

## Coverage, Opinion and Speculation: Key Features Analyzed by TURET 2.0

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**Abstract.** Developing a thesis is a process that demands time and dedication by the student since it is necessary to comply with conditions and norms established by institutional guides of the universities. This work describes a computational web tool that allows to evaluate the conclusion section of a thesis, focusing on three aspects: “Coverage”, i.e. the connection between the general objective and the conclusion, “Opinion”, value judgments about the concluded research, and “Speculation”, i.e. evidence of a reflection on future work. This tool is incorporated into TURET 2.0. With the release of this updated version, TURET becomes a tool that the student can employ to analyze his/her thesis draft under acceptable parameters before submitting it to his/her adviser for further review. TURET will provide the analysis of the lexical richness and the analysis of key features of a conclusion section. We present details about the performance and the interfaces of the computational tool developed.

**Keywords:** E-learning, natural language processing, coverage, opinion, speculation, thesis conclusion.

### 1 Introduction

The completion of a bachelor’s, master’s or doctoral degree is usually accompanied by the realization of a thesis. The student carries out a research project according to his career and investigates it thoroughly until generating a document that contains the most accurate description about the main subject of the project. Writing the thesis is laborious, and often occurs that the student has no idea of what to write in such document [1]. An additional problem is complying with the parameters that are

suggested by the methodology book authors and institutional guides. So, writing the thesis is really an arduous work.

Students can easily find different guides and steps to follow on internet to develop a thesis. However, there is no guarantee that students achieve the target using only a guide, i.e. elaborating a thesis is more than just following steps of a web page [2, 3]. It is necessary that students write their own first draft and improve it with the observations of the academic reviewer. Theoretical foundation to develop it represents a methodology and designs already established to be carried out correctly. For students, it is essential to know that there exist some key elements that must be fulfilled in some of the thesis sections, such as coherence, argumentation, opinion, or speculation. These features provide support for a thesis to have a better internal structure. We focus on the analysis of conclusion section, since it focuses on the results obtained from the project.

A pattern that summarizes what is expected in a conclusion section is provided by Teaching & Learning Centre at University of England, Australia (UNE)<sup>1</sup>. This pattern goes from the specific to the general, and begins with a reformulation of the problem, followed by key findings (the student should express his thoughts and opinions, avoiding a list of results), and ending with recommendations and future work. This guide pattern is like the conclusion of a scientific article, but more extensive.

In the five-paragraph essay paradigm [4], the introduction and conclusion share the main topic, this is the theme or subject matter of the essay. This approach is similar to the conclusions section, since the conclusion should be related to the general objective (considering methodological guidelines), in the initial paragraph of the conclusion. The Online Writing Lab at Purdue University provides an outline to write the conclusion section, emphasizing that the conclusion must contain well-argued viewpoints and avoid inclusion of additional items that are not contained within the thesis [5]. Future work and recommendations included in the conclusion are evidence that the student has gone beyond the solution of the problem and can identify possible derivations of the work.

For this purpose, in previous work [6], three main subcomponents (models) were designed to identify in the conclusions the following features:

- Coverage: The model seeks to assess whether some of the sentences of the conclusion section have some connection with the general objective. This will reveal that the proposed solution to the problem is discussed.
- Opinion: Value judgments and reflections elaborated by students are key features of a conclusion. With the proposed model in this work, we attempt to assess whether the conclusion has some level of opinion. The idea is to help the student to undertake a process of analyzing his results and that the conclusion is not just a list of completed activities.
- Speculation: Our proposed model identifies the presence of speculative terms in conclusion sentences. As a result of the reflections of the research already done by the student, we expect that the conclusion shows evidence of future work or possible derivations of it.

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<sup>1</sup> <https://aso-resources.une.edu.au/academic-writing-course/paragraphs/conclusion-paragraphs/>

Our computational tool fits within the systems performing Automated Writing Evaluation (AWE). Also called Automated Essay Scoring (AES), such task refers to the process of evaluating and scoring written text using a computer system. These systems build a scoring model by extracting linguistic features on a specific corpus that has been annotated by humans. For this task, the researchers have been using artificial intelligence techniques such as natural language processing and machine learning algorithms [7].

In this context, the system Writing Pal (WPal) offers strategy instruction and game-based practice in the writing process for developing writers. The AWE system in WPal, assesses essay quality using a combination of computational linguistics and statistical modeling. The authors selected different linguistic properties and were used as predictors [8].

In a related work, lexical richness is studied in terms of lexical variation and sophistication, analyzing its relationship with oral proficiency in L2 learners [9]. The main conclusion was that helping learners to increase their knowledge of less-commonly-used words will impact positively on their lexical variation and the overall lexical richness, as we aspire after draft assessment.

