Level-Up: Learning to Improve Proficiency Level of Essays

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Abstract

- What is the goal of this work?

  To level up learner’s essays

- We proposed a method for

  Extract grammatical elements

  Suggest grammatical elements at higher levels

  Analyze and recommend words

Abstract

- Our result

  Provide useful grammatical element for learners

- Conclusion

  Have potential in writing assistance for learners

  Pattern-matching is simple but effective to identify elements

  Identified elements can be used as features for automated essays scoring systems as features

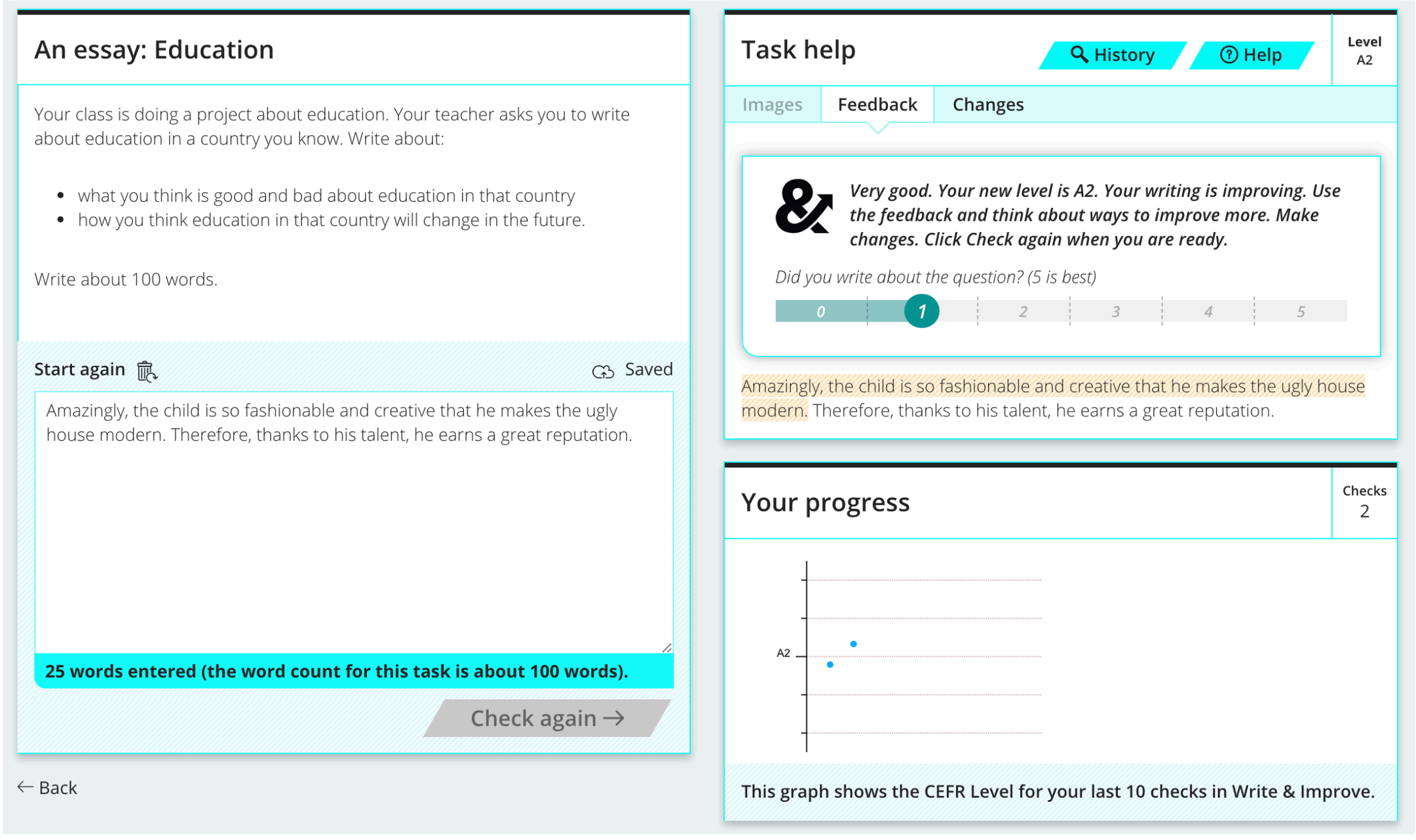
1. Introduction

Computer Assisted Language Learning (CALL)

