requested changes are made. The paper will undergo another review process to make sure all requested changes have been incorporated as far as appropriate before the final acceptance decision is taken. References need some improvements to conform to APA 7th edition. Language editing is required. If the revised paper is not submitted on time, it may be moved to the June 2023 issue.
Editor's Note
1. Format the paper strictly according to the template (attached). Ensure that the main sections are numbers (1., 2., 3., etc), including the references section.
Add the orcid of all authors. If you do not have one, please create it on orcid.org
2. Follow APA style strictly for the references. References must strictly follow APA format 7th edition, otherwise publication will be delayed.
Publication Manual of the American Psychological Association, Seventh Edition (2020) (apa.org)
Getting Started in APA 7th - APA 7th Referencing - Library Guides at Victoria University (vu.edu.au)
The document for the 6th edition is also attached as it is still relevant and useful in the majority of cases.
3. Cross-check if all references mentioned in the text are also present in the references list and vice-versa. The paper must have at least 25 references.
Failure to correct the references will delay the review process.
Also include recent papers (2020-2023) in the references.

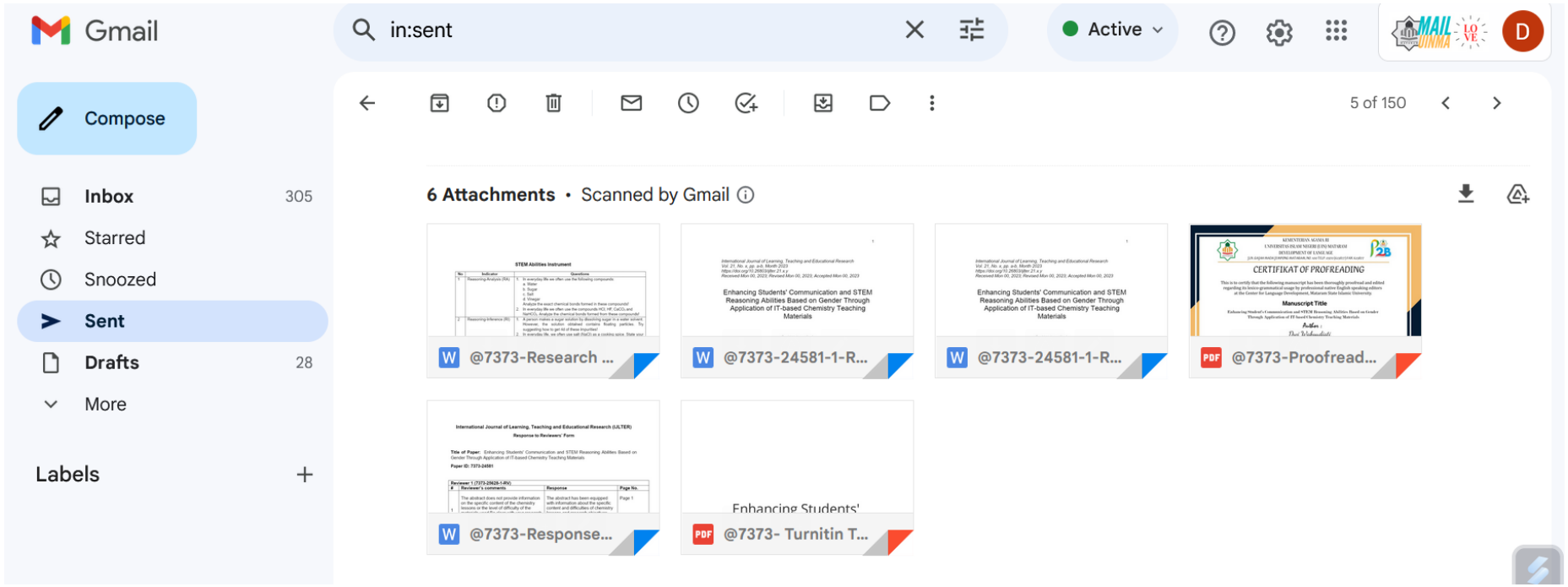

Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
Add the orcid of all authors. If you do not have one, please create it on orcid.org
2. Follow APA style strictly for the references. References must strictly follow APA format 7th edition, otherwise publication will be delayed.
Publication Manual of the American Psychological Association, Seventh Edition (2020) (apa.org)
Getting Started in APA 7th - APA 7th Referencing - Library Guides at Victoria University (vu.edu.au)
The document for the 6th edition is also attached as it is still relevant and useful in the majority of cases.
3. Cross-check if all references mentioned in the text are also present in the references list and vice-versa. The paper must have at least 25 references.
Failure to correct the references will delay the review process.
Also include recent papers (2020-2023) in the references.
Any non-English words must have their equivalent inside square brackets [ ].
References must be ordered in alphabetical order.
Foreign sources (sources not in English) must be referenced as appropriate. The original names of the source must be included followed by its English translation in square brackets.
https://libguides.msvu.ca/apa/foreign
When writing the references in APA 7the edition style, please pay attention to all details. Everything matters to us (a space, a comma, a full-stop, a bracket, a hyphen, lowercase vs uppercase, etc, etc).
4. Address all the concerns of the reviewers, as far as appropriate. Additional comments are provided in the attachments. See note 6 below.
5. Mention the doi of each reference where available.
a. Go to http://search.crossref.org/
b. Copy and paste the title of the paper in the search box
c. Press the Enter key.
d. Copy and paste the doi back to the paper (into the reference section) is one is available. DOI may not be available for some of the references. This is fine.
e. There are two ways you can write the doi (1) doi:10.1037/a0028240 or (2) http://doi.org/10.1037/a0028240 [preferred option]
6. Prepare a separate word document to indicate the changes that were made as a result of each reviewer's comments. This is compulsory. The revised paper will not be considered without this. You must explain how you responded to EACH comment from EACH reviewer. A template is attached. It does not suffice to write done or fulfilled next to a review comment. You need to explain in detail how the comment was responded to and provide page numbers as well. Also highlight the changes made in the paper.

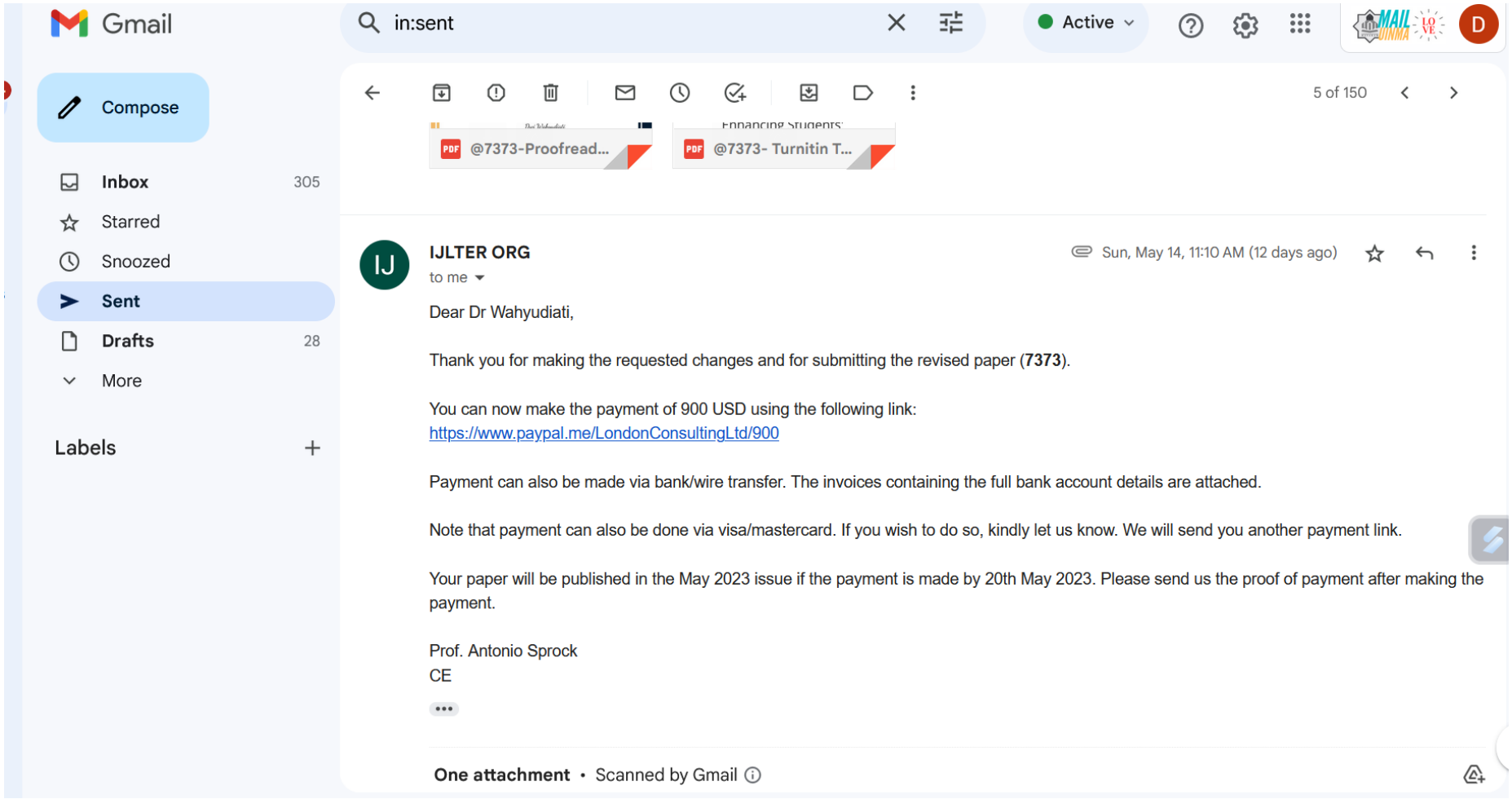

Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
compulsory. The revised paper will not be considered without this. You must explain how you responded to EACH comment from EACH reviewer. A template is attached. It does not suffice to write done or fulfilled next to a review comment. You need to explain in detail how the comment was responded to and provide page numbers as well. Also highlight the changes made in the paper.
7. Paper must be at least 5500 words (inclusive of references) and must not usually exceed 10,000 words.
8. The abstract must be between 175-250 words. The abstract must preferably be in one paragraph only.
9. The conclusion must be between 175-300 words. One or two paragraphs is preferred but not compulsory.
10. All tables and figures must be included at the required locations within the paper. Captions for figures must be placed below the figure while captions for tables must be placed above the table. All table and figure numbers must be included/referenced in the text as well. Ensure that table and figure numbers are not missing.
11. You are required to have the paper professionally edited before submitting the final revised version.
Evidence in the form of track changes must be provided if editing is done. Editing certificate only is not acceptable.
One such good service is: https://www.proofers.co.uk/editing-process/
Note that we are not affiliated in any way with them but we know they do a good job in good price and fast. We got this information from our authors.
Note that proof-reading and editing are not the same thing. Proof-reading is a very minor check on the language of the paper. The proof-reader will only correct minor mistakes in the paper while an editor (who performs editing) will also rephrase certain sentences or replace certain words where appropriate. It is a more in-depth correction of the language.
12. Similarity score must be reduced to less than 10%. This is a very strict requirement. The report is attached.
13. If you have any supplementary files (such as a survey questionnaire), please send them to us via email or include them in your main paper (recommended).
14. The final paper & other documents must be submitted by REPLYING to this email.
15. After finalising the paper, kindly update all the metadata of the paper in the portal, The full names and affiliation of all authors must be updated. Failure to update the metadata will delay the publication of the paper.
16. The names of all documents submitted must start with the Paper ID (7373_).
17. Additional documents from reviewers are attached. Please take into consideration.

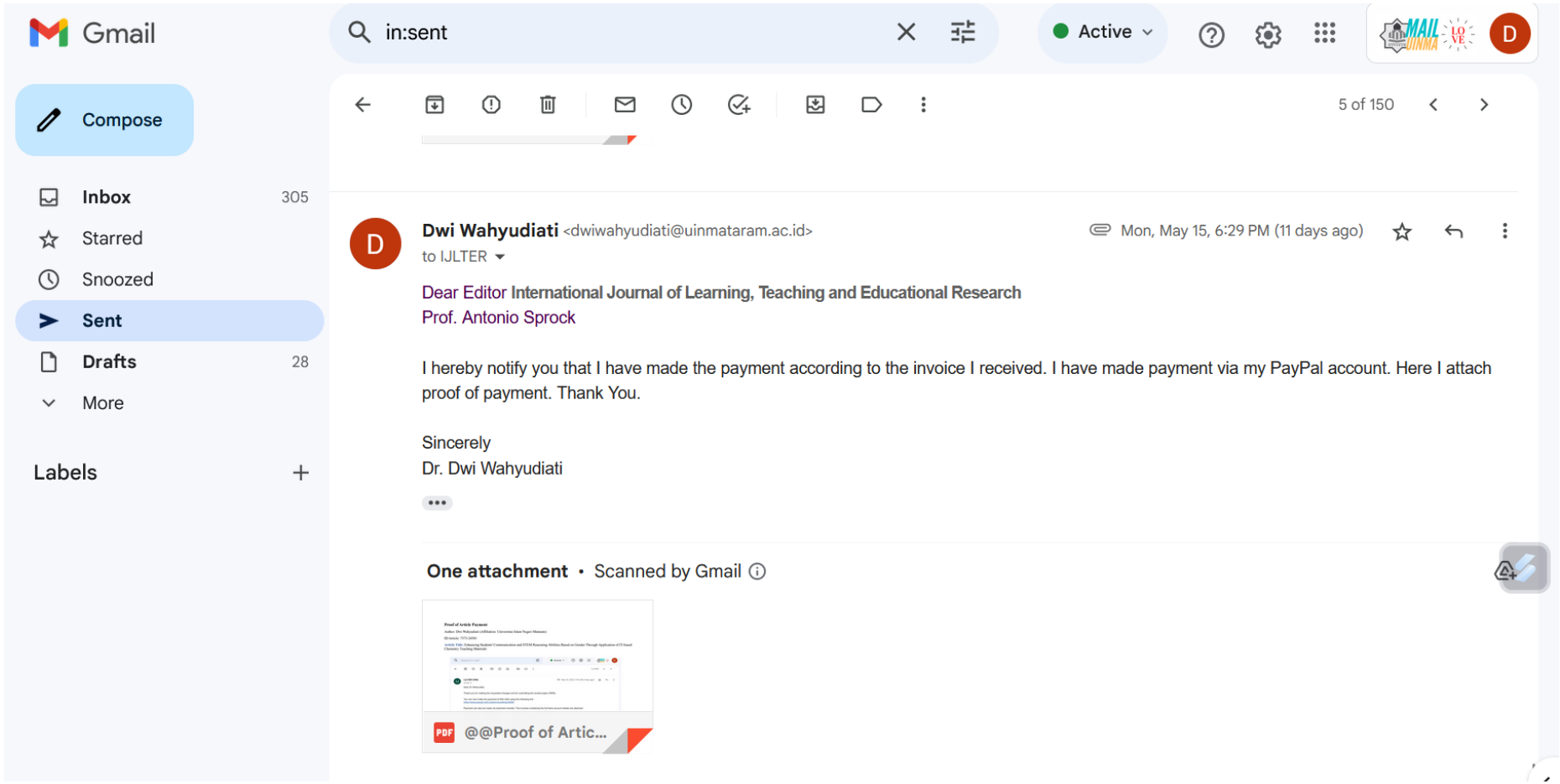

Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
16. The names of all documents submitted must start with the Paper ID (7373_).
17. Additional documents from reviewers are attached. Please take into consideration.
The paper will undergo a second round of review to ensure that all requested changes were made to the full satisfaction of the reviewers and IJLTER.
Failure to make the requested changes will delay the publication of the paper and it will be moved to the June 2023 issue.
If you have any queries, please let us know.
Prof. Antonio Sprock
CE
Response-to-Reviewers-Template-IJLTER-2020.docx
Template_IJLTER_2022.docx
APA_Guide_6th_edition.pdf
APA 7th Edition.pdf
--
Editorial Office
International Journal of Learning, Teaching and Educational Research

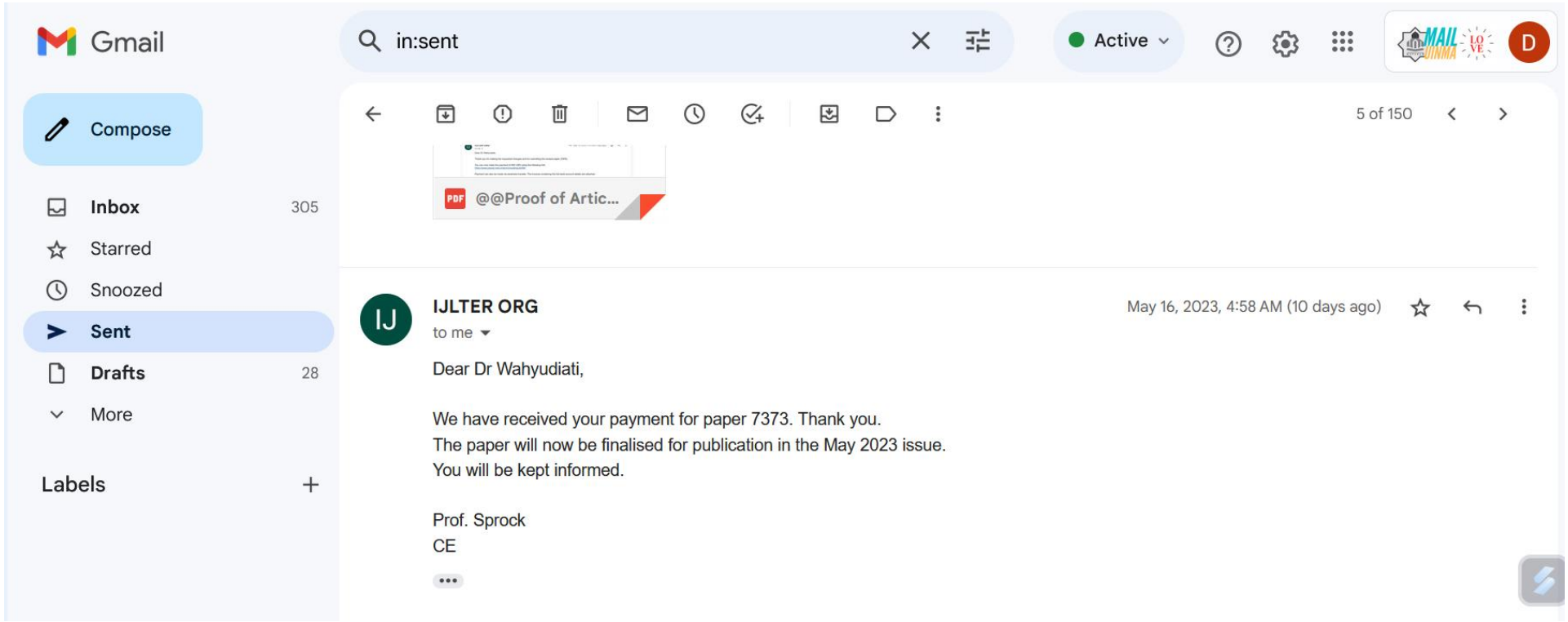

Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
Email: ijlter.org@gmail.com
11 Attachments • Scanned by Gmail
7373-25628-1-RV....
7373-25342-1-RV....
7373-25196-1-RV....
7373-24926-1-RV....
7373.pdf
7373-25437-1-RV....
7373-25718-1-RV(...
Response-to-Rev...
Template_IJLTER...
A Guide to APA Referencing Style: 6th Edition
APA_Guide_6th_e...
APA STYLE 7TH EDITION
APA 7th Edition.pdf

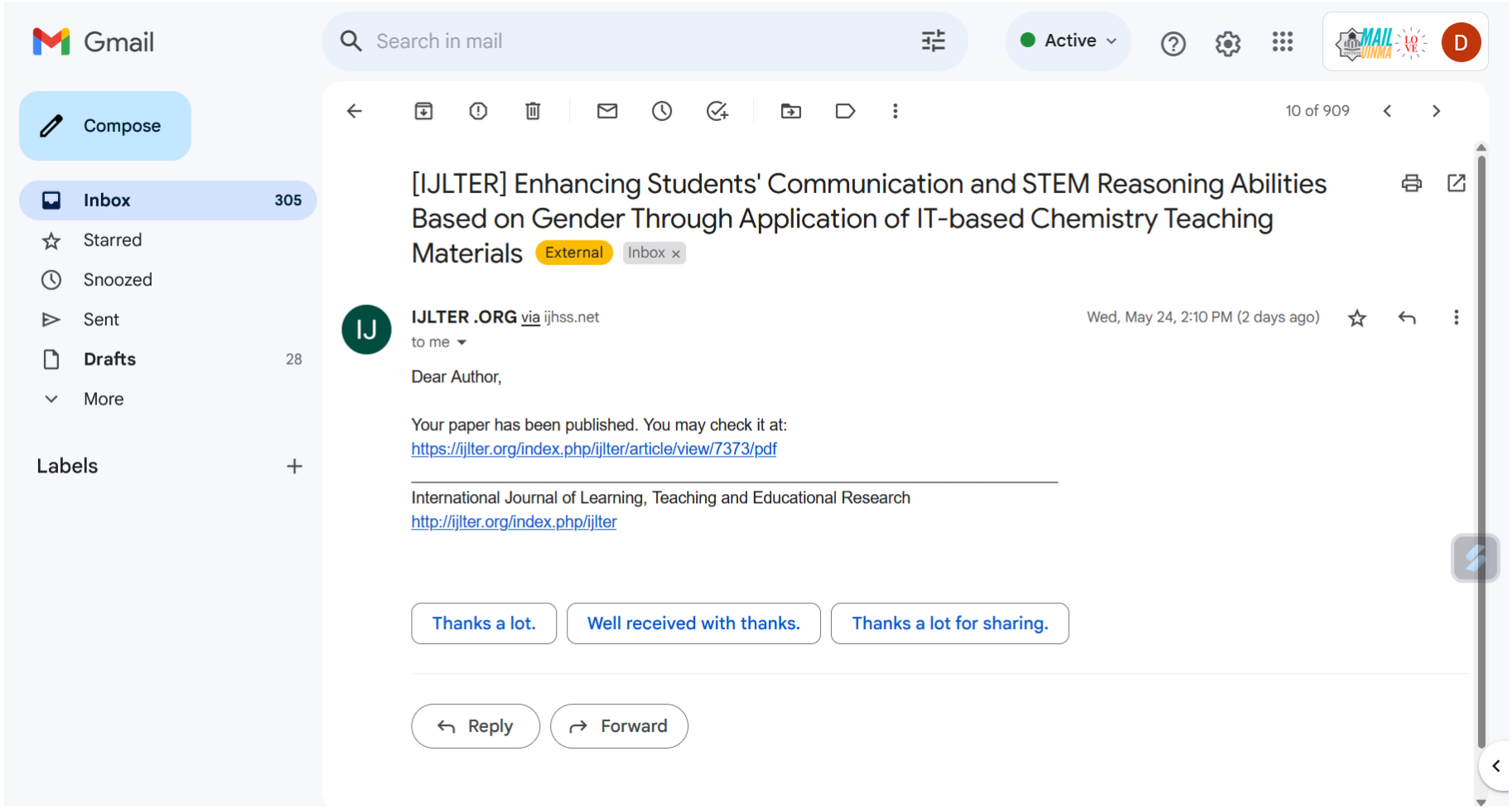

Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
Template_IJLTER...
APA_Guide_6th_e...
APA 7th Edition.pdf
Dwi Wahyudiati <dwiwahyudiati@uinmataram.ac.id>
to IJLTER
Wed, May 10, 1:08 PM
Dear Editor International Journal of Learning, Teaching and Educational Research
Prof. Antonio Sprock
With respect, I would like to inform you that I have finished revising the article according to the input and suggestions from the editors and reviewers. Herewith I enclose:
1. Article revision files
2. The result of the article turnitin test is 7%
3. Response form to the reviewer
4. Proofreading evidence
5. Research Instruments as supporting files.
I really hope to be able to publish this article in June 2023 and ask for directions for the next steps, such as the payment process or other processes. Thank You
Sincerely,
Dwi Wahyudiati


Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
6 Attachments • Scanned by Gmail
@7373-Research ...
@7373-24581-1-R...
@7373-24581-1-R...
@7373-Proofread...
@7373-Response...
@7373- Turnitin T...


Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
@7373-Proofread...
@7373- Turnitin T...
IJ
IJLTER ORG
to me
Sun, May 14, 11:10 AM (12 days ago)
Dear Dr Wahyudiati,
Thank you for making the requested changes and for submitting the revised paper (7373).
You can now make the payment of 900 USD using the following link:
https://www.paypal.me/LondonConsultingLtd/900
Payment can also be made via bank/wire transfer. The invoices containing the full bank account details are attached.
Note that payment can also be done via visa/mastercard. If you wish to do so, kindly let us know. We will send you another payment link.
Your paper will be published in the May 2023 issue if the payment is made by 20th May 2023. Please send us the proof of payment after making the payment.
Prof. Antonio Sprock
CE
One attachment • Scanned by Gmail


Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
Dwi Wahyudiati <dwiwahyudiati@uinmataram.ac.id>
to IJLTER
Mon, May 15, 6:29 PM (11 days ago)
Dear Editor International Journal of Learning, Teaching and Educational Research
Prof. Antonio Sprock
I hereby notify you that I have made the payment according to the invoice I received. I have made payment via my PayPal account. Here I attach proof of payment. Thank You.
Sincerely
Dr. Dwi Wahyudiati
One attachment • Scanned by Gmail
@@Proof of Artic...


Gmail
in:sent
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
5 of 150
@@Proof of Artic...
IJ
IJLTER ORG
to me
May 16, 2023, 4:58 AM (10 days ago)
Dear Dr Wahyudiati,
We have received your payment for paper 7373. Thank you.
The paper will now be finalised for publication in the May 2023 issue.
You will be kept informed.
Prof. Sprock
CE


Gmail
Search in mail
Active
Compose
Inbox 305
Starred
Snoozed
Sent
Drafts 28
More
Labels
10 of 909
[IJLTER] Enhancing Students' Communication and STEM Reasoning Abilities Based on Gender Through Application of IT-based Chemistry Teaching Materials
External
Inbox ×
IJ
IJLTER .ORG via ijhss.net
to me
Wed, May 24, 2:10 PM (2 days ago)
Dear Author,
Your paper has been published. You may check it at:
https://ijlter.org/index.php/ijlter/article/view/7373/pdf
International Journal of Learning, Teaching and Educational Research
http://ijlter.org/index.php/ijlter
Thanks a lot.
Well received with thanks.
Thanks a lot for sharing.
Reply
Forward

International Journal of Learning, Teaching and Educational Research (IJLTER)

Response to Reviewers' Form

Title of Paper: Enhancing Students' Communication and STEM Reasoning Abilities Based on Gender Through Application of IT-based Chemistry Teaching Materials

Paper ID: 7373-24581

Reviewer 1 (7373-25628-1-RV)			
#	**Reviewer's comments**	**Response**	**Page No.**
1	The abstract does not provide information on the specific content of the chemistry lessons or the level of difficulty of the materials used Be clear with your research purposes or goals to show the significant requirements of doing this study	The abstract has been equipped with information about the specific content and difficulties of chemistry lessons and research objectives according to the reviewer's suggestions.	Page 1
2	1. The background section of the research based on the abstract provided should provide a brief overview of the current state of chemistry education, including the challenges faced by instructors in delivering effective chemistry lessons, such as the lack of IT-based teaching materials. It should also highlight the importance of developing students' communication skills and STEM reasoning abilities in chemistry education. 2. The background should then discuss the potential of digital technology to enhance teaching and learning, including the use of bandicam and canva applications. It should also describe the advantages of using Google Classroom platform for delivering IT-based teaching materials in both e-learning and face-to-face learning environments.	1. The background section is equipped with chemistry problems such as the lack of IT-based teaching materials and the importance of developing students' communication skills and STEM reasoning abilities in chemistry education according to the reviewer's suggestions. 2. The background section is equipped with an explanation regarding the advantages of using the Google Classroom platform to deliver IT-based teaching materials both in e-learning and face-to-face learning environments.	Page 2 paragraph 1 & Page 3 paragraph 2 Page 3 paragraph 1 &2
3	In the literature review section, you must be comprehensively drawn the previous studies that are relevant to the research question and objectives of the study should be discussed. In the case of the research mentioned in the abstract, the	1. The focus of this research is to improve students' communication skills and STEM abilities through the application of IT-based chemistry teaching materials so that the theoretical review of learning outcomes is not explained because it is not	

	literature review should cover the following topics: 1. The use of IT-based teaching materials in chemistry education and their impact on student learning outcomes. 2. The use of digital technologies such as bandicam and canva applications in education and their effectiveness in enhancing student communication skills and STEM reasoning abilities. 3. The use of the Google Classroom platform in delivering IT-based teaching materials and its effectiveness in enhancing student learning outcomes. 4. The literature related to gender differences in communication skills and STEM reasoning abilities and their impact on student performance in chemistry education. The literature review should include both theoretical and empirical studies that are relevant to the research question and provide a comprehensive overview of the existing literature on the topic. The review should also highlight the gaps and limitations in the existing literature and explain how the present study will address these gaps and contribute to the field.	relevant to the research objectives. 2. Researchers have explained the use of digital technology such as the Bandicam and Canva applications in education and their effectiveness in improving students' communication skills and STEM reasoning abilities according to the reviewer's suggestions in the literature review section. 3. The focus of this research is to improve students' communication skills and STEM abilities through the application of IT-based chemistry teaching materials so that the theoretical review of learning outcomes is not explained because it is not relevant to the research objectives. 4. The researcher has explained in the literature review regarding gender differences in communication skills and STEM reasoning abilities and their influence on student performance in chemistry education according to the reviewer's suggestions.	Page 4 paragraph 1-3 Page 5 paragraph 1-2
4	In this method part, the researcher must also show the ethical considerations. Why? Because Ethical considerations are an important part of any research study, and researchers should follow relevant guidelines and regulations to ensure that the study is conducted in an ethical manner. Here are some pieces of advice, for the researcher of this study, regarding ethical considerations: • Obtain informed consent: Researchers should obtain informed consent from participants, explaining the nature	The implementation of this research has obtained permission from the school that became the research location as a condition for fulfilling the research code of ethics (permission number: 20/Ma.19.02/PP.00.6/2022).	Page 6 paragraph 1

	of the study, the potential risks and benefits, and the rights of the participants. Participants should be given the opportunity to ask questions and to withdraw from the study at any time. • Protect participant confidentiality: Researchers should take steps to protect the confidentiality of participants' data, such as using participant codes instead of names and storing data securely. • Minimize harm or discomfort: Researchers should take steps to minimize harm or discomfort to participants, such as ensuring that the study procedures are not physically or emotionally harmful and offering support services if needed. • Obtain ethical approval: Researchers should obtain ethical approval from relevant institutional review boards or ethics committees before starting the study. • Report ethical considerations: Researchers should report the ethical considerations in their research, including the measures taken to ensure informed consent, confidentiality, and participant well-being. Therefore, researchers should prioritize the ethical considerations of this study here and take steps to ensure that this study is conducted in an ethical and responsible manner. This not only protects the rights and well-being of participants but also ensures the validity and reliability of the research findings.		
5	In this part (Results and Discussions), the researcher should consistently formulate the findings as stated in the abstract part above as follows: 1. Students' communication skills and STEM reasoning abilities may be enhanced through the application of GC-integrated IT-based chemistry teaching materials.	1. Researchers have explained in the discussion section that students' STEM communication and reasoning abilities can be improved through the application of IT-based chemistry teaching materials that are integrated with GC. 2. The researcher explained in the discussion section that there	Page 15 & 16 paragraph 1-2

	2. Significant differences existed in the students' communication skills based on gender, with the highest increase identified on the WCS indicator for females and the SCS indicator for males. 3. Significant differences were identified in students' STEM reasoning abilities based on gender, with the highest increase on the RI indicator for females, followed by the RD indicator for males, and RA for females.	were significant differences in students' communication skills based on gender, with the highest increase in the WCS indicator for women and the SCS indicator for men. 3. Researchers have explained in the discussion section regarding the existence of significant differences in students' STEM reasoning abilities based on gender, with the highest increase in the RI indicator for women, followed by the RD indicator for men, and RA for women.	Page 15 paragraph 2 Page 16 paragraph 2
6	Restructurized the result and discussion to be separated to each other. Please focus more on the discussion part. In the discussion section of this study, the research findings should be interpreted and explained in detail. The discussion should cover how the results align with the existing literature and previous research, what the implications are, and what recommendations can be made based on the findings. Specifically, the discussion should address how the IT-based teaching materials using Canva and Bandicam, integrated with the Google Classroom platform, effectively enhanced students' communication skills and STEM reasoning abilities. The discussion should also highlight the significant differences in students' communication skills and STEM reasoning abilities based on gender, and what possible explanations for these differences could be. Additionally, the discussion should touch on the limitations of the study and suggest directions for future research.	The results and discussion have been separated according to the reviewer's suggestions. The discussion is accompanied by an explanation of the limitations of the research that has been conducted.	Page 9 & Page 15 Page 18
7	This two different parts should be kept separation. It is recommended to separate the conclusion and limitation sections in a research paper. The conclusion should summarize the main findings of the study and provide recommendations based on those findings, while the limitation section should discuss any shortcomings or weaknesses of the study and suggest areas	The conclusion and research limitations sections have been separated and arranged according to the reviewer's suggestions.	Page 18

	for future research. By separating the two sections, it allows for a clearer and more organized presentation of the research findings and their implications, as well as acknowledging the study's limitations and providing opportunities for further exploration.		
8	It is suggested to use Mendeley citation system to this paper for helping readers to generate the perspectives of this study.	Writing references already refers to the APA style.	Page 18

Reviewer 2 (7373-25342-1-RV)			
#	**Reviewer's comments**	**Response**	**Page No.**
1	Please ensure that, before resubmission, a person proficient in written English edits the manuscript. It is important that the message being conveyed in the manuscript is as unambiguous as possible (Article title).	The title of the article has been revised according to the reviewer's suggestions and has been checked by an English language expert.	Page 1
2	Please upload as a separate supplementary file the questionnaire(s) used in this study and please confirm in the Methods whether the questionnaires used in this study are validated, and if so, include the appropriate citation.	1. As for before being used, the two instruments were validated by four experts (2 experts with Ph.D. degrees and 2 experts with MEd degrees). 2. The questionnaire used was uploaded in this study as an additional file separate from the article.	Page 8 paragraph 2 Attachment to the article.
3	Also, please confirm in the main document whether ethics approval to conduct this study was obtained or this requirement was waived by an Institutional Review Board (IRB)/Independent Ethics Committee (IEC). Also, please include the ethics approval/waiver number, if applicable.	The implementation of this research has obtained permission from the school that became the research location as a condition for fulfilling the research code of ethics (permission number: 20/Ma.19.02/PP.00.6/2022).	Page 6 paragraph 1
4	Please provide the previous study that suggest similar sample size with your research (participant)	The reference for determining the number of samples in this study is in accordance with previous research that was carried out using 50 samples consisting of 25 people for the experimental class and 25 people for the control class (Wahyudiati, et al., 2022).	Page 6 paragraph 2
5	Inclusion and exclusion criteria? **Demographic samples**	Table 2 is the inclusion criteria, namely the sample criteria that the researcher wants based on the research objectives.	Page 6

6	Refernces? Table 3	References have been added according to reviewer suggestions (Iksan, et al., 2011).	Page 7
7	Refernces? **Table 4**	References have been added according to reviewer suggestions (Iksan, et al., 2011).	Page 7
8	Refernces? Table 5	References have been added according to reviewer suggestions (Verawati, et al., 2022).	Page 8
9	Results & Discussion Separate for results and discussion.	The results and discussion have been separated according to the reviewer's suggestions.	Page 9 & Page 15
10	The discussion has accommodated the results, but you need to add an explanation about the limitations of your research.	The discussion is accompanied by an explanation of the limitations of the research that has been conducted.	Page 18
11	Make a table can easy to reading. Please according og template Mean.SD	The data analysis does not require an SD value, but requires an average value and an N gain score so that Table 6 does not include the SD value.	Page 9
12	Please discuss in full the limitations of the study in the Discussion.	The discussion is accompanied by an explanation of the limitations of the research that has been conducted.	Page 18
13	some references are too old and must be updated	The author has updated the references according to the reviewer's suggestions.	Page 18-21

Reviewer 3 (7373-25196-1-RV)			
#	**Reviewer's comments**	**Response**	**Page No.**
1	You need to engage a linguist with native speaker skills (Judul)	The title of the article has been revised according to the reviewer's suggestions and has been checked by an English language expert.	Page 1
2	Your abstract has described the entire content of the paper as a solid summary.	Abstract has described the entire content of the paper as a solid summary.	Page 1
3	The introduction has reviewed the problem to the problem gap.	The introduction has reviewed the problem to the problem gap.	Page 1 & 3 paragraph 1-2
4	Data analysis has not been raised in the research methodology. Add and review in new sub-headings.	Data analysis has been raised in the research methodology according to the reviewer's suggestions	Page 8

5	Results and discussions should be separated under different sub-headings. Then review it sharply, especially the discussion that boils down to novelty.	The results and discussion have been separated according to the reviewer's suggestions	Page 9 & Page 15
6	The writing of references and citations must be checked again with the provisions of APA Style Ed 7. It is recommended that you use a tool, namely Mendeley.	The writing of references and quotations has been checked again with the provisions of APA Style Ed 7.	Page 18-21

Reviewer 4 (7373-25718-1-RV)			
#	**Reviewer's comments**	**Response**	**Page No.**
1	Abstract; Put semicolon	Revisions have been made according to the reviewer's suggestions.	Page 1
2	Do you think essays can be the main features to test students' communications (speaking skills)?	Essay tests are used to measure students' STEM abilities while for communication skills abilities use a questionnaire.	Page 1 (abstract)
3	Why "maybe"? You have already proved that through your intervention and then test? Please use an appropriate word.	The word may be has been deleted.	Page 1 (abstract)
4	Please cite the first author followed by et al… (Verawati ernita paragraph 1)	Revisions have been made according to the reviewer's suggestions.	Page 2 in paragraph 1.
5	The idea is very interesting but you should not also forget stating the lack of interaction in the classroom. How do you negotiate that? Can you really safeguard your thought in this regard?	The purpose of this explanation is to explain to the reader that IT-based learning is an alternative to facilitate the achievement of learning objectives, but still requires interaction between teachers and students so that learning becomes more effective. This explanation is also a quote from research results (Lewin & McNicol, 2015).	Page 2 in paragraph 2.
6	Cite the first author and then et al.	Revisions have been made according to the reviewer's suggestions.	Page 2 in paragraph 2.
7	You need to hypothesize rather than obliging or advising readers to apply technology in education. Right?	This explanation is a suggestion and does not require the reader to follow it.	Page 2 in paragraph 2.
8	What about the interaction, as I have already raised it in the above? Education without interaction (as technology lacks it) may result in ineffectiveness.	The purpose of this explanation is to explain to the reader that IT-based learning is an alternative to facilitate the achievement of learning objectives, but still requires interaction between teachers and	Page 2 in paragraph 1 & 2.

		students so that learning becomes more effective.	
9	Have you conducted any preliminary study? If yes, please substantiate your thought with practical research findings.	Researchers have conducted a preliminary study by conducting observation and interviews with teachers so that it was found that students had difficulty understanding chemical bonding material and students' communication skills and STEM were still low.	Page 3 in paragraph 1.
10	That is very great, but you need to state the problem that you would like to focus on. What is your focus area? What is/are the benefit/s of the problem to be studied? Is that due to the lack of such studies, the problem is still existing and unsettled? Or what? Anyway, state the rationales very well.	Research problems have been revealed. The research focus has been explained in the article.	Page 3 in paragraph 3 Page 4 in paragraph 1.
11	Put " to" here as: objectives of this research are to: 1. 2.	Revisions have been made according to the reviewer's suggestions.	Page 4 in paragraph 1.
12	Replace it with improvement	Revisions have been made according to the reviewer's suggestions.	Page 4
13	he same! However, I think it would be better if you rewrite your objectives as: To examine if applying IT-based chemistry teaching materials does have impacts of students communication skills improvement; 2……..and likewise do the next one. The main reason is that such kind of designing objectives will help you show both the products (as you wrote them as scores) and the processes (e,g, the intervention).	Revisions have been made according to the reviewer's suggestions.	Page 4
14	That is very great, but you need to state the problem that you would like to focus	Research problems have been revealed.	Page 4 in paragraph 1.

	on. What is your focus area? What is/are the benefit/s of the problem to be studied? Is that due to the lack of such studies, the problem is still existing and unsettled? Or what? Anyway, state the rationales very well.	The research focus has been explained in the article.	Page 4 in paragraph 1.
15	How did you determine the groups as experimental and control in a situation where you didn't give pretests? What if, for instance, their knowledge was not homogenous? I argue that you should have given pretests prior to assigning them as experimental and controlled groups. The procedure you did follow or apply was not right!	Before the researcher determines the experimental and control classes to ensure that the two groups have homogeneous abilities, a sample normality test is first carried out. Based on the test results, it showed that both samples had homogeneous abilities (experimental and control classes).	Page 6 paragraph 2.
16	What is it? You mean conventional method? You need to briefly state it so as to make it understandable for non-expert readers.	The researcher mentions that in the article the expository method is not the conventional method.	Page 5 in paragraph 3.
17	What were your roles as teachers? How did the usual teacher do the intervention? Have you given him/her training or what? Demonstrate your ideas briefly.	Prior to giving treatment, perceptions were equalized and training was first carried out as a form of research preparation in order to obtain the right data in measuring students' communication and STEM abilities.	Page 6 in paragraph 2.
19	How did you do that? How did you convert the Likert Scale data (categorical) into continuous data? This is a fundamental issue that you should state. Thus, please try to demonstrate it clearly.	The method used by researchers is to calculate the mean value of each indicator of students' communication skills with reference to the criteria in Table 4.	Page 7 in paragraph 2.
20	How did you adapt the criteria? Or is it a standardized parameter? The last one i.e. 'bad' is not trendy! For instance, why not satisfactory or unsatisfactory?	This parameter is a standard parameter that refers to a reference source (Verawati, et al., 2022).	Page 8 in paragraph 1.
21	So which T-test was run? Please state the analysis technique you employed and the reason why.	The type of t test used is the independent sample t test because the data is normally distributed and homogeneous.	Page 11 in paragraph 1-2.
22	Are both group student taught by the same teacher or what? I couldn't get you. Please demonstrate your ideas elaborately.	To avoid subjectivity in research activities, the chemistry teacher at the school where the research was conducted taught in the experimental and control classes. However, prior to giving treatment, perceptions were equalized and training was first carried out as a form of research preparation in	Page 6 in paragraph 2.

