Successful essay writing by students typically involves multiple rounds of revision and assistance from teachers, peers, or automated writing evaluation (AWE) systems. Natural language processing (NLP) has become a key component of AWE systems, with NLP being used to assess the content and structure of student writing. Typically, students are involved in cycles of essay drafting and revising with or without AWE systems. After drafting an essay, students often receive formative feedback automatically generated by a system or provided by other humans such as teachers or student peers. During the revision process, students then produce texts that are in line with the feedback, to improve the quality of the essay. Hence, analyzing student revisions in terms of their desirability for improving the essay is important.

Current intelligent writing assistant tools typically provide instant feedback by locating problems in the text (e.g., spelling mistake) and providing possible solutions but fail to tell if the user successfully implemented the feedback, especially feedback that involves higher-level semantic analysis (e.g., better example). In this thesis, we take a step towards advancing automated revision analysis capabilities. First, we propose a framework for analyzing the nature of students' revision of evidence use and reasoning in text-based argumentative essay writing tasks. Using statistical analysis, we evaluate the reliability of the proposed framework and establish the relationship of the scheme to essay improvement. Then we propose computational models to study the automatic classification of the desirable revisions. We explore two catalysts for predicting revision desirability – the context of the revision, and the feedback students received before the revision. To the best of our knowledge, this is the first study to explore using feedback messages for a revision classification task. Finally, we also explore how auxiliary knowledge from a different writing task might help improve the identification of desirable revisions using a multi-task model and transfer-learning.