## 2 Coverage, Opinion and Speculation

To analyze the text, some text analysis tools of open source are necessary, among which is Freeling<sup>2</sup>. One of the main functions that allows to achieve this tool is the lemmatization of words, i.e. obtains the infinite form of the word, removing the conjugation in any form, and leaving the word in its base form.

In order to apply Freeling on line, the API provided by the UNAM<sup>3</sup> server was installed. The next step was to remove empty words such as prepositions, conjunctions, articles, pronouns, and so on. Freeling does not have this functionality, so the tool to use is NLTK<sup>4</sup> that has a range of options for the Spanish language. Attached to this tool, the removal of symbols allows to have more control over the analysis to perform, so that only the content words that are important to obtain the expected result are left. Having already the preprocessed text, it is possible to begin to carry out the study for the features of interest, i.e. Coverage, Opinion and Speculation. Below, we provide the expressions applied to compute each characteristic. These formulas were proposed in [6].

Coverage equation:

$$C = \frac{\#(So \cap SC_i)}{N}, \quad (1)$$

C = Coverage,

So = List of words of an objective,

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<sup>2</sup> <http://nlp.lsi.upc.edu/freeling/>

<sup>3</sup> <http://www.corpus.unam.mx/servicio-freeling/>

<sup>4</sup> <http://www.nltk.org/>

SC<sub>i</sub> = Sentence i of conclusion,

N = Number of terms in the objective.

For Coverage measure the parameters are:

Absence of connection < 0.12, 0.12 < Acceptable < 0.41 Strong connection > 0.41.

Opinion equation:

$$T = \sum Wi \left( \frac{On + Op}{N} \right), \quad (2)$$

T = Score (the result is obtained by adding the average load of each word of the sentence).

On = NegativeScore,

Op = PositiveScore,

N = Number of occurrences (noun, pronoun),

Wi = each word of sentence.

For Opinion measure the parameters are:

No Opinion < 7.84 7.84 < Yes, a Little < 26.98 Yes, a lot > 26.98.

To achieve the result of the analysis, it is necessary to obtain the values that will be entered in each one of the formulas. In the case of the connection, one must find the similar words that exist between the objective and each one of the sentences of the conclusion. The number obtained from this comparison will be divided by how many words the objective contains. The formula applies for each of the conclusion's sentences and the result, that will be obtained as the user's score, will be the maximum value obtained in the formula.

For Opinion feature, SentiWordNet<sup>5</sup> was employed, this lexical resource contains more than 117 000 records among which we can find a little more than 900 000 words that express an opinion that has a certain weighting of sentiment either negative, positive or objective. The same word can appear more than once since its opinion level changes depending on whether it is being used as a verb or noun. It is noteworthy that to carry out this analysis, it was necessary to translate the words from Spanish to English language since SentiWordNet was developed for the English language.

The third model aims at identifying evidence of sentences that describes future work or derivations of the research. For this purpose, we resort to two lists of speculative terms. The way to obtain these values was through a comparison of 227 speculative terms [6], based on some sources and research works that are the theoretical basis of TURET 2.0. In order to carry out the analysis of this model, the list of words was compared with the text of the conclusion in its original form before lemmatization. If there were more than two similar terms in the text, it can be inferred that the student evidenced future work.

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<sup>5</sup> <http://sentiwordnet.isti.cnr.it/>

### **3 TURET 2.0**

TURET2.0, mentioned in the title of this article, is the complement to an earlier version that was developed to analyze the lexical richness existing in the different sections that are part of a thesis [10].

TURET is developed in Django 1.11 which is a framework that allows to create Web pages without the need to be repeating code, ordering it with models and a database administrator that facilitates the storage of the information. To be programmed, the language Python was used with a series of special functions that give the possibility to make a connection between the code of the frontend and the backend, i.e., besides being the base language of Django, it also serves as intermediary to show to the user the variables in the web page.

HTML5 was employed to develop the interface that would be displayed to the student. Django presented itself as the best choice. The data derived during the analysis, are shown to the user in the corresponding categories and one of them stores all the results. Notes and grades that the user obtains, are stored in the database that can only be viewed by users who have an administrator account, this will allow them to follow the progress of the student, as well as keep a record of each of the analyses that will be helpful when the instructor wants to evaluate that has helped the intelligent tutor to thesis.

The student's evaluation will serve as a reference to reach some improvements concerning the three models that are being evaluated in its conclusion. As part of the notes shown in the interface when is returned to the student the rating on his models, it adds a small extra content that indicates what his level has been, either low, acceptable or an excellent level, and in turn, will indicate the value the student must obtain to reach the next level.

### **4 TURET and the Conclusion Analyzer**

The interface was done as friendly as possible to the student so that it was not difficult to use it and at the same time, it provides an easy to interpret result. In the top bar, as Figure1 illustrates, a link was placed so that the student can go to the previous version of Turet and thus analyze the lexical part of his thesis. Only users who registered correctly can use the analyzer, because it is mandatory to have the results of their evaluations in order to be saved in their database records.