		order to obtain the right data in measuring students' communication and STEM abilities.	
23	The way you represented the scores with bar graph is not fitting. It would be, I think, good if you put it vertically.	The researcher chose a horizontal form to make it easier for the reader to see the comparison of each score obtained for each item.	Page 10 (figure 1 and 2)
24	I couldn't see the sig-value in the tables. May I ask you that?	This level of significance is a reference for whether or not the criteria are significant so that only the results of the data analysis are shown in the table, while these criteria are not shown in the table.	
25	The graphs are not suitably good to read. Plot the graphs vertically please.	Revisions have been made according to the reviewer's suggestions.	Page 12 & 13 (figure 3 and 4)
26	How did you measure the impact of the independent variable on this domains?	Researchers only focus on measuring communication skills and STEM only.	
27	How did you prove whether students were taking part actively, interacting lively, and communicating effectively? Have you video recorded? Do you have any means to show the process of the intervention? What about the intervention fidelity?	This quote refers to the results of the study (Iksan, et al., 2011; Akinbobola, 2015; Chan & Nagatomo, 2022).	Page 18-21

Reviewer 5 (7373-24926-1-RV)			
#	**Reviewer's comments**	**Response**	**Page No.**
1	Provide 1-2 sentence implication or conclusion of your finidngs as take home message to the readers.	Due to the limited number of words which is limited to 250 words, the researcher cannot add more sentences because the number of words in the abstract has reached 246 words.	Page 1
2	You can incorporate your research objectives and research questions in the last paragraph in your introduction.	Revisions have been made according to the reviewer's suggestions.	Page 4 in paragraph 1.
3	You can incorporate your research objectives and research questions in the last paragraph in your introduction.	Revisions have been made according to the reviewer's suggestions.	Page 4 in paragraph 1.
4	How did you assigned them to their respective grouping to avoided if not minimize bias in terms of their cognitive level and ability? Did you match their	Before the researcher determines the experimental and control classes to ensure that the two groups have homogeneous	Page 6 paragraph 2.

	grade equivalent? I think purposive sampling is NOT the proper method to use. You have to natch the students according to their level of cognitive ability. Example match pairing of their grades then make draw lots to assign them to experimental an control group. Each group should have same level of cognitive ability, Please explain further how did you do the assignment of your respondents to their corresponding groups	abilities, a sample normality test is first carried out. Based on the test results, it showed that both samples had homogeneous abilities (experimental and control classes).	
5	Spell out RSi, RE, RD, RA	The terms RSi, RE, RD, RA have been mentioned according to the reviewer's suggestions.	Page 12 in paragraph 1.
6	Spell out RSs	The terms RSs have been mentioned according to the reviewer's suggestions.	Page 13 in paragraph 1.
7	Spell out WCS and SCS	The terms WCS and SCS have been mentioned according to the reviewer's suggestions.	Page 15 in paragraph 2.
8	Remove these citations. Conclusion should be novel, focus on the findings and implications of your study. Please enhance or revise your conclusion and recommendations following these guides: • Restate the problem statement addressed in the paper • Summarize your overall arguments or findings • Suggest the key takeaways from your paper – this will focus the implication and recommendation of your study	The researcher has revised the conclusions and recommendations according to the reviewer's suggestions.	Page 18
9	Few references are quite obsolete Akinbobola, A.O. (2015). Effects of learning style and instructional strategies on students' achievement in Nigerian senior secondary school physics. Advance in Physics Theories and Applications, 41, 20-29. Campbell, D. T., & Stanley, J. (1963). *Experimental and quasi-experimental designs for research*. Chicago, IL: Rand McNally.	It's been deleted	Page 18 -19

International Journal of Learning, Teaching and Educational Research
Vol. 21, No. x, pp. a-b, Month 2023
https://doi.org/10.26803/ijlter.21.x.y
Received Mon 00, 2023; Revised Mon 00, 2023; Accepted Mon 00, 2023

Enhancing Students' Communication and STEM Reasoning Abilities Based on Gender Through Application of IT-based Chemistry Teaching Materials

Dwi Wahyudiati[*]
Universitas Islam Negeri Mataram
Mataram, Indonesia
https://orcid.org/0000-0003-2655-1807

Abstract; Among the difficulties faced by instructors in delivering chemistry lessons are lack of information technology (IT)-based teaching materials that would very effectively support e-learning or face-to-face learning especially in effort to enhance students' communication skills and STEM reasoning skills. Digital technology advancement provides the opportunities to help resolve this problem. This study aimed to enhance students' communication skills and STEM reasoning abilities through application of IT-based (bandicame and canva applications) chemistry teaching materials that is integrated to Google Classroom platform and to identify the differences in students' communication skills and STEM reasoning abilities based on genders. The research took samples of 50 students (19 male and 31 female) at an Indonesian senior high school by applying quasi experiment pretest-posttest control group design. Communication skills were measured by means of a questionnaire, while reasoning abilities were gauged using an essay test. The results were then analyzed descriptively focusing on increases in communication skills and STEM reasoning abilities scores and independent sample t-test. Findings of the study show that: (1) Students' communication skills and STEM reasoning abilities can be enhanced through application of GC-integrated IT-based chemistry teaching materials; (2) Significant differences existed in the students' communication skills based on genders, of which highest increase was identified on WCS indicator for females and SCS indicator for males; and (3) significant differences were identified in students' STEM reasoning abilities based on genders with highest increase on RI indicator for females, followed by RD indicator for males, and RA for females.

[*] Corresponding author: *Dwi Wahyudiati, dwiwahyudiati@uinmataram.ac.id*

Keywords: communication skills; Stem reasoning abilities; IT-based chemistry teaching materials; Gender

1. Introduction

Application of technology has developed very rapidly and entered all spheres of life, including education. Application of technology in education plays a very important role to support implementation of 21st century learning in the era of industrial revolution 5.0 (Verawati et al., 2022; Pavlova, 2013). Chemistry learning requires media and learning resources that can visualize abstract concepts so that students can easily understand them, one of which is by having chemistry module based on the canva and bandicame applications. However, based on the results of previous studies, it is indicate that the availability of chemistry module based on the canva and bandicame applications is still lacking, resulting in low students' reasoning abilities and communication skills (Fadli & Irwanto, 2020; Kong & Matore, 2022; Irwanto et al., 2023). Moreover, teachers still couldn't develop chemistry module based on the Canva and Bandicame applications in chemistry learning, so learning is still focused on achieving cognitive learning objectives and neglects students' communication and STEM abilities development (Wahyudiati, 2023).

Technology-based learning innovations are very relevant to be used as learning media and resources by teachers and students to develop their 21st century skills, thus becoming individuals with professional competitiveness in the era of industrial revolution 5.0 (Sumardi et al., 2020; Lewin & McNicol, 2015). The 21st century skills that students should develop include problem solving skills, communication skills, collaboration skills, and STEM reasoning abilities (Wahyudiati, 2023). Chemistry learning, in particular, needs learning media and resources that would visualize abstract concepts to be easily understood by the students. So far, technology has been used more as a medium of communication than as a medium of learning (Ramma et al., 2015). For this reason, to make a difference, technology must be used extensively as a pedagogic means in teaching and learning activities as both media and teaching materials (Strayer, 2012).

In the framework of STEM education that is very rapidly developing technology, the new direction of learning worldwide currently is virtual or e-learning system (Estevemon et al., 2022; Krumsvik, 2012). For this reason, educational institutions are encouraged to design chemistry module for e-learning activities in order to stay update with current technological advancements and no longer use conventional media and teaching materials (Castro et al., 2020). These conditions are relevant to E-learning, a pedagogically effective learning design is necessary to help achieve learning objectives that cover cognitive, affective and psychomotor aspects. It includes development of IT-based media and teaching materials, Google Classroom (GC) platform, LMS platform or learning management system that triggers students' active participation in learning activities (Clark & Mayer, 2011).

Students' interactions and participation in STEM-based learning remain a crucial issue (Verawati et al, 2022), especially with regard to training students' reasoning abilities and communication skills (Fadli & Irwanto, 2020; Kong & Matore, 2022). These reasoning abilities are crucial since they constitute the predictors of students' achievements in STEM (Kong & Matore, 2022). In more specific contexts, reasoning is known as critical thinking skills (Ali et al., 2021) with indicators including analysis, inference, evaluation, and problem solving (Ali et al., 2021; Wahyudiati et al., 2019; Wahyudiati et al., 2020). As such, it is very important that students have critical thinking skills or reasoning abilities (Fadli & Irwanto, 2020; Prayogi et al., 2019). However, previous studies show that effective learning designs to train students' 21st century skills have not been established yet, especially in supporting students' STEM abilities and developing their communication skills (Fadli & Irwanto, 2020; Kong & Matore, 2022; Anggraeni & Pentury, 2021). It is especially the case in teaching chemistry concepts with topics requiring high levels of abstraction, such as chemical bonding. This results in students' low reasoning abilities and communication skills due to lack of motivation in learning abstract concepts. In addition, an interview with a chemistry teacher with 12 years of teaching experience disclosed that the teacher faced difficulties in making the students understand abstract concepts, especially the topic of chemical bonding. Likewise, based on the results of preliminary studies that have been carried out by researchers by observing and interviewing activities at school, it was found that students had difficulty understanding chemical bonding material and students' communication and STEM abilities were still low, and there was still a lack of availability of IT-based chemistry module.

This research focused on developing Chemistry teaching materials based on the Canva and Bandicam (CTMBCB) applications are integrated with Google Classroom. Findings of past studies show that sciences teaching using bandicame application through Google Classroom platform in both e-learning and face-to-face learning environments had a positive impact on the students' learning interest and outcomes (Iksan et al., 2011). Likewise, application of canva through Google Classroom platform as learning resources in both e-learning and face-to-face learning environments had a positive effect on students' academic performance, in terms of knowledge, skills and attitude (Christiana & Anwar, 2021; Iksan et al., 2011). Another advantage in the use of canva and bandicame applications is that as a learning medium, making learning more interesting and fun and help solve other learning issues with respect to accessibility (Christiana & Anwar, 2021; Iksan et al., 2011; Erlinawaty & Sellan, 2021).

Other studies highlight the attitude aspect in their use (Lewin & McNicol, 2015). However, as far as we are concerned, use of technology (bandicame and canva applications) as the basis for developing chemistry teaching materials (chemical bonding topic) to develop students' communication skills and STEM reasoning abilities in chemistry subject based on genders has never been undertaken (based on previous study). For this reason, this study is very important to be carried out to give positive contribution to STEM-based learning currently being

encouraged as a form of learning innovation during industrial revolution 5.0, and to determine if it will increase student communication skill scores and STEM reasoning ability scores after the implementation of CTMBCA applications. Specifically it give answers to the following research questions: 1) Is there a statistically significant improvement in communication skill scores before and after the implementation of CTMBCA applications? and 2) Is there a statistically significant improvement in STEM reasoning ability scores before and after the implementation of CTMBCA applications? Besides that, the objectives of this research purposes: 1) To examine if implementation of CTMBCA applications does have impacts of student communication skills improvement; and 2) To examine implementation of CTMBCA applications does have impacts of students STEM reasoning ability improvement.

2. Review of Literature

Students' communication skills and STEM abilities can be improved by implementation of CTMBCA that are integrated with the Google Classroom platform (e-learning). The findings of previous studies indicate that the use of the bandicame and Canva applications as learning media or teaching materials can enhancing students' critical thinking skills, enhancing students' STEM reasoning abilities, and communication skills (Verawati et al., 2022; Hakim et al., 2022). Likewise, using the Canva application as a learning resource positively affects student academic achievement regarding knowledge, skills, and attitudes (Iksan et al., 2011).

Students' interactions and participation in STEM-based learning remain a crucial issue (Verawati et al., 2022), especially with regard to training students' reasoning abilities and communication skills (Kong & Matore, 2022). These reasoning abilities are crucial since they constitute the predictors of students' achievements in STEM (Kong & Matore, 2022). In more specific contexts, reasoning is known as communication skills and critical thinking skills (Ali et al., 2021) with indicators including analysis, inference, evaluation, and problem solving (Wahyudiati et al., 2019). As such, it is very important that students have communication skills, critical thinking skills or reasoning abilities (Prayogi et al., 2019). However, previous studies show that effective learning designs to train students' 21st century skills have not been established yet, especially in supporting students' STEM abilities and developing their communication skills (Fadli & Irwanto, 2020; Anggraeni & Pentury, 2021).

The 21st century skills that students should develop include problem solving skills, communication skills, collaboration skills, STEM reasoning abilities. Chemistry learning, in particular, needs learning media and resources that would visualize abstract concepts to be easily understood by the students. So far, technology has been used more as a medium of communication than as a medium of learning (Ramma et al., 2015). Communication skills consisting of three indicators that are measured based on three criteria, namely the ability to communicate verbally, the ability to communicate in writing, and the ability to communicate socially. Communication skills as learning outcomes are very

important for students to have because they are related to the ability to express what is understood and apply it in everyday life (Iksan et al., 2011).

Application of e-learning system in integration with Google Classroom (GC) platform at schools and their use depend on designer's access approval (some are freely accessible while others are not) and the teacher has full control over the learning system through GC. A new aspect of the study is that it developed chemistry teaching materials on chemical bonding topic using GC platform-integrated canva and bandicame applications to enhance students' communication skills and STEM reasoning abilities as viewed from gender perspective. Many studies show different findings. A study by Iksan et al. (2011) revealed significant differences in students' communication skills based on genders, where male students have better written communication skills in making discussions than their female counterparts (Nurlu, 2017). On the contrary, other studies found no differences in STEM reasoning abilities based on genders, while a study by Spelke (2005) did identify differences in students' STEM reasoning abilities based on genders.

Implementation of CTMBCA can improve students' communication skills and STEM abilities. Previous research proved that using chemistry module positively impacts students' communication and STEM abilities (Fraile et al., 2021). The findings of previous studies indicated that the use of the bandicame and Canva applications as learning media or teaching materials could improve students' digital literacy competencies students STEM reasoning abilities and have a positive impact on improving students' communication skills (Verawati et al., 2022; Hakim et al., 2022). Likewise, using the Canva application as a learning resource positively affects student academic achievement in terms of knowledge, skills, and attitudes (Iksan et al., 2011). Thus, applying IT-based chemistry (bandicame and Canva) through the GC platform expected to improve students' communication and STEM skills in chemistry learning.

3. Method

3.1 Research Design

This study is an experimental study with quasi experiment nonequivalent pretest-posttest control group design. Experimental and control classes were determined randomly. The experimental group was given the CTMBCA treatment via GC, while the control group was given the expository method. Before treatment was given, an observation was carried out on the two groups' communication skills and STEM reasoning abilities (pretest) and another was carried out after treatment (post-test). The research design in its simple form is shown on Table 1 below.

Table 1: The nonequivalent pretest and posttest control group design.

Groups	*Pretest*	*Treatment*	*Posttest*
Experimental	Communication Skills Questionnaire and STEM Reasoning Test	CTMBCA	Communication Skills Questionnaire and STEM Reasoning Test
Control	Communication Skills Questionnaire and STEM Reasoning Test	Face-to-face learning with the expository method	Communication Skills Questionnaire and STEM Reasoning Test

Research was carried out on the two sample groups on the same materials with chemical bonding topics, including covalent bonding, ionic bonding, hydrogen bonding and metallic bonding. The materials were taught to students in 8 sessions to both experimental and control classes. This research was permitted by the school that became the research location as a condition for fulfilling the research code of ethics (permission number: 20/Ma.19.02/PP.00.6/2022).

3.2 Participants

Samples for the research involved 50 students of an Indonesian senior high school. Using cluster random sampling technique, 25 students (9 male students and 16 female students) were designated as the control group and another 25 students (10 male students and 15 female students) as the experimental group with average age of 16-17 years (Table 2). Before the researcher determines the experimental and control classes to ensure that the two groups have homogeneous cognitive abilities, a sample normality test is first carried out. Based on the test results, it showed that both samples had homogeneous abilities (experimental and control classes). The reference for determining the number of samples in this study is in accordance with previous studies that have been carried out using 50 samples consisting of 25 people for the experimental class and 25 for the control class (Wahyudiati et al., 2022). They were taught by a teacher with 7 years of teaching experience. To avoid subjectivity in research activities, the chemistry teacher taught the experimental and control classes at the school where the research was conducted. However, before giving treatment, perceptions were equalized. The training was first conducted as research preparation to obtain the right data to measure students' communication and STEM abilities.

Table 2: Demographic characteristics of the samples

Characteristics		**Experimental Class, n = 25**		**Control Class, n = 25**	
		Quantity	**%**	**Quantity**	**%**
Genders	Female	10	40%	9	36%
	Male	15	60%	16	64%
Age (year)	16	11	44%	10	40%
	17	14	56%	15	60%

3.3 Research Instruments

The study employed two instruments, namely communication skill and STEM reasoning ability instruments.

3.3.1 Communication Skill Instrument

The communication skill questionnaire adopted the instrument developed by Iksan et al. (2011), which comprises three indicators, namely verbal communication skills (VCS), written communication skills (WCS) and social communication skills (SCS) with a total of 43 items as shown in Table 3.

Table 3: Communication skills instrument grid (Iksan et al., 2011)

Indicators	Subindicators	Num. of items
Verbal Communication Skills (VCS)	Presenting ideas verbally	3
	Understanding what was heard	4
	Giving feedback	4
	Presentation	5
Written Communication Skills (WCS)	Presenting ideas in written form	4
	Giving feedback in written form	5
Social Communication Skills (SCS)	Negotiating to get agreement	4
	Communicating to people from different cultures	4
	Communicating in different languages	4
	Communicating humbly	6
Total Number of Items		43

Answer options in the questionnaire refer to five-point likert scale, which includes strongly disagree, disagree, slightly disagree, agree and strongly agree with 5 as the highest score and 1 the least score (applicable for both negative and positive statements). Based on the scoring criteria, the scores were then converted into interval equation (Iksan et al., 2011), and the interval category of communication skills is summarized in Table 4. A mean range of 0-1.67 is classified as low skills; a mean range of 1.68-3.34 is classified as average skills, and a mean range of 2.25-5.00 is classified to have good skills.

Table 4: Communication skills criteria (Iksan et al., 2011)

Communication Skills Criteria	Mean range
Low skills	0-1.67
Average skills	1.68-3.34
Good skills	3.35-5.00

3.3.2 STEM Reasoning Ability Instrument

Data on students' STEM reasoning abilities consist of four indicators (Verawati et al., 2022), namely reasoning-analysis (RA), reasoning-inference (RI), reasoning-evaluation (RE), and reasoning-decision (RD), which were collected

using an essay test instrument. Each indicator consists of two questions, so that there were a total of eight test questions for STEM reasoning abilities. Reasoning skills were measured based on indicator (RSi) and individual (RSs) parameters (Verawati et al., 2022).

Table 5: STEM reasoning ability criteria based on RSi and RSs parameters

STEM Reasoning Ability Criteria	RSi Score Interval	RSs Score Interval
Very Good	RSi > 3.21	RSs > 25.60
Good	2.40 < RSi ≤ 3.21	19.20 < RSs ≤ 25.60
Fair	1.60 < RSi ≤ 2.40	12.80 < RSs ≤19.20
Poor	0.80 < RSi ≤ 1.60	6.41 < RSs ≤12.80
Bad	RSi ≤ 0.80	RSs ≤ 6.41

As for before being used, the two instruments were validated by four experts (2 experts with Ph.D. degrees and 2 experts with MEd degrees) from the University of Mataram and UIN Mataram, Indonesia. The Cronbach alpha coefficient for the Communication Skill Questionnaire is $\alpha = 0.87$ and the STEM Reasoning Test is $\alpha = 0.86$. This value is above the acceptable limit of 0.70 (Hair et al., 2010) thus both instruments are declared valid.

3.4 Data Analysis

Analysis of data on students' communication skills and STEM reasoning abilities descriptively refers to the criteria in Tables 4 and 5, and score gain (n-gain) refers to Hake formula (Hake, 1999). A statistical analysis (difference test on sample groups) was then carried out to identify differences in the score gains in students' communication skills and STEM reasoning abilities in both samples ($p < 0.05$). This was preceded by normality test ($p > 0.05$) using Shapiro Wilk test (since sample membership ≤ 50). Statistical analysis used SPSS 24.0 program.

3.5 Research Procedures

This research conforms to Helsinki Declaration on studies involving humans. After the researcher explained on research objectives, a consent form was distributed to and signed by each participant prior to intervention. The research comprised of 2 key phases: (1) development of CTMBCA that were integrated to Google Clasroom (GC) platform, and (2) application of CTMBCA in the experimental classes. Bandicame application was used to design a learning interactive video (chemical bonding and molecule forms, & material and changes), while canva application was used to choose interesting features in presenting chemical bonding topic in order to make learning more interesting and fun so that learning would not be boring to students. Application of the CTMBCA used Google Clasroom (GC) platform and held for twelve sessions (April-June 2022) and each session comprised one hundred and sixty minutes. The experiment group was taught with CTMBCA, while the control class had face-to-face learning with expository method.

4. Results

4.1 Communication Skills

Results of descriptive analysis of students' communication skills based on genders are presented in Table 8 with reference to communication skills criteria (Iksan et al., 2011).

Table 6: Results of measurement of students' communication skills based on genders for each indicator

Groups	Score	Genders	Communication skill indicators			Mean range	Category
			VCS	WCS	SCS		
Experimental	Pretest	Male	2.4	2.6	2.5	2.5	Average skills
		Female	2.12	2.4	2.16	2.23	Average skills
	Posttest	Male	4.22	4.3	4.23	4.25	Good skills
		Female	4.14	4.3	4.2	4.21	Good skills
	N-gain	Male	0.7	0.71	0.69	0.7	high
		Female	0.7	0.73	0.72	0.72	high
Control	Pretest	Male	2.2	2.13	2.15	2.16	Average skills
		Female	2.14	2.16	2.17	2.16	Average skills
	Posttest	Male	2.8	2.9	2.7	2.8	Average skills
		Female	2.92	2.95	2.98	2.95	Average skills
	N-gain	Male	0.16	0.2	0.14	0.17	Low
		Female	0.2	0.21	0.21	0.21	Low

Table 6 above shows that there was an increase in communication skills from pretest scores to posttest scores based on genders for the two treatment groups. The highest increase for the experimental group occurs on WCS indicator for females, followed by SCS indicator for females, and the lowest score on SCS indicator for males. Average increase of N-gain score for experimental class for males was 0.70 and for females of 0.72 with high criteria. Increase in communication skills with low criteria was identified on the control group with N-gain of 0.14 for SCS indicator in males. Meanwhile, the control class records highest score increase on written communication skills (WCS) and social communication skills (SCS) indicators for females with a score of 0.21. Average increase of N-gain score for control class for males was 0.17 and for females 0.21 with low criteria (Figures 1 and 2).

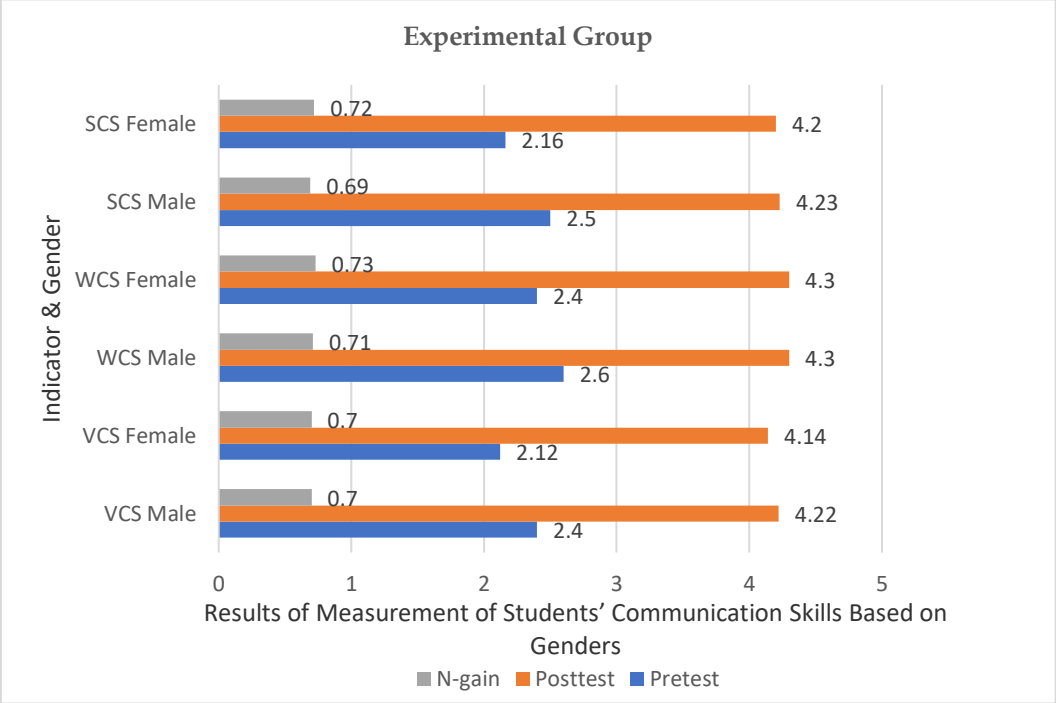


Figure 1: Students' Communication Skills Based on Gender in the Experimental Group

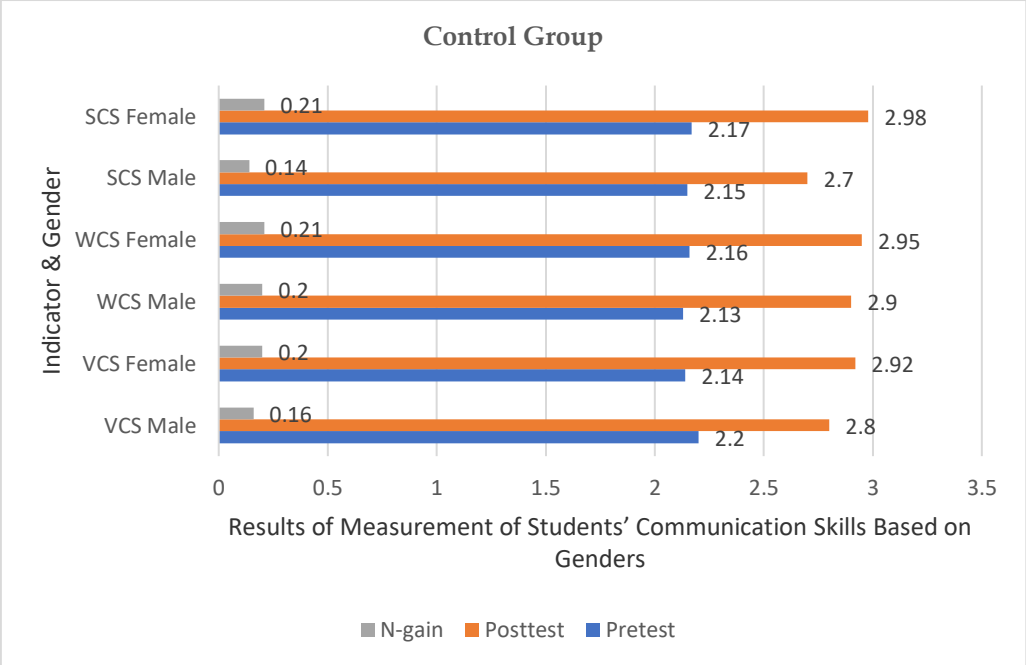


Figure 2: Students' Communication Skills Based on Genders at Control Class

Data on Figures 1 and 2 clearly show the difference in students' communication skills for both treatment groups. Results of before and after treatment show that students' communication skills in the treatment class show an increase from

average skills category to good skills category. On the contrary, the control group did not record any increase and remained at the average skills category. Furthermore, differences in the increase in the scores of the two groups were tested statistically by first carrying out homogeneity and normality tests in both groups. The homogeneity value obtained a significance value of p> 0.05, namely 0.22 in the control class and 0.26 in the experimental class and the normality values obtained are shown in Table 7.

Table 7: Results of normality test of experimental and control groups

Groups	***Shapiro-Wilk***		
	Statistic	**df**	**Sig.**
Control	0.637	50	0.540
Experimental	0.734	50	0.630

Table 7 shows that the two data groups are distributed normally. As such, a difference test on the two data groups using parametric statistic test (sample independent test t-test) comes with test results (Table 8). Results of t-test sample independent test show p > 0.05, meaning a significant difference exists in the communication skills based (CSB) on genders of the two treatment groups.

Table 8: Results of t-test independent test

Scores	**CSB**	**t-test**		
		t	df	Sig 2 tailed
Standard N-Gain	Equal variances assumed	12.069	48	0.000
	Equal variances not assumed	12.069	29.045	0.000

4.2 STEM Reasoning Abilities

Results of a descriptive analysis of STEM reasoning abilities based on genders is provided in Table 9, which refers to each treatment group's reasoning ability criteria.

Table 9: Results of measurement of students' STEM reasoning abilities based on genders for each indicator

Groups	***n***	***Score***	***Genders***	***Reasoning skill indicators***				***RSi average***	***Category***
				RA	RI	RE	RD		
Experimental	25	Pretest	Male	1.10	1.12	1.70	1.50	1.35	less
			Female	1.12	1.13	1.16	1.15	1.14	less
		Posttest	Male	3.22	3.28	3.23	3.24	3.24	good
			Female	3.14	3.30	3.20	3.21	3.21	good
		N-gain	Male	0.73	0.75	0.67	0.70	0.71	high
			Female	0.70	0.76	0.72	0.72	0.72	high
Control	25	Pretest	Male	1.13	1.13	1.12	1.14	1.13	less
			Female	1.12	1.15	1.13	1.12	1.13	less
		Posttest	Male	1.42	1.43	1.45	1.48	1.45	less
			Female	1.38	1.48	1.47	1.40	1.43	less
		N-gain	Male	0.10	0.10	0.11	0.12	0.11	Low
			Female	0.09	0.12	0.12	0.10	0.10	Low

Table 9 shows an increase from pretest scores to posttest scores based on genders according to reasoning skills were measured based on criteria for both treatment groups. The highest increases in treatment groups occur on reasoning inference (RI) indicator for females and reasoning decision (RD) for males, followed by reasoning evaluation (RE) indicator for males, while the lowest score was RA indicator for females. Average increase of RSi N-gain score for treatment class for males was 0.71 and for females 0.72 with high criteria. Enhancing in RSi with low criteria was identified on the class is not given treatment with N-gain of 0.09. For the class is not given treatment, the highest score increase was for RD indicator for males and RI indicator for females, while the lowest score was for Ra indicator for females. Visualization of students' STEM Reasoning skills based on gender differences with reference to RSi parameters (Figures 3 and 4).

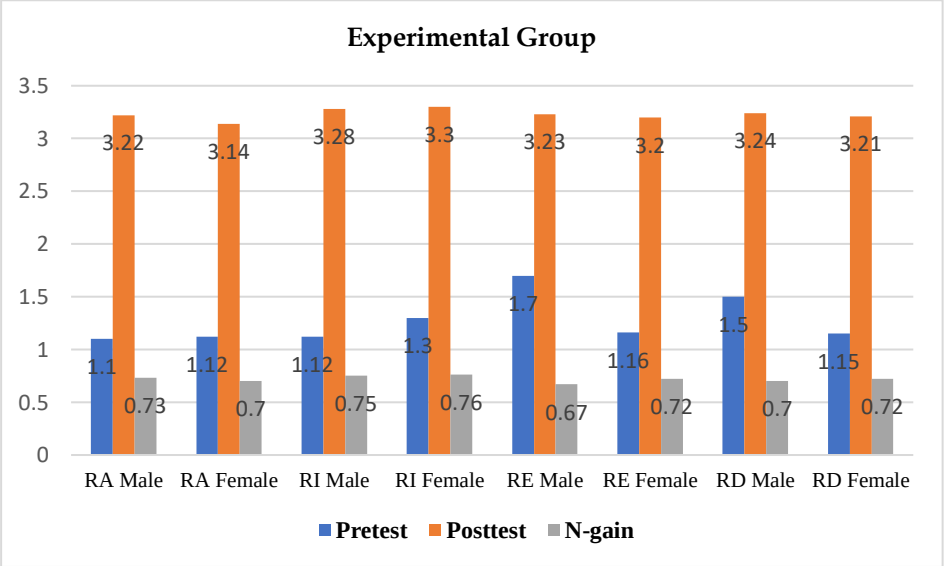


Figure 3: Students' STEM Reasoning Abilities Based on Gender in the Experimental Group

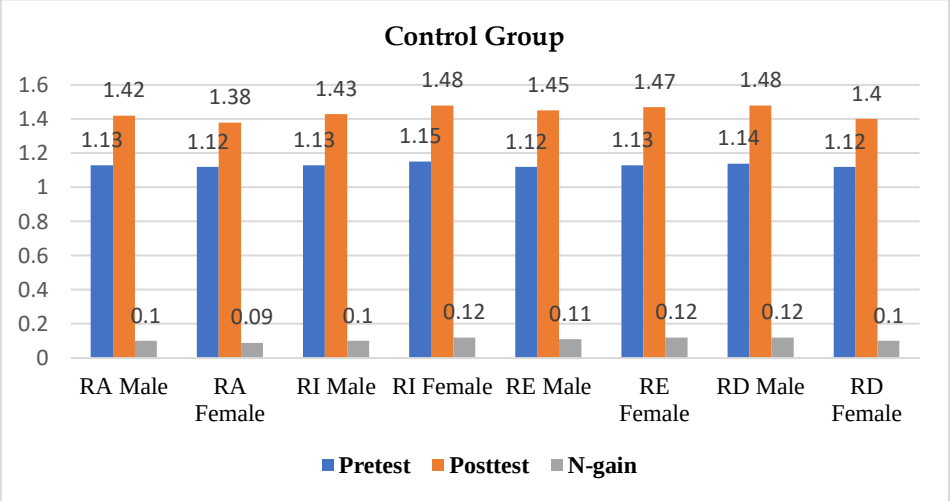


Figure 4: Students' STEM Reasoning Abilities Based on Gender in the Control Group

A summary of each treatment group's STEM reasoning ability performance based on genders with Reasoning skills were measured based on individual (RSs) parameters. RSs parameters is shown on Table 10.

Table 10: Results of measurement of students' STEM reasoning abilities based on genders

Groups	N	Genders	STEM Reasoning Abilities score and criteria				N-gain	Category
			Pretest	Category	Posttest	Category		
Experimental	25	Male	9.50	less	25.28	good	0.70	High
		Female	9.00	less	25.60	good	0.72	High
Control	25	Male	9.50	less	12.00	less	0.11	Low
		Female	9.15	less	11.50	less	0.10	Low

A summary of students' STEM reasoning abilities based on genders in Table 9 shows students' STEM reasoning abilities in the experimental class is classified in good category, while the control class in less category. Likewise, N-gain scores show that the enhancing STEM reasoning abilities in the treatment class was in high category, while that in the control class in low category. Visualization of students' STEM Reasoning abilities based on gender differences with reference to RSi parameters for experimental and control classes is shown in Figure 5.

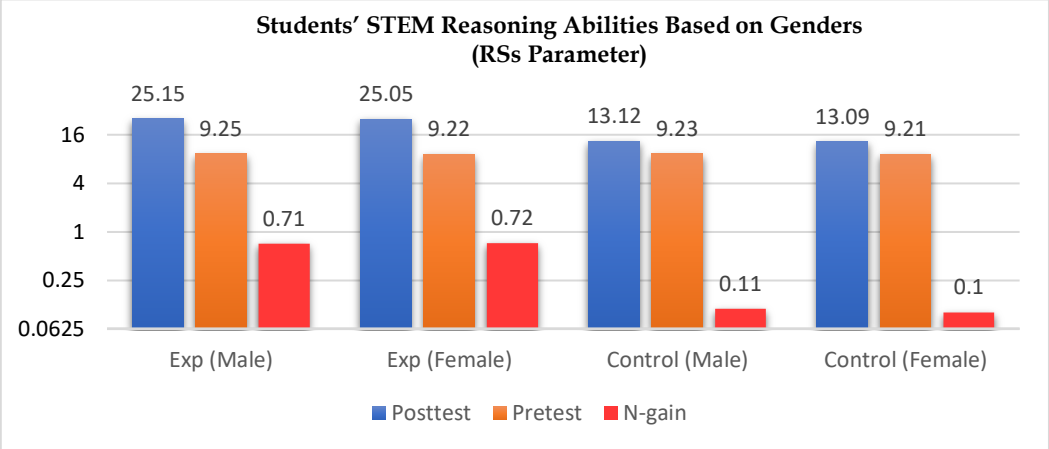


Figure 5: Students' STEM Reasoning Abilities Based on Genders for Experimental and Control Classes

Figure 5 above clearly shows the distinction STEM reasoning abilities in the two treatment groups. Results of before and after treatment show that students' communication skills in the experimental class show an increase from less category to good category. On the contrary, the control group did not record any increase and remained at the less category. Furthermore, differences in the increase in the scores of the two groups were tested statistically by first carrying out homogeneity and normality tests in both groups. The homogeneity value obtained a significance value of p> 0.05, namely 0.32 in the control class and 0.36 in the experimental class and the normality values obtained are shown in Table 11.

Table 11: Results of Normality Test of Experimental and Control Groups

Groups	Shapiro-Wilk		
	Statistic	df	Sig.
Control	0.638	50	0.530
Experimental	0.688	50	0.580

Table 10 show that the two data groups to be compared are distributed normally. As such, a distinction test on the two data groups using t-test sample independent test comes with test results as shown in Table 12. Results of t-test independent test show sig. < p (0.05), meaning a significant difference exists in the STEM reasoning abilities based on genders of the two treatment groups in favor of the experimental group. This means that the intervention given which is the application CTMBCA in teaching enhance the reasoning skills of the students than those students who wer exposed to face-to-face expository method.

Table 12: Results of t-test independent test, p < 0.05

Scores	STEM Reasoning Abilities	Score		
		t	df	Sig 2 tailed
Standard N-Gain	Equal variances assumed	13.312	48	0.000
	Equal variances not assumed	13.312	24.265	0.000

5. Discussions

5.1 Communication Skills

Data analysis shows that students' communication skills using IT-based (bandicame and canva applications) chemistry teaching materials integrated to Google Classroom platform are better than that of face-to-face learning using expository method. Findings of this study are consistent with previous studies that IT-based visual media utilization may develop students' digital literacy competencies and communication skills (Hakim et al., 2022). Similarly, utilization of IT-based chemistry module has positive impacts on the students' communication skills (Fraile et al., 2021) and there is a significant difference in students' communication skills based on genders (Yoon et al., 2021; Almuzakir & Qamariah, 2019). Research findings also show that female students' communication skills are higher than that of their male counterparts in both experimental and control groups. These findings are strongly consistent with previous studies that report that female students' communication skills are better than male students' (Hariyanto et al., 2019). This is because women are more motivated to interact in a group work, are more active in verbal presentation session, and are active in giving feedback and suggestions such that their communication skills develop better than their male counterparts (Qazi et al., 2022).

The fact that female students' communication skills are higher than that of male students is shown by the highest score on written communication skills (WCS) indicator by female, followed by social communication skills (SCS) indicator by female, and lowest score being SCS indicator for male. This research finding is strongly consistent with previous studies that show women have better verbal and written communication skills than men (Hariyanto et al., 2019; Pajk, et al., 2021). In addition, this research finding is corroborated by other research findings that prove female students' verbal competencies are more accurate and detailed, while male students are more critical with different interpretations. As such, women excel in language and writing, while men excel in mathematical calculation and logical thinking.

Another interesting finding of the study is the significant difference in the students' communication skills based on genders. The experimental group showed an increase in communication abilities from average skills category to good skills category. On the contrary, the control group did not show any increase and remained at the average skills category. The increase in the communication skills of the students in the experimental group was thanks to the advantage of the CTMBCA that were developed by integrating bandicame and canva applications that were run by means of GC platform. This necessitated the students to actively take part in the discussion, record important information, actively raise questions and respond to other students' questions so that they were able to develop their verbal communication skills (VCS), written communication skills (WCS), and social communication skills (SCS). In addition, the application of the CTMBCA enabled the students to train their visual representation abilities during the learning process, train their skills to actively

take part in communicating ideas and giving oral presentation that result in an increase in their verbal and social (Fraile et al., 2021), and train their analysis skills and written communication skills (Cleland et al., 2005, Iksan et al., 2011).

Findings of previous studies also vindicate that the use of bandicame and canva applications as learning media or teaching materials may enhance students' digital literacy competencies, increase students' STEM reasoning abilities, and have positive impacts in enhancing students' communication skills (Verawati et al., 2022; Hakim et al., 2022). Likewise, the use of canva application as learning resources has positive effect on the students' academic performance, in terms of knowledge, skills, and attitudes (Iksan et al., 2011). Moreover, use of canva and bandicame applications really helped making learning more meaningful, interesting and fun (El Kharki et al., 2021; Erlinawaty & Selan, 2021; Pajk et al., 2021). As such, application of IT-based (bandicame and canva) chemistry through GC platform may be an alternative to enhance students' communication skills and make learning more meaningful and contextual, so that learning objectives may be achieved optimally.

5.2 STEM Reasoning Abilities

Other research findings also show that there is an increase in students' STEM reasoning abilities through the application of CTMBCA. Based on the research findings, it is explicitly proven that STEM reasoning abilities using IT-based (bandicame and canva applications) chemistry teaching materials integrated to GC platform are better than those of learning using expository method. Findings of this research are consistent with the previous studies that virtual simulation may enhance students' reasoning abilities (Verawati et al., 2022) and that a distinction exists in students' STEM reasoning abilities based on genders (Valanides 1997).

Findings of this research also reveal an interesting fact that distinction were identified STEM reasoning abilities based on gender, with the highest increase on the RI indicator for females, followed by the RD indicator for males, and RA for females. The highest increase in the RI indicator for women was due to women having better systematic reasoning abilities than men. Hence, students' RI abilities experienced the highest increase after being taught using IT-based chemical teaching materials. This study's findings agree with previous studies' results, which prove that women have better STEM reasoning abilities than male students in analytical reasoning and mathematical reasoning and have higher self-confidence (Zhang, 2019; Wahyudiati et al., 2019). However, male students have better decision-making reasoning and evaluation reasoning abilities than that of female students. These findings are strongly consistent with Spelke's study (2004) that reports male students' abilities in developing and applying theories are better than that of female students. Similarly, a study by Valanides (1997) corroborates that men's performance in probabilistic reasoning far surpass women. However, different findings show that female students have better STEM reasoning abilities than male students in analytical reasoning, mathematical calculation and self-efficacy (Zhang, 2019).