At the time of registration, the student has to complete the form with actual data and at the same time, verify that the information that is being provided is correct. The data entered in the sections of the form will be used only to maintain a profile to the user and has its own advances that can be analyzed by the advisor in progress for a better final review.

In Figure 2 the text boxes placed under the blue button show the information of the analysis result. Note in the example that the objective and conclusion of one of the thesis that has already been evaluated by a committee of reviewers has been supplied.



Fig. 1. Conclusion Analyzer [https://utnturet.herokuapp.com/].



Fig. 2. Analyzer interface.

As shown in the result, the student has obtained a “strong connection” between his initial objective and the conclusion. TURET informs the student that has reached an excellent grade. In the part of the Speculation, the student has used three words that indicate a future work, otherwise TURET send a message to student that is necessary to incorporate a text that contains future work

By clicking “Show all the details”, a window that contains the detailed description of the computation done by each model is opened. The sample analysis shows an objective and a conclusion of an element in our corpus.

In Figure 3, the similar words that have been found between the objective and the conclusion are 24, in this case. The sentence that has a greater connection and that is the one shown as evaluation is taken into account. In the event that the student wants to copy the complete sentence of the objective and pass it to the conclusion, it has a maximum acceptable value to avoid giving it an inadequate grade.

Palabras especulativas encontradas
Se han encontrado 3 palabras sobre especulación, estas palabras son: propuesto , propuesta , factible Felicidades, has alcanzado una excelente nota.
Palabras similares encontradas en cada oración
En la oración 1 se tienen 12 palabras similares, las cuales son: control , adaptativo , parámetro , parámetro , tiempo , vida , ttl , algoritmo , colonia , hormiga , aplicar , solución En la oración 2 se tiene una palabra similar la cual es: parámetro En la oración 3 se tienen 3 palabras similares, las cuales son: control , local , parámetro En la oración 4 se tiene una palabra similar la cual es: parámetro En la oración 5 se tienen 7 palabras similares, las cuales son: control , manera , local , parámetro , ttl , algoritmo , sqrp En la oración 6 no se tienen palabras similares.
Total de palabras similares encontradas
24 palabras similares entre tu objetivo y conclusión, estas palabras son: control , adaptativo , parámetro , parámetro , tiempo , vida , ttl , algoritmo , colonia , hormiga , aplicar , solución , parámetro , control , local , parámetro , parámetro , control , manera , local , parámetro , ttl , algoritmo , sqrp
Palabras con opinión encontradas en tu tesis
Tienes un buen juicio, se han encontrado 33 palabras de opinión, las cuales son: Trabajo , innovador , enfoque , solución , problema , parámetro , ajuste , adaptable , control , particular , aplicado , vida , tiempo , hormiga , colonia , acuerdo , especializado , dividido , sintonización , Eficientemente , resolver , semántica , consulta , modelado , complejo , controlando , usando

**Fig. 3.** Detailed analysis of the results.

In a proposed example, 12 similar words have been found between the objective and the conclusion in sentence 1. When doing the analysis of the value judgments that the student has given to reaffirm his arguments on the content of his thesis, the conclusion of the example has given a grade of 4.17, which is low.

**Table 1.** Grade obtained from the used example.

Model	Grade	Result
Speculation	3 words	Acceptable
Opinion	4.17	Low Judgment
Coverage	0.54	Strong Connection

To reach the acceptable level, it is necessary to have a note higher than 8 and if the student wants to reach a strong connection he has to overcome the 26.98, this is a grade almost 4 times higher than the one the student has obtained in this example supplied.

Considering the values achieved in the assessment by TURET, depicted in Table 1, the student has reached an acceptable grade in 2 of the 3 categories that are being evaluated and the only one that a low grade was obtained, is far from being outstanding. Noteworthy, that the thesis was reviewed by an advisor and he gave his approval to it.

If we take into consideration the result of the analysis of this thesis, we can determine that it is necessary to implement this type of tools for the advisor to take care of these small details before giving the approval.

## **5 Conclusions**

TURET 2.0 is a tool aimed at supporting students to guide them in the writing of their thesis, it is a mistake to think that this will get rid of the academic advisor, on the contrary, this is a tool that comes to reduce the extra time dedicated by the advisor and the student to correct common errors. It is expected in the future to carry out a pilot test with students who are either developing a research project or elaborating their thesis.

The conclusion can be analyzed as often as necessary to make sure that the student is following the right path without deviating from the initial objectives, this allows the student to check the advances that is taking as he progresses in his writing.

In addition, TURET 2.0 is expected to expand the functionality to make the analysis more customizable. TURET has been complemented to the present and is intended to expand with other models, so that students have a complete tool that allows them to have a thesis with a more than admissible writing, with a high degree of possibility to be accepted in a shorter time after its review.

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