Another interesting finding from this study was that there were differences in STEM reasoning skills based on gender between the class that was given the treatment and the class that was not given the treatment. The treatment class shows an increase in students' STEM abilities prior to treatment from less category into high category, while the control class also shows an increase from less category into low category. The enhancing in the STEM abilities of the experimental group was thanks to the application of CTMBCA that enabled students to develop visual representations during learning processes, train their independence to construct knowledge from abstract into more concrete form that further increases their' critical reasoning, and train their reasoning, analytical, and problem-solving abilities (Wahyudiati, 2023). Another advantage of the CTMBCA that were developed in integration with bandicame and canva applications as visual media applied through GC platform (e-learning) was that it made learning more meaningful, interesting and fun. Findings of previous studies also show that use of bandicame and canva applications as visual media was a means that was potential to provide students with opportunities to actively take part in learning processes, enhance students' digital literacy competencies, even enhance high level thinking skills and more effective communication skills (Iksan et al., 2011; Chan & Nagatomo, 2022). Previous studies also show that students' acceptance of virtual simulation application in the class was very good and had positive impacts on learning domains in terms of knowledge, skills, and attitudes (Verawati et al., 2022; Havola et al., 2021).

This study has met expectations on the fulfillment of students' accessibility in understanding chemical bonding concepts beyond the constraint of space and time. Compared to face-to-face learning with expository method, students' STEM reasoning performance is much better used the CTMBCA. The advantage of CTMBCA was appropriate to help enhancing communication abilities and help solve other problems in learning related to accessibility (Iksan et al., 2011; Fraenkel et al., 2012). Finally, for sustainable learning process we recommend use of CTMBCA with diverse application options, especially in teaching abstract concepts in sciences. This certainly requires professionalism and serious efforts on the part of the stakeholders to achieve better learning objectives and outcomes ahead of industrial revolution 5.0.

However, there are limitations to the applied IT-based chemistry teaching materials, such as the applications used are limited to the Canva and Bandicame applications integrated with the Google Classroom platform. The weakness of using the Canva and Bandicame applications is that designing an interactive video takes quite a long time. It also requires a stable internet connection, so implementing it in class requires adequate internet facilities. Likewise, the results of previous research also revealed the weaknesses of the Canva and Bandicame applications that it takes quite a long time to make, and students must have adequate multimedia facilities to be able to support the effectiveness of using the Canva and Bandicame applications during learning activities (Hakim et al., 2022). Thus, it is suggested for further research to use a variety of other applications, such as augmented reality or visual laboratories, in chemistry

learning as a form of implementing CTMBCA that can improve students' communication skills and STEM abilities to support achieving chemistry learning goals.

6. Conclusions

Based on findings of the study, the following conclusions are drawn: (1) Students' communication skills and STEM reasoning abilities may be enhanced through application of GC-integrated IT based (bandicame and canva applications) chemistry teaching materials; (2) Significant differences were noted in students' communication skills based on genders, of which highest increase was identified on WCS indicator for females, followed by SCS indicator for females, and lowest score in SCS indicator for males; and (3) significant differences were identified in students' STEM reasoning abilities based on genders with highest increase on RI indicator for females and RD for males, followed by RE for males, and lowest score for RA indicator for females. We recommend the application of GC platform-integrated IT-based (bandicame and canva applications) as one of the best solutions to enhance students' 21st century skills not only for chemistry learning, but also for science learning in the broadest sense. We recommend implementing an integrated IT-based GC platform (bandicame and canva applications) in chemistry learning as one of the best solutions to improve 21st century skills, and can support the effectiveness of e-learning based chemistry learning.

7. Limitations and Recommendations

The limitation of this research is that the applications used are limited to the Canva and Bandicame applications which are integrated with the Google Classroom platform so that further research is suggested to use other applications such as augmented reality or visual laboratories and their effects on chemistry learning. In addition, to gain a deeper understanding of the impact of implementing CTMBCA on communication skills and STEM reasoning abilities, further research needs to use qualitative data. Thus, to develop communication skills and STEM reasoning abilities of high school students, researchers suggest that chemistry learning needs to be designed using IT-based teaching materials combined with chemistry concepts that are relevant to students' daily experiences to achieve maximum chemistry learning goals. We recommend implementing an integrated IT-based GC platform (bandicame and canva applications) in chemistry learning as one of the best solutions to improve 21st century skills, and can support the effectiveness of e-learning based chemistry learning.

8. References

Ali, R., Bhadra, J., Siby, N., Ahmad, Z., & Al-Thani, N. J. (2021). A STEM model to engage students in sustainable science education through sports: A case study in Qatar. *Sustainability, 13*(1), 1-26. https://doi.org/10.3390/su13063483

Almuzakir & Qamariah, Z. (2019). Gender differences and students' verbal communication. *Proceedings of the 3rd INACELT International Conference on English Language Teaching,* 30-43. http://e-proceedings.iain-palangkaraya.ac.id/index.php/inacelt

Anggraeni & Pentury, H. (2021). Empowering students' 21st century skills through canva application. *Jurnal Kependidikan: Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran, 8*(1), 50-57. https://doi.org/10.33394/jk.v8i1.4391

Castro, A. J. T. M. L., Arango, D. M., Branch, W. J., & Burgos, D. (2020). Digital transformation in higher education institutions: A systematic literature review. *Sensors, 20*(11), 62-69. https://doi.org/10.3390/s20113291

Christiana, E., & Anwar, K. (2021). The perception of using technology canva application asa media for English teacher creating media virtual teaching and English learning in Loei Thailand. *Journal of English Teaching, Literature, and Applied Linguistics*, *5*(1), 62-69. http://dx.doi.org/10.30587/jetlal.v5i1.2253.

Chan, M. N., & Nagatomo, D. (2022). Study of STEM for Sustainability in Design Education: Framework for Student Learning and Outcomes with Design for a Disaster Project. *Sustainability*, *14*(1), 312. https://doi.org/10.3390/su14010312

Clark, R., & Mayer, R. E. (2011). E-Learning and the science of instruction (2nded.), J. Wiley inc. https://doi.org/10.1002/9781118255971

Cleland, J., Foster, K., & Moffat, M. (2005). Undergraduate students' attitudes to communication skills learning differ depending on year of study and gender. *Medical Teacher*, 27(3), 246-251. https://doi.org/ 10.1080/01421590400029541

Erlinawaty., & Sellan, S. (2021). The effectiveness of using bandicam in students' speaking english during midst covid 19 pandemi. *Indonesian Journal of ELT and Applied Linguistics, 1*(1), 22-35. https://jurnal-lp2m.umnaw.ac.id

El Kharki, K., Berrada., & Burgos, D. (2021). Design and implementation of a virtual labora- tory for physics subjects in moroccan universities. *Sustainability*, *13*(7), 3711. https://doi.org/10.3390/su13073711

Estevemon, F. M., Nebot,M. A. L., Cosentino V.V., & Adell-Segura, J. (2022). Digital teaching competence of university teachers: levels and teaching typologies. *International Journal of Emerging Technologies in Learning (iJET)*, *17*(13), 200–216. https://doi.org/10.3991/ijet.v17i13.24345

Fadli, A., & Irwanto. (2020). The effect of local wisdom-based ELSII learning model on the problem solving and communication skills of pre-service islamic teachers. *International Journal of Instruction*, *13*(1), 731-746. https://doi.org/10.29333/iji.2020.13147a

Fraenkel, R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research*, 8th ed. New York: Mc Graw Hill.

Fraile, F. J., Martínez, R., García., & Castejón-Limas. (2021). Constructionist learn- ing tool for acquiring skills in understanding standardised engineering drawings of me- chanical assemblies in mobile devices. *Sustainability*, 13(6), 3305. https://doi.org/10.3390/su13063305

Hake, R. (1999). Analyzing change/gain scores. Indiana University: Woodland Hills, CA – USA.

Hakim, A. R., Wulansari, N. I., & Admoko, S. (2022). Optimizing bandicam in the making of video presentations for interactive static fluid materials. *Jurnal Pendidikan Fisika Dan Teknologi*, *8*(1), 16–22. https://doi.org/10.29303/jpft.v8i1.3462

Hariyanto, H., Yamtinah, S., Sukarmin, S., Saputro, S., & Mahardiani, L. (2019). The analysis of student's verbal communication skills by gender in the middle school in South Tangerang. *International Conference on Science and Applied Science (ICSAS)*. https://doi.org/10.1063/1.5141677

Havola, S., Haavisto, E., Mäkinen, H., Engblom, J., & Koivisto, J. M. (2021). The effects of computer-based simulation game and virtual reality simulation in nursing students' self- evaluated clinical reasoning skills. *Comput Inform Nurs*, *39*(11), 725–735, https://doi.org/10.1097/CIN.0000000000000748

Iksan, Z. H., Zakaria, E., Meerah, T.S.M., Osman, K., Lian, D.K.C,. Mahmud, S. N. D., & Krish, P. (2011). Communication skills among university students. *Procedia Social and Behavioral Sciences,* (59). UKM Teaching and Learning Congress 2011. https://doi:10.1016/j.sbspro.2012.09.247

Ikonnikova, I., Sabirova, F., Batrakova, I., Filippova, A., & Garnova, N. (2022). Covid-19 effect on the assessment of the use of smartphone apps in STEM learning. *International Journal of Instruction*, *15*(4), 1113-1132. https://doi.org/10.29333/iji.2022.15459a

Irwanto, I., Wahyudiati, D., Saputro, A. D., & Lukman, I. R. (2023). Massive open online courses (MOOCs) in higher education: A bibliometric analysis (2012-2022). *International Journal of Information and Education Technology*, *13*(2), 223-231. https://doi.org/10.18178/ijiet.2023.13.2.1799

Irwanto, I., Wahyudiati, D., Saputro, A. D., & Laksana, S. D. (2023). Research trends and applications of gamification in higher education: A bibliometric analysis spanning 2013–2022. *International Journal of Emerging Technologies in Learning (iJET)*, *18*(05), 19–41. https://doi.org/10.3991/ijet.v18i05.37021

Kong, S. F., & Matore, M. E. E. (2022). Can a science, technology, engineering, and mathematics (STEM) approach enhance students' mathematics performance? *Sustainability*, *14*(1), 379. https://doi.org/10.3390/su14010379

Krumsvik, J. R. (2012). Teacher educators' digital competence. *Scandinavian Journal of Educational Research*, *58*(3), 25-38. https://doi.org/10.1080/00313831.2012.726273

Lewin, C., & McNicol, S. (2015). Supporting the development of 21st century skills through ICT. *Universität Potsdam*, 7, 181–198. https://publishup.uni-potsdam.de/opus4ubp/frontdoor/deliver/index/docId/8267/file/cid07_S181-198.pdf

Nurlu, O. (2017). Developing a teachers' gender stereotype scale toward mathematics. *Electronic Journal of Elementary Education*, *10*(2), 287-299. https://doi:10.26822/iejee.2017236124

Pavlova, M. (2013). Teaching and learning for sustainable development: ESD research in technology education. *International Journal of Technology and Design Education*, *23*(3), 733-748. https://doi.org/10.1007/s10798-012-9213-9

Pajk, T., Van Isacker, K., Aberšek, B., & Flogie, A. (2021). STEM education in ecofarming supported by ICT and mobile applications. *Journal of Baltic Science Education, 20*(2), 277–288. https://doi.org/10.33225/jbse/21.20.277

Prayogi, S., Muhali, M., Yuliyanti, S., Asy'ari, M., Azmi, I., & Verawati, N. N. S. P. (2019). The effect of presenting anomalous data on improving student's critical thinking ability. *International Journal of Emerging Technologies in Learning (iJET)*, *14*(06), pp. 133–137. https://doi.org/10.3991/ijet.v14i06.9717

Prayogi, S., Yuanita, L., & Wasis. (2018). Critical inquiry based learning: a model of learning to promote critical thinking among prospective teachers of physic. *Journal of Turkish Science Education*, *15*(1), 105-120. https://doi.org/10.1088/17426596/947/1/012013

Qazi, A., Hasan, N., Scherer, R., Sarker, Y., Alli, A.O., Paul, K. S., Hardker, G., & Maitama, J. Z. (2022). Gender diferences in information and communication technology use & skills: a systematic review and meta-analysis. *Education And Information Technologies*, *27*(3), 4225–4258 https://doi.org/10.1007/s10639-021-10775-x

Ramma, Y., Samy, M., & Gopee, A. (2015). Creativity and innovation in science and technology: Bridging the gap between secondary and tertiary levels of education. *International Journal of Educational Management*, *29*(1), 2-17. https://doi.org/10.1108/ IJEM-05-2013-0076

Spelke, E. (2005). Sex differences in intrinsic aptitude for mathematics and science? *American Psychologycal Association, 60*(9), 950-958. https://doi:10.1037/0003-066x.60.9.950

Strayer, J. (2012). How learning in an inverted classroom influences cooperation, innovation and task orientations. *Learning Environ Research*, 15(2), 171-193. https://doi.org/10.1007/s10 984-012-9108-4

Sumardi, L., Rohman, A., & Wahyudiati, D. (2020). Does the teaching and learning process in primary schools correspond to the characteristics of the 21st century learning? *International Journal of Instruction*, *13*(3), 357-370 https://doi.org/10.29333/iji.2020.13325a

Verawati, N. N. S. P., Ernita, N., & Prayogi, S. (2022). Enhancing the Reasoning Performance of STEM Students in Modern Physics Courses Using Virtual Simulation in the LMS Platform. *International Journal of Emerging Technologies in Learning (iJET)*, *17*(13), 267–277. https://doi.org/10.3991/ijet.v17i13.31459

Valanides, N. (1997). Formal reasoning abilities and school achievement. *Studies in Educational Evaluation, 23*(2), 169-185. https://doi.org/10.1016/S0191-491X(97)00011-4

Wahyudiati, D., Rohaeti, E., Irwanto, Wiyarsi, A., & Sumardi (2020). Attitudes toward chemistry, self-efficacy, and learning experiences of pre-service chemistry teachers: grade level and gender differences. *International Journal of Instruction*, 13(1), 235-254. https://doi.org/10.29333/iji.2020.13116a

Wahyudiati, D., Sutrisno, H., & Supiah, I. (2019). Self-efficacy and attitudes toward chemistry of pre-service chemistry teachers: Gender and grades level perspective. *International Journal of Scientific & Technology Research, 8*(9), 1041–1044. https://www.ijstr.org

Wahyudiati, D. (2023). The effect of implementing IT-based chemistry teaching materials on the chemistry students' stem skills. *Journal of Educational and Social Research*, *13*(3), 171-180. https://doi.org/10.36941/jesr-2023-0067.

Wahyudiati, D., Irwanto, I. & Ningrat, H. K., (2022). Improving pre-service chemistry teachers' critical thinking and problem-solving skills using project-based learning. World Journal on Educational Technology: Current Issues. *14*(5), 1291-1304. https://doi.org/10.18844/wjet.v14i5.7268

Yang, F. Y. (2004). Exploring high school students' use of theory and evidence in an everyday context: The role of scientific thinking in environmental science decision-making. *International Journal of Science Education, 26*(11), *1345-1364* https://doi:10.1080/0950069042000205404

Yoon, H. G., Kim, M., & Lee, E. A. (2021). Visual representation construction for collective reasoning in elementary science classrooms. *Education Sciences*, *11*(5), 246-254. https://doi.org/10.3390/educsci11050246

Zhang, Y. (2019). The Effect of Metaphorical Competence on Students' Writing Skill. *Creative Education*, *10*(1), 151-155. https://doi.org/10.4236/ce.2019.101011

International Journal of Learning, Teaching and Educational Research
Vol. 21, No. x, pp. a-b, Month 2023
https://doi.org/10.26803/ijlter.21.x.y
Received Mon 00, 2023; Revised Mon 00, 2023; Accepted Mon 00, 2023

Enhancing Students' Communication and STEM Reasoning Abilities Based on Gender Through Application of IT-based Chemistry Teaching Materials

Dwi Wahyudiati[*]
Universitas Islam Negeri Mataram
Mataram, Indonesia
https://orcid.org/0000-0003-2655-1807

Abstract; Among the difficulties faced by instructors in delivering chemistry lessons are lack of information technology (IT)-based teaching materials that would very effectively support e-learning or face-to-face learning especially in effort to enhance students' communication skills and STEM reasoning skills. Digital technology advancement provides the opportunities to help resolve this problem. This study aimed to enhance students' communication skills and STEM reasoning abilities through application of IT-based (bandicame and canva applications) chemistry teaching materials that is integrated to Google Classroom platform and to identify the differences in students' communication skills and STEM reasoning abilities based on genders. The research took samples of 50 students (19 male and 31 female) at an Indonesian senior high school by applying quasi experiment pretest-posttest control group design. Communication skills were measured by means of a questionnaire, while reasoning abilities were gauged using an essay test. The results were then analyzed descriptively focusing on increases in communication skills and STEM reasoning abilities scores and independent sample t-test. Findings of the study show that: (1) Students' communication skills and STEM reasoning abilities can be enhanced through application of GC-integrated IT-based chemistry teaching materials; (2) Significant differences existed in the students' communication skills based on genders, of which highest increase was identified on WCS indicator for females and SCS indicator for males; and (3) significant differences were identified in students' STEM reasoning abilities based on genders with highest increase on RI indicator for females, followed by RD indicator for males, and RA for females.

[*] Corresponding author: *Dwi Wahyudiati, dwiwahyudiati@uinmataram.ac.id*

Keywords: communication skills; Stem reasoning abilities; IT-based chemistry teaching materials; Gender

1. Introduction

Application of technology has developed very rapidly and entered all spheres of life, including education. Application of technology in education plays a very important role to support implementation of 21st century learning in the era of industrial revolution 5.0 (Verawati et al., 2022; Pavlova, 2013). Chemistry learning requires media and learning resources that can visualize abstract concepts so that students can easily understand them, one of which is by having chemistry module based on the canva and bandicame applications. However, based on the results of previous studies, it is indicate that the availability of chemistry module based on the canva and bandicame applications is still lacking, resulting in low students' reasoning abilities and communication skills (Fadli & Irwanto, 2020; Kong & Matore, 2022; Irwanto et al., 2023). Moreover, teachers still couldn't develop chemistry module based on the Canva and Bandicame applications in chemistry learning, so learning is still focused on achieving cognitive learning objectives and neglects students' communication and STEM abilities development (Wahyudiati, 2023).

Technology-based learning innovations are very relevant to be used as learning media and resources by teachers and students to develop their 21st century skills, thus becoming individuals with professional competitiveness in the era of industrial revolution 5.0 (Sumardi et al., 2020; Lewin & McNicol, 2015). The 21st century skills that students should develop include problem solving skills, communication skills, collaboration skills, and STEM reasoning abilities (Wahyudiati, 2023). Chemistry learning, in particular, needs learning media and resources that would visualize abstract concepts to be easily understood by the students. So far, technology has been used more as a medium of communication than as a medium of learning (Ramma et al., 2015). For this reason, to make a difference, technology must be used extensively as a pedagogic means in teaching and learning activities as both media and teaching materials (Strayer, 2012).

In the framework of STEM education that is very rapidly developing technology, the new direction of learning worldwide currently is virtual or e-learning system (Estevemon et al., 2022; Krumsvik, 2012). For this reason, educational institutions are encouraged to design chemistry module for e-learning activities in order to stay update with current technological advancements and no longer use conventional media and teaching materials (Castro et al., 2020). These conditions are relevant to E-learning, a pedagogically effective learning design is necessary to help achieve learning objectives that cover cognitive, affective and psychomotor aspects. It includes development of IT-based media and teaching materials, Google Classroom (GC) platform, LMS platform or learning management system that triggers students' active participation in learning activities (Clark & Mayer, 2011).

Students' interactions and participation in STEM-based learning remain a crucial issue (Verawati et al, 2022), especially with regard to training students' reasoning abilities and communication skills (Fadli & Irwanto, 2020; Kong & Matore, 2022). These reasoning abilities are crucial since they constitute the predictors of students' achievements in STEM (Kong & Matore, 2022). In more specific contexts, reasoning is known as critical thinking skills (Ali et al., 2021) with indicators including analysis, inference, evaluation, and problem solving (Ali et al., 2021; Wahyudiati et al., 2019; Wahyudiati et al., 2020). As such, it is very important that students have critical thinking skills or reasoning abilities (Fadli & Irwanto, 2020; Prayogi et al., 2019). However, previous studies show that effective learning designs to train students' 21st century skills have not been established yet, especially in supporting students' STEM abilities and developing their communication skills (Fadli & Irwanto, 2020; Kong & Matore, 2022; Anggraeni & Pentury, 2021). It is especially the case in teaching chemistry concepts with topics requiring high levels of abstraction, such as chemical bonding. This results in students' low reasoning abilities and communication skills due to lack of motivation in learning abstract concepts. In addition, an interview with a chemistry teacher with 12 years of teaching experience disclosed that the teacher faced difficulties in making the students understand abstract concepts, especially the topic of chemical bonding. Likewise, based on the results of preliminary studies that have been carried out by researchers by observing and interviewing activities at school, it was found that students had difficulty understanding chemical bonding material and students' communication and STEM abilities were still low, and there was still a lack of availability of IT-based chemistry module.

This research focused on developing Chemistry teaching materials based on the Canva and Bandicam (CTMBCB) applications are integrated with Google Classroom. Findings of past studies show that sciences teaching using bandicame application through Google Classroom platform in both e-learning and face-to-face learning environments had a positive impact on the students' learning interest and outcomes (Iksan et al., 2011). Likewise, application of canva through Google Classroom platform as learning resources in both e-learning and face-to-face learning environments had a positive effect on students' academic performance, in terms of knowledge, skills and attitude (Christiana & Anwar, 2021; Iksan et al., 2011). Another advantage in the use of canva and bandicame applications is that as a learning medium, making learning more interesting and fun and help solve other learning issues with respect to accessibility (Christiana & Anwar, 2021; Iksan et al., 2011; Erlinawaty & Sellan, 2021).

Other studies highlight the attitude aspect in their use (Lewin & McNicol, 2015). However, as far as we are concerned, use of technology (bandicame and canva applications) as the basis for developing chemistry teaching materials (chemical bonding topic) to develop students' communication skills and STEM reasoning abilities in chemistry subject based on genders has never been undertaken (based on previous study). For this reason, this study is very important to be carried out to give positive contribution to STEM-based learning currently being

encouraged as a form of learning innovation during industrial revolution 5.0, and to determine if it will increase student communication skill scores and STEM reasoning ability scores after the implementation of CTMBCA applications. Specifically it give answers to the following research questions: 1) Is there a statistically significant improvement in communication skill scores before and after the implementation of CTMBCA applications? and 2) Is there a statistically significant improvement in STEM reasoning ability scores before and after the implementation of CTMBCA applications? Besides that, the objectives of this research purposes: 1) To examine if implementation of CTMBCA applications does have impacts of student communication skills improvement; and 2) To examine implementation of CTMBCA applications does have impacts of students STEM reasoning ability improvement.

2. Review of Literature

Students' communication skills and STEM abilities can be improved by implementation of CTMBCA that are integrated with the Google Classroom platform (e-learning). The findings of previous studies indicate that the use of the bandicame and Canva applications as learning media or teaching materials can enhancing students' critical thinking skills, enhancing students' STEM reasoning abilities, and communication skills (Verawati et al., 2022; Hakim et al., 2022). Likewise, using the Canva application as a learning resource positively affects student academic achievement regarding knowledge, skills, and attitudes (Iksan et al., 2011).

Students' interactions and participation in STEM-based learning remain a crucial issue (Verawati et al., 2022), especially with regard to training students' reasoning abilities and communication skills (Kong & Matore, 2022). These reasoning abilities are crucial since they constitute the predictors of students' achievements in STEM (Kong & Matore, 2022). In more specific contexts, reasoning is known as communication skills and critical thinking skills (Ali et al., 2021) with indicators including analysis, inference, evaluation, and problem solving (Wahyudiati et al., 2019). As such, it is very important that students have communication skills, critical thinking skills or reasoning abilities (Prayogi et al., 2019). However, previous studies show that effective learning designs to train students' 21st century skills have not been established yet, especially in supporting students' STEM abilities and developing their communication skills (Fadli & Irwanto, 2020; Anggraeni & Pentury, 2021).

The 21st century skills that students should develop include problem solving skills, communication skills, collaboration skills, STEM reasoning abilities. Chemistry learning, in particular, needs learning media and resources that would visualize abstract concepts to be easily understood by the students. So far, technology has been used more as a medium of communication than as a medium of learning (Ramma et al., 2015). Communication skills consisting of three indicators that are measured based on three criteria, namely the ability to communicate verbally, the ability to communicate in writing, and the ability to communicate socially. Communication skills as learning outcomes are very

important for students to have because they are related to the ability to express what is understood and apply it in everyday life (Iksan et al., 2011).

Application of e-learning system in integration with Google Classroom (GC) platform at schools and their use depend on designer's access approval (some are freely accessible while others are not) and the teacher has full control over the learning system through GC. A new aspect of the study is that it developed chemistry teaching materials on chemical bonding topic using GC platform-integrated canva and bandicame applications to enhance students' communication skills and STEM reasoning abilities as viewed from gender perspective. Many studies show different findings. A study by Iksan et al. (2011) revealed significant differences in students' communication skills based on genders, where male students have better written communication skills in making discussions than their female counterparts (Nurlu, 2017). On the contrary, other studies found no differences in STEM reasoning abilities based on genders, while a study by Spelke (2005) did identify differences in students' STEM reasoning abilities based on genders.

Implementation of CTMBCA can improve students' communication skills and STEM abilities. Previous research proved that using chemistry module positively impacts students' communication and STEM abilities (Fraile et al., 2021). The findings of previous studies indicated that the use of the bandicame and Canva applications as learning media or teaching materials could improve students' digital literacy competencies students STEM reasoning abilities and have a positive impact on improving students' communication skills (Verawati et al., 2022; Hakim et al., 2022). Likewise, using the Canva application as a learning resource positively affects student academic achievement in terms of knowledge, skills, and attitudes (Iksan et al., 2011). Thus, applying IT-based chemistry (bandicame and Canva) through the GC platform expected to improve students' communication and STEM skills in chemistry learning.

3. Method

3.1 Research Design

This study is an experimental study with quasi experiment nonequivalent pretest-posttest control group design. Experimental and control classes were determined randomly. The experimental group was given the CTMBCA treatment via GC, while the control group was given the expository method. Before treatment was given, an observation was carried out on the two groups' communication skills and STEM reasoning abilities (pretest) and another was carried out after treatment (post-test). The research design in its simple form is shown on Table 1 below.

Table 1: The nonequivalent pretest and posttest control group design.

Groups	*Pretest*	*Treatment*	*Posttest*
Experimental	Communication Skills Questionnaire and STEM Reasoning Test	CTMBCA	Communication Skills Questionnaire and STEM Reasoning Test
Control	Communication Skills Questionnaire and STEM Reasoning Test	Face-to-face learning with the expository method	Communication Skills Questionnaire and STEM Reasoning Test

Research was carried out on the two sample groups on the same materials with chemical bonding topics, including covalent bonding, ionic bonding, hydrogen bonding and metallic bonding. The materials were taught to students in 8 sessions to both experimental and control classes. This research was permitted by the school that became the research location as a condition for fulfilling the research code of ethics (permission number: 20/Ma.19.02/PP.00.6/2022).

3.2 Participants

Samples for the research involved 50 students of an Indonesian senior high school. Using cluster random sampling technique, 25 students (9 male students and 16 female students) were designated as the control group and another 25 students (10 male students and 15 female students) as the experimental group with average age of 16-17 years (Table 2). Before the researcher determines the experimental and control classes to ensure that the two groups have homogeneous cognitive abilities, a sample normality test is first carried out. Based on the test results, it showed that both samples had homogeneous abilities (experimental and control classes). The reference for determining the number of samples in this study is in accordance with previous studies that have been carried out using 50 samples consisting of 25 people for the experimental class and 25 for the control class (Wahyudiati et al., 2022). They were taught by a teacher with 7 years of teaching experience. To avoid subjectivity in research activities, the chemistry teacher taught the experimental and control classes at the school where the research was conducted. However, before giving treatment, perceptions were equalized. The training was first conducted as research preparation to obtain the right data to measure students' communication and STEM abilities.

Table 2: Demographic characteristics of the samples

Characteristics		**Experimental Class, n = 25**		**Control Class, n = 25**	
		Quantity	**%**	**Quantity**	**%**
Genders	Female	10	40%	9	36%
	Male	15	60%	16	64%
Age (year)	16	11	44%	10	40%
	17	14	56%	15	60%

3.3 Research Instruments

The study employed two instruments, namely communication skill and STEM reasoning ability instruments.

3.3.1 Communication Skill Instrument

The communication skill questionnaire adopted the instrument developed by Iksan et al. (2011), which comprises three indicators, namely verbal communication skills (VCS), written communication skills (WCS) and social communication skills (SCS) with a total of 43 items as shown in Table 3.

Table 3: Communication skills instrument grid (Iksan et al., 2011)

Indicators	Subindicators	Num. of items
Verbal Communication Skills (VCS)	Presenting ideas verbally	3
	Understanding what was heard	4
	Giving feedback	4
	Presentation	5
Written Communication Skills (WCS)	Presenting ideas in written form	4
	Giving feedback in written form	5
Social Communication Skills (SCS)	Negotiating to get agreement	4
	Communicating to people from different cultures	4
	Communicating in different languages	4
	Communicating humbly	6
Total Number of Items		43

Answer options in the questionnaire refer to five-point likert scale, which includes strongly disagree, disagree, slightly disagree, agree and strongly agree with 5 as the highest score and 1 the least score (applicable for both negative and positive statements). Based on the scoring criteria, the scores were then converted into interval equation (Iksan et al., 2011), and the interval category of communication skills is summarized in Table 4. A mean range of 0-1.67 is classified as low skills; a mean range of 1.68-3.34 is classified as average skills, and a mean range of 2.25-5.00 is classified to have good skills.

Table 4: Communication skills criteria (Iksan et al., 2011)

Communication Skills Criteria	Mean range
Low skills	0-1.67
Average skills	1.68-3.34
Good skills	3.35-5.00

3.3.2 STEM Reasoning Ability Instrument

Data on students' STEM reasoning abilities consist of four indicators (Verawati et al., 2022), namely reasoning-analysis (RA), reasoning-inference (RI), reasoning-evaluation (RE), and reasoning-decision (RD), which were collected

using an essay test instrument. Each indicator consists of two questions, so that there were a total of eight test questions for STEM reasoning abilities. Reasoning skills were measured based on indicator (RSi) and individual (RSs) parameters (Verawati et al., 2022).

Table 5: STEM reasoning ability criteria based on RSi and RSs parameters

STEM Reasoning Ability Criteria	RSi Score Interval	RSs Score Interval
Very Good	RSi > 3.21	RSs > 25.60
Good	2.40 < RSi ≤ 3.21	19.20 < RSs ≤ 25.60
Fair	1.60 < RSi ≤ 2.40	12.80 < RSs ≤19.20
Poor	0.80 < RSi ≤ 1.60	6.41 < RSs ≤12.80
Bad	RSi ≤ 0.80	RSs ≤ 6.41

As for before being used, the two instruments were validated by four experts (2 experts with Ph.D. degrees and 2 experts with MEd degrees) from the University of Mataram and UIN Mataram, Indonesia. The Cronbach alpha coefficient for the Communication Skill Questionnaire is $\alpha = 0.87$ and the STEM Reasoning Test is $\alpha = 0.86$. This value is above the acceptable limit of 0.70 (Hair et al., 2010) thus both instruments are declared valid.

3.4 Data Analysis

Analysis of data on students' communication skills and STEM reasoning abilities descriptively refers to the criteria in Tables 4 and 5, and score gain (n-gain) refers to Hake formula (Hake, 1999). A statistical analysis (difference test on sample groups) was then carried out to identify differences in the score gains in students' communication skills and STEM reasoning abilities in both samples ($p < 0.05$). This was preceded by normality test ($p > 0.05$) using Shapiro Wilk test (since sample membership ≤ 50). Statistical analysis used SPSS 24.0 program.

3.5 Research Procedures

This research conforms to Helsinki Declaration on studies involving humans. After the researcher explained on research objectives, a consent form was distributed to and signed by each participant prior to intervention. The research comprised of 2 key phases: (1) development of CTMBCA that were integrated to Google Clasroom (GC) platform, and (2) application of CTMBCA in the experimental classes. Bandicame application was used to design a learning interactive video (chemical bonding and molecule forms, & material and changes), while canva application was used to choose interesting features in presenting chemical bonding topic in order to make learning more interesting and fun so that learning would not be boring to students. Application of the CTMBCA used Google Clasroom (GC) platform and held for twelve sessions (April-June 2022) and each session comprised one hundred and sixty minutes. The experiment group was taught with CTMBCA, while the control class had face-to-face learning with expository method.

4. Results

4.1 Communication Skills

Results of descriptive analysis of students' communication skills based on genders are presented in Table 8 with reference to communication skills criteria (Iksan et al., 2011).

Table 6: Results of measurement of students' communication skills based on genders for each indicator

Groups	Score	Genders	Communication skill indicators			Mean range	Category
			VCS	WCS	SCS		
Experimental	Pretest	Male	2.4	2.6	2.5	2.5	Average skills
		Female	2.12	2.4	2.16	2.23	Average skills
	Posttest	Male	4.22	4.3	4.23	4.25	Good skills
		Female	4.14	4.3	4.2	4.21	Good skills
	N-gain	Male	0.7	0.71	0.69	0.7	high
		Female	0.7	0.73	0.72	0.72	high
Control	Pretest	Male	2.2	2.13	2.15	2.16	Average skills
		Female	2.14	2.16	2.17	2.16	Average skills
	Posttest	Male	2.8	2.9	2.7	2.8	Average skills
		Female	2.92	2.95	2.98	2.95	Average skills
	N-gain	Male	0.16	0.2	0.14	0.17	Low
		Female	0.2	0.21	0.21	0.21	Low

Table 6 above shows that there was an increase in communication skills from pretest scores to posttest scores based on genders for the two treatment groups. The highest increase for the experimental group occurs on WCS indicator for females, followed by SCS indicator for females, and the lowest score on SCS indicator for males. Average increase of N-gain score for experimental class for males was 0.70 and for females of 0.72 with high criteria. Increase in communication skills with low criteria was identified on the control group with N-gain of 0.14 for SCS indicator in males. Meanwhile, the control class records highest score increase on written communication skills (WCS) and social communication skills (SCS) indicators for females with a score of 0.21. Average increase of N-gain score for control class for males was 0.17 and for females 0.21 with low criteria (Figures 1 and 2).

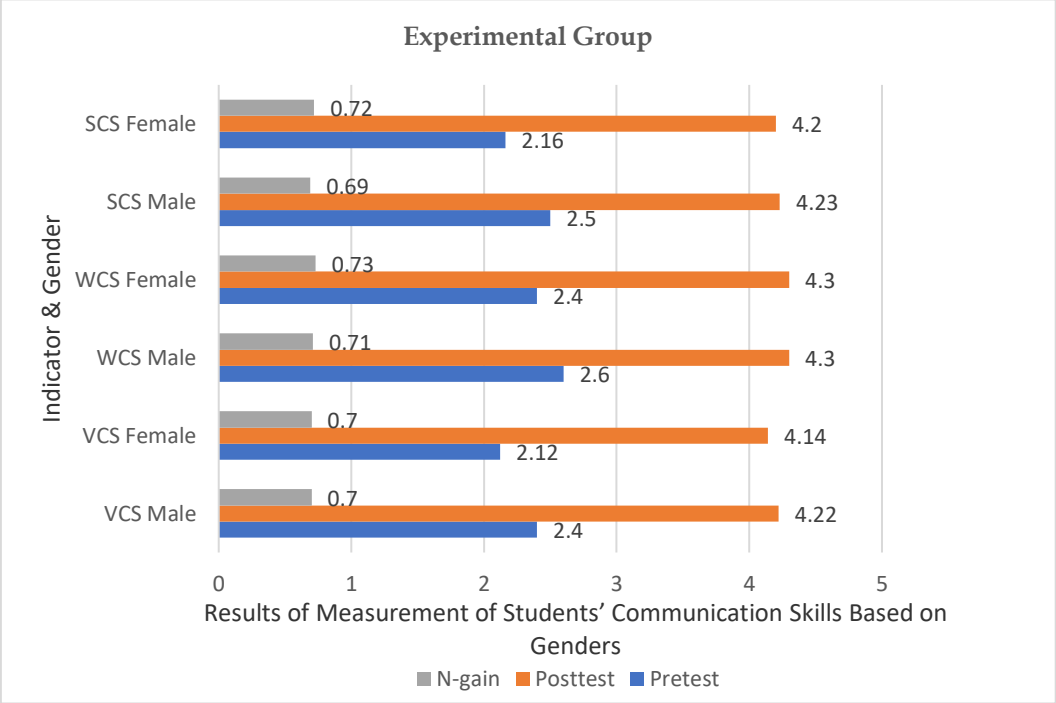


Figure 1: Students' Communication Skills Based on Gender in the Experimental Group

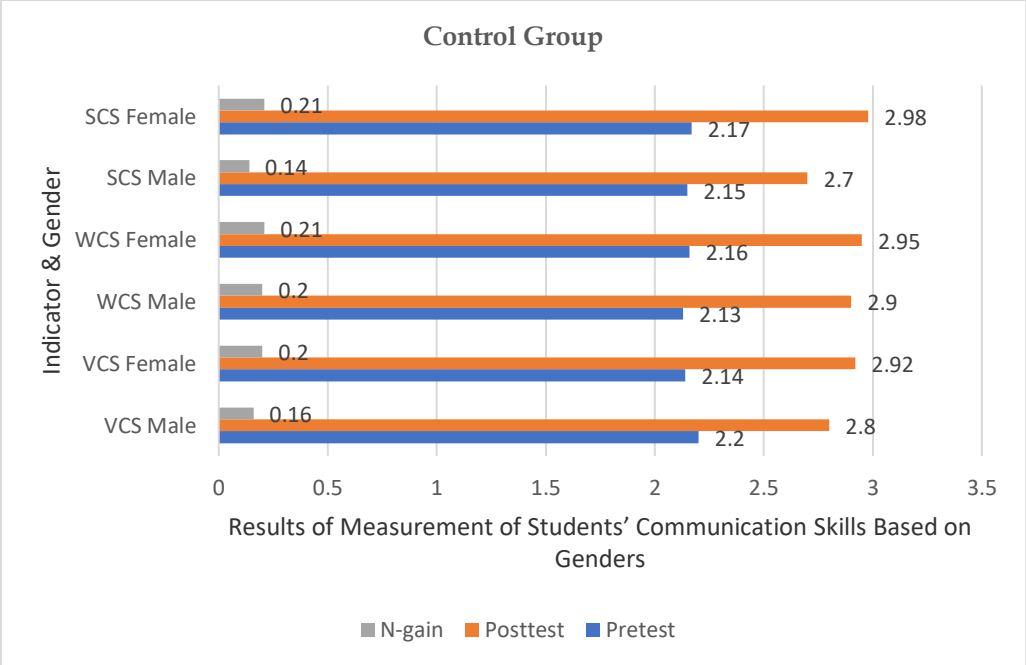


Figure 2: Students' Communication Skills Based on Genders at Control Class

Data on Figures 1 and 2 clearly show the difference in students' communication skills for both treatment groups. Results of before and after treatment show that students' communication skills in the treatment class show an increase from

average skills category to good skills category. On the contrary, the control group did not record any increase and remained at the average skills category. Furthermore, differences in the increase in the scores of the two groups were tested statistically by first carrying out homogeneity and normality tests in both groups. The homogeneity value obtained a significance value of p> 0.05, namely 0.22 in the control class and 0.26 in the experimental class and the normality values obtained are shown in Table 7.

Table 7: Results of normality test of experimental and control groups

Groups	***Shapiro-Wilk***		
	Statistic	**df**	**Sig.**
Control	0.637	50	0.540
Experimental	0.734	50	0.630

Table 7 shows that the two data groups are distributed normally. As such, a difference test on the two data groups using parametric statistic test (sample independent test t-test) comes with test results (Table 8). Results of t-test sample independent test show p > 0.05, meaning a significant difference exists in the communication skills based (CSB) on genders of the two treatment groups.

Table 8: Results of t-test independent test

Scores	**CSB**	**t-test**		
		t	df	Sig 2 tailed
Standard N-Gain	Equal variances assumed	12.069	48	0.000
	Equal variances not assumed	12.069	29.045	0.000

4.2 STEM Reasoning Abilities

Results of a descriptive analysis of STEM reasoning abilities based on genders is provided in Table 9, which refers to each treatment group's reasoning ability criteria.

Table 9: Results of measurement of students' STEM reasoning abilities based on genders for each indicator

Groups	***n***	***Score***	***Genders***	***Reasoning skill indicators***				***RSi average***	***Category***
				RA	RI	RE	RD		
Experimental	25	Pretest	Male	1.10	1.12	1.70	1.50	1.35	less
			Female	1.12	1.13	1.16	1.15	1.14	less
		Posttest	Male	3.22	3.28	3.23	3.24	3.24	good
			Female	3.14	3.30	3.20	3.21	3.21	good
		N-gain	Male	0.73	0.75	0.67	0.70	0.71	high
			Female	0.70	0.76	0.72	0.72	0.72	high
Control	25	Pretest	Male	1.13	1.13	1.12	1.14	1.13	less
			Female	1.12	1.15	1.13	1.12	1.13	less
		Posttest	Male	1.42	1.43	1.45	1.48	1.45	less
			Female	1.38	1.48	1.47	1.40	1.43	less
		N-gain	Male	0.10	0.10	0.11	0.12	0.11	Low
			Female	0.09	0.12	0.12	0.10	0.10	Low

Table 9 shows an increase from pretest scores to posttest scores based on genders according to reasoning skills were measured based on criteria for both treatment groups. The highest increases in treatment groups occur on reasoning inference (RI) indicator for females and reasoning decision (RD) for males, followed by reasoning evaluation (RE) indicator for males, while the lowest score was RA indicator for females. Average increase of RSi N-gain score for treatment class for males was 0.71 and for females 0.72 with high criteria. Enhancing in RSi with low criteria was identified on the class is not given treatment with N-gain of 0.09. For the class is not given treatment, the highest score increase was for RD indicator for males and RI indicator for females, while the lowest score was for Ra indicator for females. Visualization of students' STEM Reasoning skills based on gender differences with reference to RSi parameters (Figures 3 and 4).

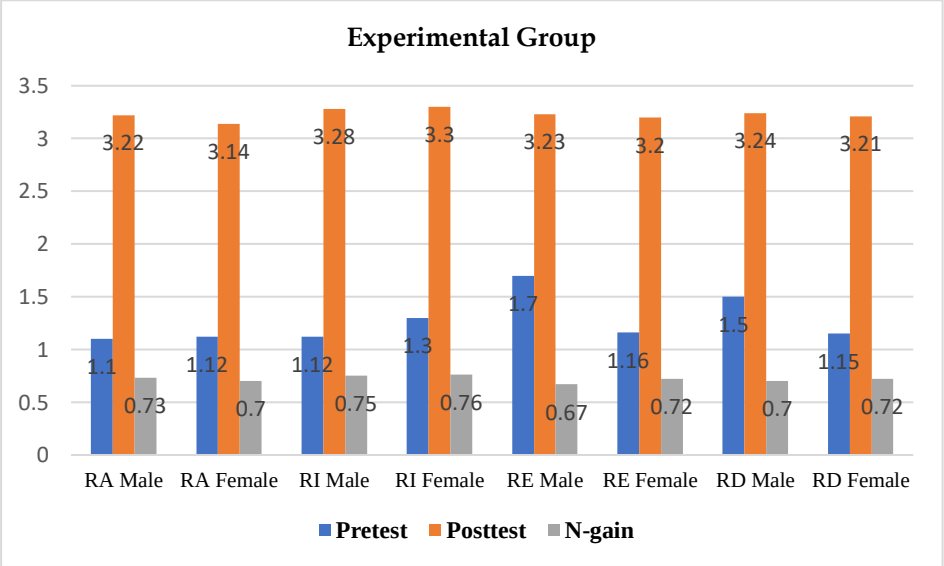


Figure 3: Students' STEM Reasoning Abilities Based on Gender in the Experimental Group

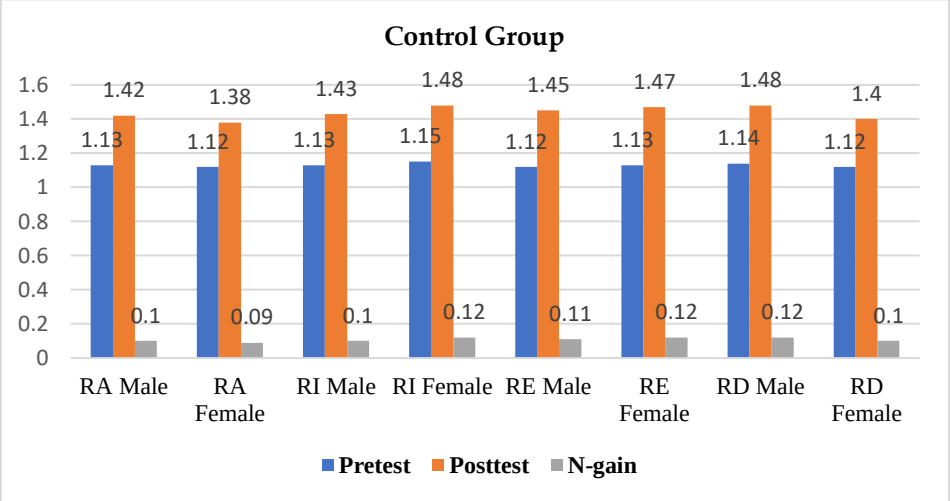


Figure 4: Students' STEM Reasoning Abilities Based on Gender in the Control Group

A summary of each treatment group's STEM reasoning ability performance based on genders with Reasoning skills were measured based on individual (RSs) parameters. RSs parameters is shown on Table 10.

Table 10: Results of measurement of students' STEM reasoning abilities based on genders

Groups	N	Genders	STEM Reasoning Abilities score and criteria				N-gain	Category
			Pretest	Category	Posttest	Category		
Experimental	25	Male	9.50	less	25.28	good	0.70	High
		Female	9.00	less	25.60	good	0.72	High
Control	25	Male	9.50	less	12.00	less	0.11	Low
		Female	9.15	less	11.50	less	0.10	Low

A summary of students' STEM reasoning abilities based on genders in Table 9 shows students' STEM reasoning abilities in the experimental class is classified in good category, while the control class in less category. Likewise, N-gain scores show that the enhancing STEM reasoning abilities in the treatment class was in high category, while that in the control class in low category. Visualization of students' STEM Reasoning abilities based on gender differences with reference to RSi parameters for experimental and control classes is shown in Figure 5.

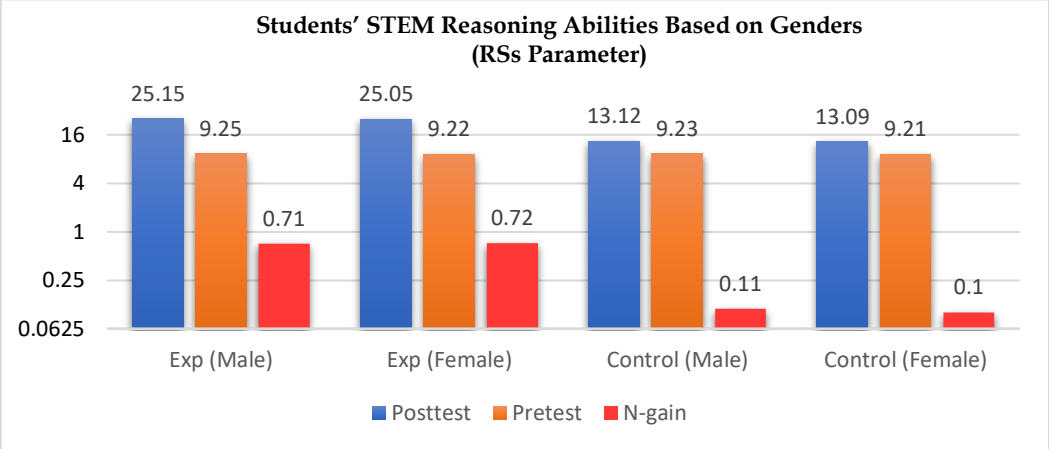


Figure 5: Students' STEM Reasoning Abilities Based on Genders for Experimental and Control Classes

Figure 5 above clearly shows the distinction STEM reasoning abilities in the two treatment groups. Results of before and after treatment show that students' communication skills in the experimental class show an increase from less category to good category. On the contrary, the control group did not record any increase and remained at the less category. Furthermore, differences in the increase in the scores of the two groups were tested statistically by first carrying out homogeneity and normality tests in both groups. The homogeneity value obtained a significance value of p> 0.05, namely 0.32 in the control class and 0.36 in the experimental class and the normality values obtained are shown in Table 11.

Table 11: Results of Normality Test of Experimental and Control Groups

Groups	Shapiro-Wilk		
	Statistic	df	Sig.
Control	0.638	50	0.530
Experimental	0.688	50	0.580

Table 10 show that the two data groups to be compared are distributed normally. As such, a distinction test on the two data groups using t-test sample independent test comes with test results as shown in Table 12. Results of t-test independent test show sig. < p (0.05), meaning a significant difference exists in the STEM reasoning abilities based on genders of the two treatment groups in favor of the experimental group. This means that the intervention given which is the application CTMBCA in teaching enhance the reasoning skills of the students than those students who wer exposed to face-to-face expository method.

Table 12: Results of t-test independent test, p < 0.05

Scores	STEM Reasoning Abilities	Score		
		t	df	Sig 2 tailed
Standard N-Gain	Equal variances assumed	13.312	48	0.000
	Equal variances not assumed	13.312	24.265	0.000

5. Discussions

5.1 Communication Skills

Data analysis shows that students' communication skills using IT-based (bandicame and canva applications) chemistry teaching materials integrated to Google Classroom platform are better than that of face-to-face learning using expository method. Findings of this study are consistent with previous studies that IT-based visual media utilization may develop students' digital literacy competencies and communication skills (Hakim et al., 2022). Similarly, utilization of IT-based chemistry module has positive impacts on the students' communication skills (Fraile et al., 2021) and there is a significant difference in students' communication skills based on genders (Yoon et al., 2021; Almuzakir & Qamariah, 2019). Research findings also show that female students' communication skills are higher than that of their male counterparts in both experimental and control groups. These findings are strongly consistent with previous studies that report that female students' communication skills are better than male students' (Hariyanto et al., 2019). This is because women are more motivated to interact in a group work, are more active in verbal presentation session, and are active in giving feedback and suggestions such that their communication skills develop better than their male counterparts (Qazi et al., 2022).

The fact that female students' communication skills are higher than that of male students is shown by the highest score on written communication skills (WCS) indicator by female, followed by social communication skills (SCS) indicator by female, and lowest score being SCS indicator for male. This research finding is strongly consistent with previous studies that show women have better verbal and written communication skills than men (Hariyanto et al., 2019; Pajk, et al., 2021). In addition, this research finding is corroborated by other research findings that prove female students' verbal competencies are more accurate and detailed, while male students are more critical with different interpretations. As such, women excel in language and writing, while men excel in mathematical calculation and logical thinking.

Another interesting finding of the study is the significant difference in the students' communication skills based on genders. The experimental group showed an increase in communication abilities from average skills category to good skills category. On the contrary, the control group did not show any increase and remained at the average skills category. The increase in the communication skills of the students in the experimental group was thanks to the advantage of the CTMBCA that were developed by integrating bandicame and canva applications that were run by means of GC platform. This necessitated the students to actively take part in the discussion, record important information, actively raise questions and respond to other students' questions so that they were able to develop their verbal communication skills (VCS), written communication skills (WCS), and social communication skills (SCS). In addition, the application of the CTMBCA enabled the students to train their visual representation abilities during the learning process, train their skills to actively

take part in communicating ideas and giving oral presentation that result in an increase in their verbal and social (Fraile et al., 2021), and train their analysis skills and written communication skills (Cleland et al., 2005, Iksan et al., 2011).

Findings of previous studies also vindicate that the use of bandicame and canva applications as learning media or teaching materials may enhance students' digital literacy competencies, increase students' STEM reasoning abilities, and have positive impacts in enhancing students' communication skills (Verawati et al., 2022; Hakim et al., 2022). Likewise, the use of canva application as learning resources has positive effect on the students' academic performance, in terms of knowledge, skills, and attitudes (Iksan et al., 2011). Moreover, use of canva and bandicame applications really helped making learning more meaningful, interesting and fun (El Kharki et al., 2021; Erlinawaty & Selan, 2021; Pajk et al., 2021). As such, application of IT-based (bandicame and canva) chemistry through GC platform may be an alternative to enhance students' communication skills and make learning more meaningful and contextual, so that learning objectives may be achieved optimally.

5.2 STEM Reasoning Abilities

Other research findings also show that there is an increase in students' STEM reasoning abilities through the application of CTMBCA. Based on the research findings, it is explicitly proven that STEM reasoning abilities using IT-based (bandicame and canva applications) chemistry teaching materials integrated to GC platform are better than those of learning using expository method. Findings of this research are consistent with the previous studies that virtual simulation may enhance students' reasoning abilities (Verawati et al., 2022) and that a distinction exists in students' STEM reasoning abilities based on genders (Valanides 1997).

Findings of this research also reveal an interesting fact that distinction were identified STEM reasoning abilities based on gender, with the highest increase on the RI indicator for females, followed by the RD indicator for males, and RA for females. The highest increase in the RI indicator for women was due to women having better systematic reasoning abilities than men. Hence, students' RI abilities experienced the highest increase after being taught using IT-based chemical teaching materials. This study's findings agree with previous studies' results, which prove that women have better STEM reasoning abilities than male students in analytical reasoning and mathematical reasoning and have higher self-confidence (Zhang, 2019; Wahyudiati et al., 2019). However, male students have better decision-making reasoning and evaluation reasoning abilities than that of female students. These findings are strongly consistent with Spelke's study (2004) that reports male students' abilities in developing and applying theories are better than that of female students. Similarly, a study by Valanides (1997) corroborates that men's performance in probabilistic reasoning far surpass women. However, different findings show that female students have better STEM reasoning abilities than male students in analytical reasoning, mathematical calculation and self-efficacy (Zhang, 2019).

Another interesting finding from this study was that there were differences in STEM reasoning skills based on gender between the class that was given the treatment and the class that was not given the treatment. The treatment class shows an increase in students' STEM abilities prior to treatment from less category into high category, while the control class also shows an increase from less category into low category. The enhancing in the STEM abilities of the experimental group was thanks to the application of CTMBCA that enabled students to develop visual representations during learning processes, train their independence to construct knowledge from abstract into more concrete form that further increases their' critical reasoning, and train their reasoning, analytical, and problem-solving abilities (Wahyudiati, 2023). Another advantage of the CTMBCA that were developed in integration with bandicame and canva applications as visual media applied through GC platform (e-learning) was that it made learning more meaningful, interesting and fun. Findings of previous studies also show that use of bandicame and canva applications as visual media was a means that was potential to provide students with opportunities to actively take part in learning processes, enhance students' digital literacy competencies, even enhance high level thinking skills and more effective communication skills (Iksan et al., 2011; Chan & Nagatomo, 2022). Previous studies also show that students' acceptance of virtual simulation application in the class was very good and had positive impacts on learning domains in terms of knowledge, skills, and attitudes (Verawati et al., 2022; Havola et al., 2021).

This study has met expectations on the fulfillment of students' accessibility in understanding chemical bonding concepts beyond the constraint of space and time. Compared to face-to-face learning with expository method, students' STEM reasoning performance is much better used the CTMBCA. The advantage of CTMBCA was appropriate to help enhancing communication abilities and help solve other problems in learning related to accessibility (Iksan et al., 2011; Fraenkel et al., 2012). Finally, for sustainable learning process we recommend use of CTMBCA with diverse application options, especially in teaching abstract concepts in sciences. This certainly requires professionalism and serious efforts on the part of the stakeholders to achieve better learning objectives and outcomes ahead of industrial revolution 5.0.

However, there are limitations to the applied IT-based chemistry teaching materials, such as the applications used are limited to the Canva and Bandicame applications integrated with the Google Classroom platform. The weakness of using the Canva and Bandicame applications is that designing an interactive video takes quite a long time. It also requires a stable internet connection, so implementing it in class requires adequate internet facilities. Likewise, the results of previous research also revealed the weaknesses of the Canva and Bandicame applications that it takes quite a long time to make, and students must have adequate multimedia facilities to be able to support the effectiveness of using the Canva and Bandicame applications during learning activities (Hakim et al., 2022). Thus, it is suggested for further research to use a variety of other applications, such as augmented reality or visual laboratories, in chemistry

learning as a form of implementing CTMBCA that can improve students' communication skills and STEM abilities to support achieving chemistry learning goals.

6. Conclusions

Based on findings of the study, the following conclusions are drawn: (1) Students' communication skills and STEM reasoning abilities may be enhanced through application of GC-integrated IT based (bandicame and canva applications) chemistry teaching materials; (2) Significant differences were noted in students' communication skills based on genders, of which highest increase was identified on WCS indicator for females, followed by SCS indicator for females, and lowest score in SCS indicator for males; and (3) significant differences were identified in students' STEM reasoning abilities based on genders with highest increase on RI indicator for females and RD for males, followed by RE for males, and lowest score for RA indicator for females. We recommend the application of GC platform-integrated IT-based (bandicame and canva applications) as one of the best solutions to enhance students' 21st century skills not only for chemistry learning, but also for science learning in the broadest sense. We recommend implementing an integrated IT-based GC platform (bandicame and canva applications) in chemistry learning as one of the best solutions to improve 21st century skills, and can support the effectiveness of e-learning based chemistry learning.

7. Limitations and Recommendations

The limitation of this research is that the applications used are limited to the Canva and Bandicame applications which are integrated with the Google Classroom platform so that further research is suggested to use other applications such as augmented reality or visual laboratories and their effects on chemistry learning. In addition, to gain a deeper understanding of the impact of implementing CTMBCA on communication skills and STEM reasoning abilities, further research needs to use qualitative data. Thus, to develop communication skills and STEM reasoning abilities of high school students, researchers suggest that chemistry learning needs to be designed using IT-based teaching materials combined with chemistry concepts that are relevant to students' daily experiences to achieve maximum chemistry learning goals. We recommend implementing an integrated IT-based GC platform (bandicame and canva applications) in chemistry learning as one of the best solutions to improve 21st century skills, and can support the effectiveness of e-learning based chemistry learning.

8. References

Ali, R., Bhadra, J., Siby, N., Ahmad, Z., & Al-Thani, N. J. (2021). A STEM model to engage students in sustainable science education through sports: A case study in Qatar. *Sustainability*, *13*(1), 1-26. https://doi.org/10.3390/su13063483

Almuzakir & Qamariah, Z. (2019). Gender differences and students' verbal communication. *Proceedings of the 3rd INACELT International Conference on English Language Teaching,* 30-43. http://e-proceedings.iain-palangkaraya.ac.id/index.php/inacelt

Anggraeni & Pentury, H. (2021). Empowering students' 21st century skills through canva application. *Jurnal Kependidikan: Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran, 8*(1), 50-57. https://doi.org/10.33394/jk.v8i1.4391

Castro, A. J. T. M. L., Arango, D. M., Branch, W. J., & Burgos, D. (2020). Digital transformation in higher education institutions: A systematic literature review. *Sensors*, *20*(11), 62-69. https://doi.org/10.3390/s20113291

Christiana, E., & Anwar, K. (2021). The perception of using technology canva application asa media for English teacher creating media virtual teaching and English learning in Loei Thailand. *Journal of English Teaching, Literature, and Applied Linguistics*, *5*(1), 62-69. http://dx.doi.org/10.30587/jetlal.v5i1.2253.

Chan, M. N., & Nagatomo, D. (2022). Study of STEM for Sustainability in Design Education: Framework for Student Learning and Outcomes with Design for a Disaster Project. *Sustainability*, *14*(1), 312. https://doi.org/10.3390/su14010312

Clark, R., & Mayer, R. E. (2011). E-Learning and the science of instruction (2nded.), J. Wiley inc. https://doi.org/10.1002/9781118255971

Cleland, J., Foster, K., & Moffat, M. (2005). Undergraduate students' attitudes to communication skills learning differ depending on year of study and gender. *Medical Teacher*, 27(3), 246-251. https://doi.org/ 10.1080/01421590400029541

Erlinawaty., & Sellan, S. (2021). The effectiveness of using bandicam in students' speaking english during midst covid 19 pandemi. *Indonesian Journal of ELT and Applied Linguistics, 1*(1), 22-35. https://jurnal-lp2m.umnaw.ac.id

El Kharki, K., Berrada., & Burgos, D. (2021). Design and implementation of a virtual labora- tory for physics subjects in moroccan universities. *Sustainability*, *13*(7), 3711. https://doi.org/10.3390/su13073711

Estevemon, F. M., Nebot,M. A. L., Cosentino V.V., & Adell-Segura, J. (2022). Digital teaching competence of university teachers: levels and teaching typologies. *International Journal of Emerging Technologies in Learning (iJET)*, *17*(13), 200–216. https://doi.org/10.3991/ijet.v17i13.24345

Fadli, A., & Irwanto. (2020). The effect of local wisdom-based ELSII learning model on the problem solving and communication skills of pre-service islamic teachers. *International Journal of Instruction*, *13*(1), 731-746. https://doi.org/10.29333/iji.2020.13147a

Fraenkel, R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research*, 8th ed. New York: Mc Graw Hill.

Fraile, F. J., Martínez, R., García., & Castejón-Limas. (2021). Constructionist learn- ing tool for acquiring skills in understanding standardised engineering drawings of me- chanical assemblies in mobile devices. *Sustainability*, 13(6), 3305. https://doi.org/10.3390/su13063305

Hake, R. (1999). Analyzing change/gain scores. Indiana University: Woodland Hills, CA – USA.

Hakim, A. R., Wulansari, N. I., & Admoko, S. (2022). Optimizing bandicam in the making of video presentations for interactive static fluid materials. *Jurnal Pendidikan Fisika Dan Teknologi*, *8*(1), 16–22. https://doi.org/10.29303/jpft.v8i1.3462

Hariyanto, H., Yamtinah, S., Sukarmin, S., Saputro, S., & Mahardiani, L. (2019). The analysis of student's verbal communication skills by gender in the middle school in South Tangerang. *International Conference on Science and Applied Science (ICSAS)*. https://doi.org/10.1063/1.5141677

Havola, S., Haavisto, E., Mäkinen, H., Engblom, J., & Koivisto, J. M. (2021). The effects of computer-based simulation game and virtual reality simulation in nursing students' self- evaluated clinical reasoning skills. *Comput Inform Nurs*, *39*(11), 725–735, https://doi.org/10.1097/CIN.0000000000000748

Iksan, Z. H., Zakaria, E., Meerah, T.S.M., Osman, K., Lian, D.K.C,. Mahmud, S. N. D., & Krish, P. (2011). Communication skills among university students. *Procedia Social and Behavioral Sciences,* (59). UKM Teaching and Learning Congress 2011. https://doi:10.1016/j.sbspro.2012.09.247

Ikonnikova, I., Sabirova, F., Batrakova, I., Filippova, A., & Garnova, N. (2022). Covid-19 effect on the assessment of the use of smartphone apps in STEM learning. *International Journal of Instruction*, *15*(4), 1113-1132. https://doi.org/10.29333/iji.2022.15459a

Irwanto, I., Wahyudiati, D., Saputro, A. D., & Lukman, I. R. (2023). Massive open online courses (MOOCs) in higher education: A bibliometric analysis (2012-2022). *International Journal of Information and Education Technology*, *13*(2), 223-231. https://doi.org/10.18178/ijiet.2023.13.2.1799

Irwanto, I., Wahyudiati, D., Saputro, A. D., & Laksana, S. D. (2023). Research trends and applications of gamification in higher education: A bibliometric analysis spanning 2013–2022. *International Journal of Emerging Technologies in Learning (iJET)*, *18*(05), 19–41. https://doi.org/10.3991/ijet.v18i05.37021

Kong, S. F., & Matore, M. E. E. (2022). Can a science, technology, engineering, and mathematics (STEM) approach enhance students' mathematics performance? *Sustainability*, *14*(1), 379. https://doi.org/10.3390/su14010379

Krumsvik, J. R. (2012). Teacher educators' digital competence. *Scandinavian Journal of Educational Research*, *58*(3), 25-38. https://doi.org/10.1080/00313831.2012.726273

Lewin, C., & McNicol, S. (2015). Supporting the development of 21st century skills through ICT. *Universität Potsdam*, 7, 181–198. https://publishup.uni-potsdam.de/opus4ubp/frontdoor/deliver/index/docId/8267/file/cid07_S181-198.pdf

Nurlu, O. (2017). Developing a teachers' gender stereotype scale toward mathematics. *Electronic Journal of Elementary Education*, *10*(2), 287-299. https://doi:10.26822/iejee.2017236124

Pavlova, M. (2013). Teaching and learning for sustainable development: ESD research in technology education. *International Journal of Technology and Design Education*, *23*(3), 733-748. https://doi.org/10.1007/s10798-012-9213-9

Pajk, T., Van Isacker, K., Aberšek, B., & Flogie, A. (2021). STEM education in ecofarming supported by ICT and mobile applications. *Journal of Baltic Science Education, 20*(2), 277–288. https://doi.org/10.33225/jbse/21.20.277

Prayogi, S., Muhali, M., Yuliyanti, S., Asy'ari, M., Azmi, I., & Verawati, N. N. S. P. (2019). The effect of presenting anomalous data on improving student's critical thinking ability. *International Journal of Emerging Technologies in Learning (iJET)*, *14*(06), pp. 133–137. https://doi.org/10.3991/ijet.v14i06.9717

Prayogi, S., Yuanita, L., & Wasis. (2018). Critical inquiry based learning: a model of learning to promote critical thinking among prospective teachers of physic. *Journal of Turkish Science Education*, *15*(1), 105-120. https://doi.org/10.1088/17426596/947/1/012013

Qazi, A., Hasan, N., Scherer, R., Sarker, Y., Alli, A.O., Paul, K. S., Hardker, G., & Maitama, J. Z. (2022). Gender diferences in information and communication technology use & skills: a systematic review and meta-analysis. *Education And Information Technologies*, *27*(3), 4225–4258 https://doi.org/10.1007/s10639-021-10775-x

Ramma, Y., Samy, M., & Gopee, A. (2015). Creativity and innovation in science and technology: Bridging the gap between secondary and tertiary levels of education. *International Journal of Educational Management*, *29*(1), 2-17. https://doi.org/10.1108/ IJEM-05-2013-0076

Spelke, E. (2005). Sex differences in intrinsic aptitude for mathematics and science? *American Psychologycal Association, 60*(9), 950-958. https://doi:10.1037/0003-066x.60.9.950

Strayer, J. (2012). How learning in an inverted classroom influences cooperation, innovation and task orientations. *Learning Environ Research*, 15(2), 171-193. https://doi.org/10.1007/s10 984-012-9108-4

Sumardi, L., Rohman, A., & Wahyudiati, D. (2020). Does the teaching and learning process in primary schools correspond to the characteristics of the 21st century learning? *International Journal of Instruction*, *13*(3), 357-370 https://doi.org/10.29333/iji.2020.13325a

Verawati, N. N. S. P., Ernita, N., & Prayogi, S. (2022). Enhancing the Reasoning Performance of STEM Students in Modern Physics Courses Using Virtual Simulation in the LMS Platform. *International Journal of Emerging Technologies in Learning (iJET)*, *17*(13), 267–277. https://doi.org/10.3991/ijet.v17i13.31459

Valanides, N. (1997). Formal reasoning abilities and school achievement. *Studies in Educational Evaluation, 23*(2), 169-185. https://doi.org/10.1016/S0191-491X(97)00011-4

Wahyudiati, D., Rohaeti, E., Irwanto, Wiyarsi, A., & Sumardi (2020). Attitudes toward chemistry, self-efficacy, and learning experiences of pre-service chemistry teachers: grade level and gender differences. *International Journal of Instruction*, 13(1), 235-254. https://doi.org/10.29333/iji.2020.13116a

Wahyudiati, D., Sutrisno, H., & Supiah, I. (2019). Self-efficacy and attitudes toward chemistry of pre-service chemistry teachers: Gender and grades level perspective. *International Journal of Scientific & Technology Research, 8*(9), 1041–1044. https://www.ijstr.org

Wahyudiati, D. (2023). The effect of implementing IT-based chemistry teaching materials on the chemistry students' stem skills. *Journal of Educational and Social Research*, *13*(3), 171-180. https://doi.org/10.36941/jesr-2023-0067.

Wahyudiati, D., Irwanto, I. & Ningrat, H. K., (2022). Improving pre-service chemistry teachers' critical thinking and problem-solving skills using project-based learning. World Journal on Educational Technology: Current Issues. *14*(5), 1291-1304. https://doi.org/10.18844/wjet.v14i5.7268

Yang, F. Y. (2004). Exploring high school students' use of theory and evidence in an everyday context: The role of scientific thinking in environmental science decision-making. *International Journal of Science Education, 26*(11), *1345-1364* https://doi:10.1080/0950069042000205404

Yoon, H. G., Kim, M., & Lee, E. A. (2021). Visual representation construction for collective reasoning in elementary science classrooms. *Education Sciences*, *11*(5), 246-254. https://doi.org/10.3390/educsci11050246

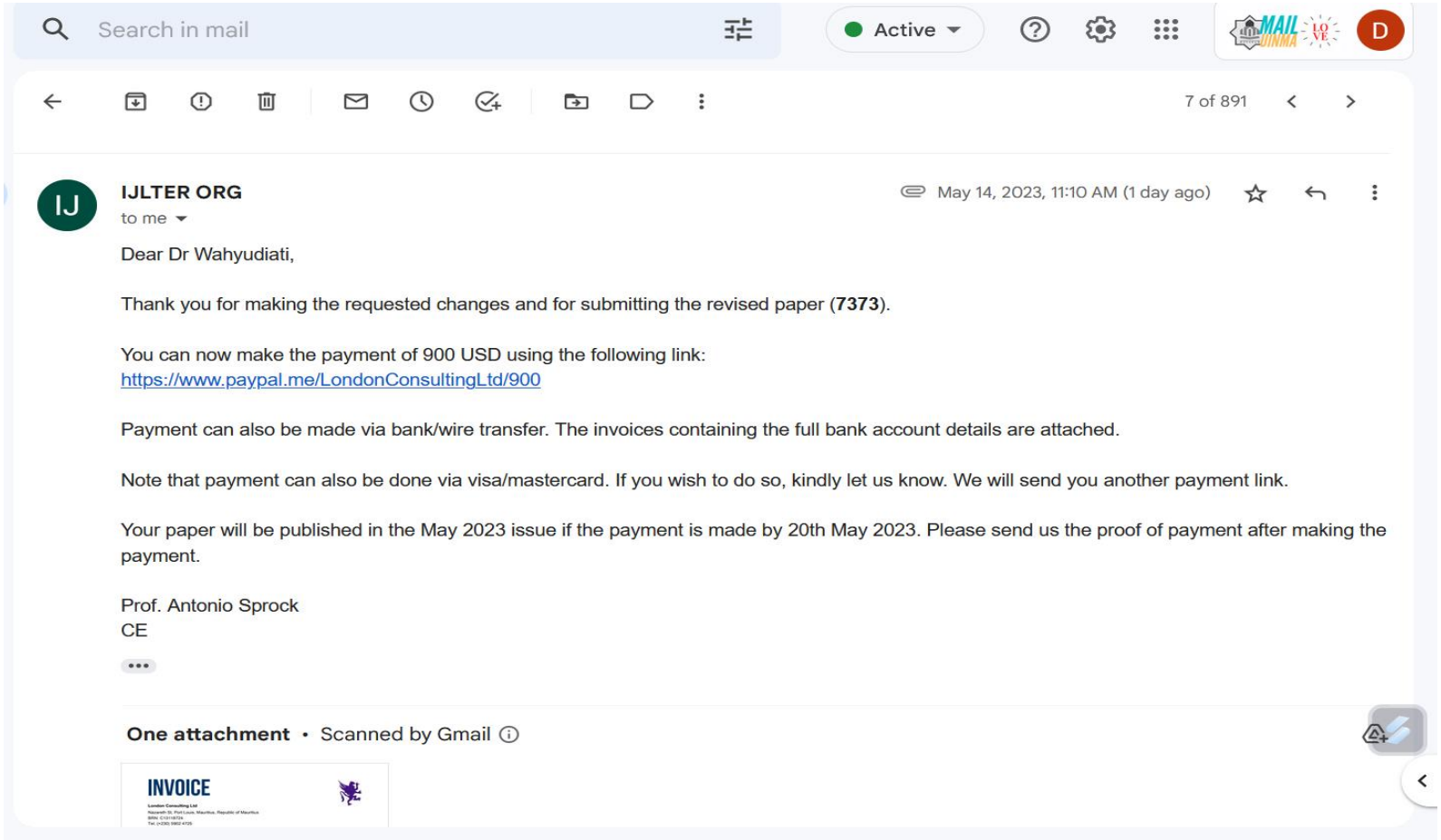
Zhang, Y. (2019). The Effect of Metaphorical Competence on Students' Writing Skill. *Creative Education*, *10*(1), 151-155. https://doi.org/10.4236/ce.2019.101011

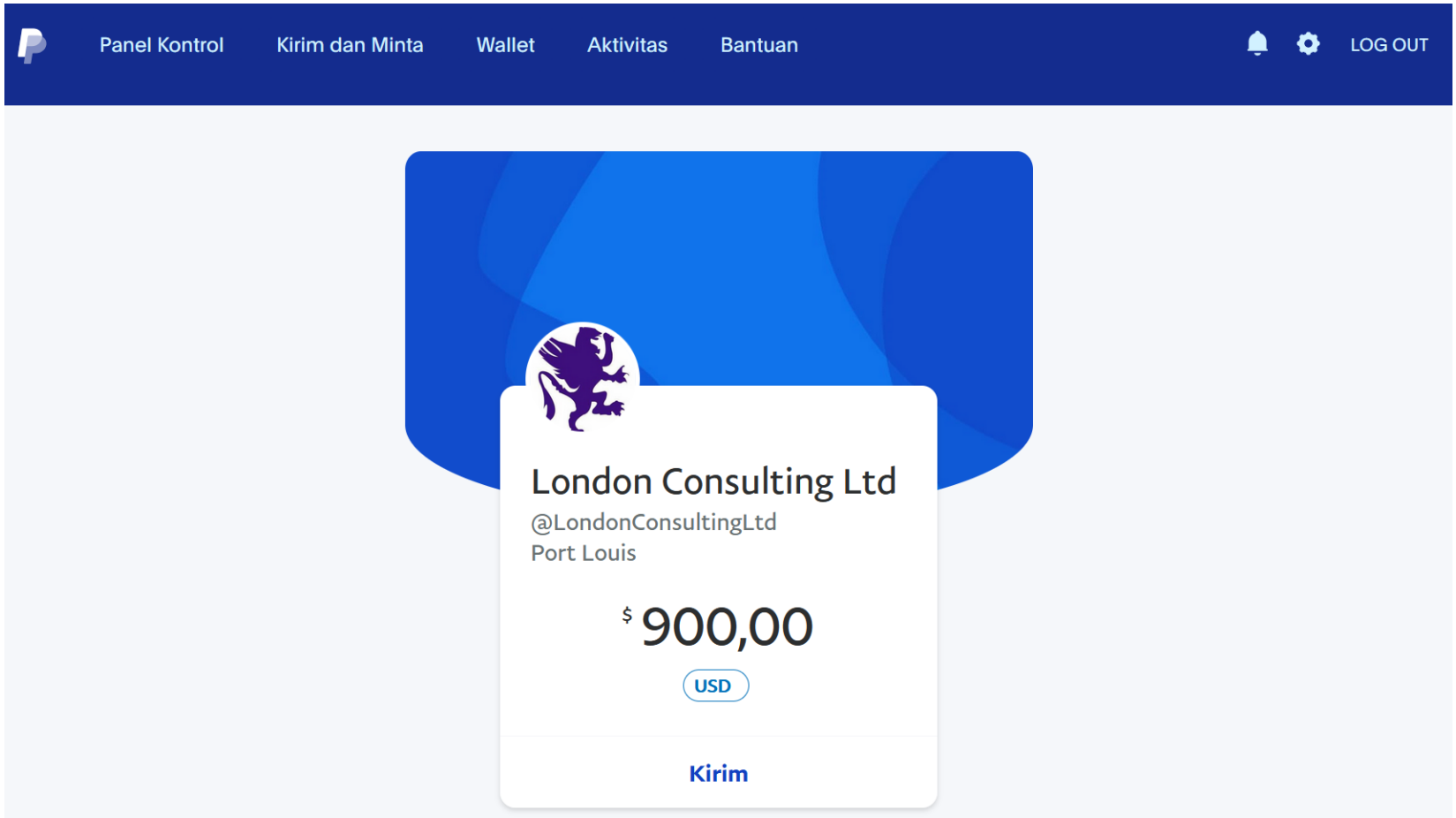
Proof of Article Payment

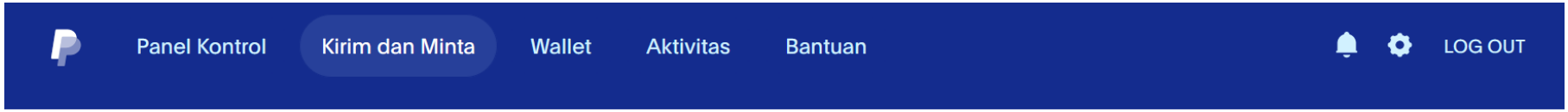
Author: Dwi Wahyudiati (Affiliation: Universitas Islam Negeri Mataram)

ID Article: 7373-24581

Article Title: Enhancing Students' Communication and STEM Reasoning Abilities Based on Gender Through Application of IT-based Chemistry Teaching Materials




Panel Kontrol
Kirim dan Minta
Wallet
Aktivitas
Bantuan
LOG OUT
London Consulting Ltd
@LondonConsultingLtd
Port Louis
$ 900,00
USD
Kirim



London Consulting Ltd
@LondonConsultingLtd

$ 900,00

USD

Bayar barang atau jasa Ubah

Dapatkan pengembalian dana penuh jika barang yang memenuhi syarat hilang atau rusak. Penjual akan membayar sejumlah kecil biayanya. Selengkapnya tentang Perlindungan Pembeli

Alamat pengiriman Anda
Kampus 2 UIN Mataram, Jalan Gajah Mada Je...

Anda mengirim dengan **Ubah**

PT. BANK NEGARA INDONESIA
Kredit ••••0439
Utama

Rp13.846.875 IDR

Anda akan membayar **Rp13.846.875 IDR**

Konversikan mata uang dengan PayPal **Ubah**

Kurs konversi: 1 IDR = 1USD
Kabar gembira! Kami menemukan kurs yang lebih baik dan telah menggunakannya di sini. Kurs ini mencakup biaya konversi mata uang.

PT. BANK NEGARA INDONESIA
Kredit ••••0439
Utama

Rp13.846.875 IDR

Anda akan membayar **Rp13.846.875 IDR**

Konversikan mata uang dengan PayPal **Ubah**

Kurs konversi: 1 IDR = 1USD
Kabar gembira! Kami menemukan kurs yang lebih baik dan telah menggunakannya di sini. Kurs ini mencakup biaya konversi mata uang.

Pembelian yang memenuhi syarat akan dilindungi oleh **Perlindungan Pembeli PayPal**

Untuk informasi lebih lanjut, baca **kesepakatan pengguna** kami.

Kirim Pembayaran Sekarang

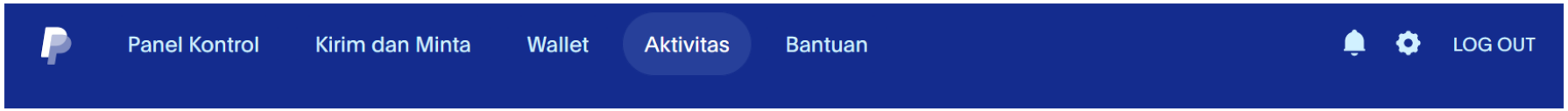
Anda telah mengirim sebesar $900,00 USD ke London Consulting Ltd

Kami akan memberi tahu London Consulting Ltd bahwa Anda telah mengirimnya.

Beritahukan kepada kami bagaimana transaksi ini berlangsung

Kirim Pembayaran Lain

Buka Ringkasan



← Kembali

London Consulting Ltd – US$900,00
15 Mei 2023 · Pembayaran Terkirim

Ulangi transaksi ini

Dibayar dengan

PT. BANK NEGARA INDONESIA (Kartu Kredit MasterCard x-0439) Anda akan melihat "PAYPAL *LONDONCONSU" — Rp 13.846.875 IDR

Informasi kontak

Pesan London Consulting Ltd

Perincian

Dikirim ke London Consulting Ltd	US$900,00
Total	**US$900,00**

Dibayar dengan

PT. BANK NEGARA INDONESIA (Kartu Kredit MasterCard x-0439)
Anda akan melihat "PAYPAL *LONDONCONSU" pada laporan kartu Anda.

Rp 13.846.875 IDR

Kurs

Rp 13.846.875 IDR = $900,00 USD
1 IDR = US$0,0001 USD

Kirim ke

Dwi Wahyudiati
Kampus 2 UIN Mataram
Jalan Gajah Mada Jempong Mataram
Mataram 83125 NUSA TENGGARA BARAT
Indonesia

Informasi kontak

Pesan London Consulting Ltd

Perincian

Dikirim ke London Consulting Ltd	US$900,00
Total	**US$900,00**

Kirim ke

Dwi Wahyudiati
Kampus 2 UIN Mataram
Jalan Gajah Mada Jempong Mataram
Mataram 83125 NUSA TENGGARA BARAT
Indonesia

ID Transaksi

0TD72164WS665664E

Anda mengirim pembayaran External Inbox ×

service@intl.paypal.com <service@intl.paypal.com> 6:05 PM (1 hour ago)

to me

Indonesian English Translate message Turn off for: Indonesian

Halo, Dwi Wahyudiati

PayPal

Anda mengirim $900,00 USD ke London Consulting Ltd

Perincian Transaksi

ID transaksi
0TD72164WS665664E

Tanggal transaksi
15 Mei 2023

Pembayaran terkirim	$900,00 USD = Rp 13.846.875 IDR
Dibayar dengan:	
MASTER_CARD x-0439	Rp 13.846.875 IDR
Anda membayar	Rp 13.846.875 IDR
Kurs konversi	1 IDR = 0 USD

Alamat Pengiriman

Kampus 2 UIN Mataram
Jalan Gajah Mada Jempong Mataram
Mataram NUSA TENGGARA BARAT 83125
Indonesia

INVOICE

London Consulting Ltd
Nazareth St, Port Louis, Mauritius, Republic of Mauritius
BRN: C13118724
Tel. (+230) 5902 4725
Email: info.londonconsultingltd@gmail.com
Tax Account Number: 27240518

BILL TO

Dwi Wahyudiati
Universitas Islam Negeri Mataram
Mataram, Indonesia

INVOICE # 2023365
INVOICE DATE 14/05/2023

DESCRIPTION	AMOUNT
Publication/Page fees for Paper 7373: Enhancing Students' Communication and STEM Reasoning Abilities Based on Gender Through Application of IT-based Chemistry Teaching Materialsl Corresponding Author: Dwi Wahyudiati Paper has been accepted for publication in Vol 22 No 5 of International Journal of Learning, Teaching and Educational Research (IJLTER)	900.00

TOTAL **$900.00 USD**

LONDON CONSULTING LTD
PORT-LOUIS

Thank you

TERMS & CONDITIONS

The bank details for Wire Transfer are as follows:
Bank Name: The Mauritius Commercial Bank Ltd
Bank Address: Sir William Newton Street, Port Louis, Republic of Mauritius
SWIFT CODE: MCBLMUMU
IBAN: MU25MCBL0944000443515360000MUR
Bank Account Number of Beneficiary: 000443515360
Name of beneficiary: London Consulting Ltd
Address: Port Louis, Republic of Mauritius

KEMENTERIAN AGAMA RI
UNIVERSITAS ISLAM NEGERI (UIN) MATARAM
DEVELOPMENT OF LANGUAGE
JLN. GAJAH MADA JEMPONG MATARAM, NO. 100 TELP. 0370 (623877) FAX: 623877

CERTIFIKAT OF PROFREADING

This is to certify that the following manuscript has been thoroughly proofread and edited regarding its lexico-grammatical usage by professional native English speaking editors at the Center for Language Development, Mataram State Islamic University.

Manuscript Title

Enhancing Student's Communication and STEM Reasoning Abilities Based on Gender Through Application of IT-based Chemistry Teaching Materials

Author :

Dwi Wahyudiati

Director :

Dr. Muhsinin, M.A.
NIP. 196812311993031022