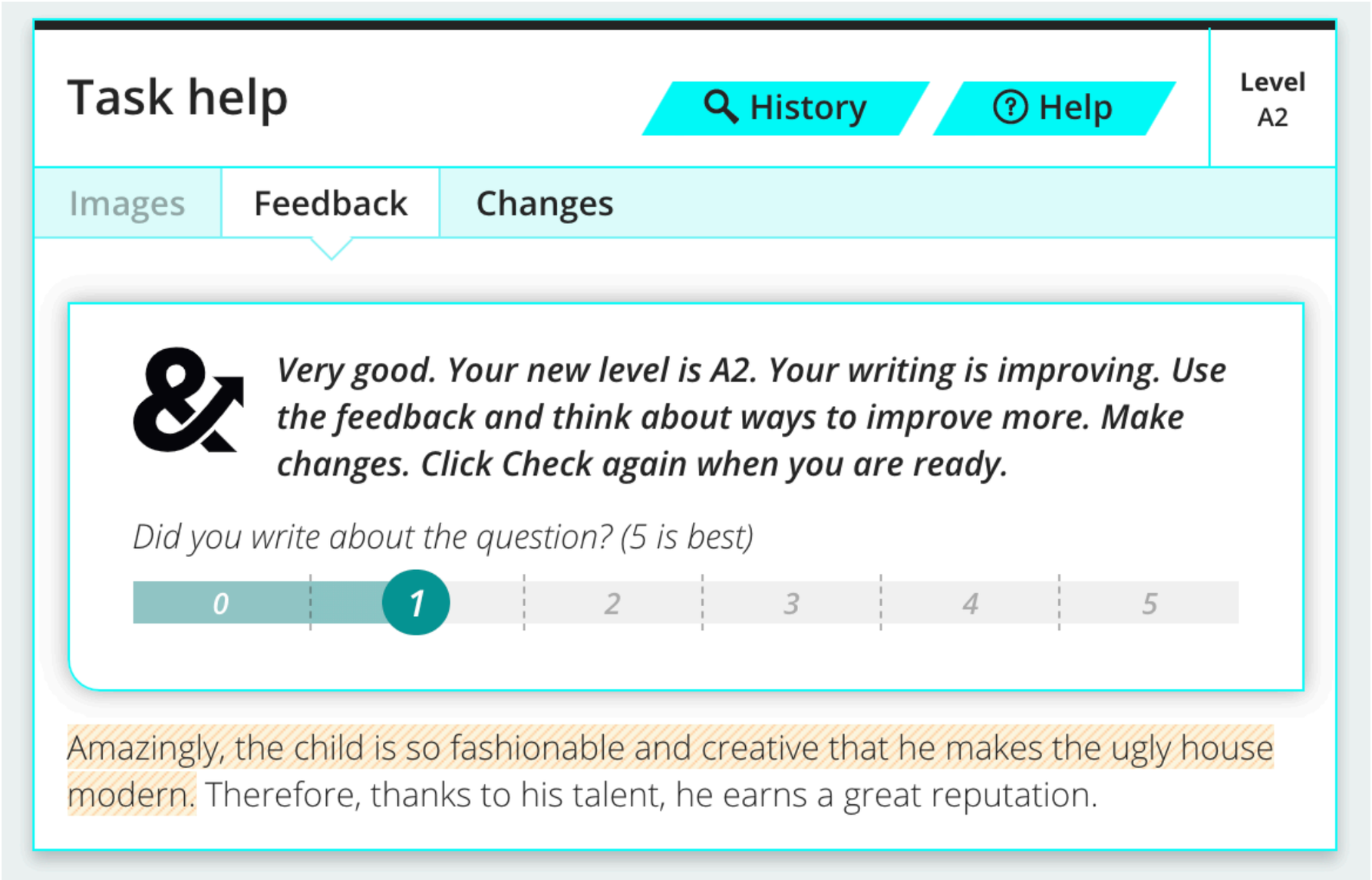
- Writing Assistance
  - WriteAhead
  - Linggle
- Grammar Error Correction
  - Grammarly
  - 1checker
  - Ginger
- Automated Essay Scoring
  - Write&Improve
  - WhiteSmoke

1. Introduction

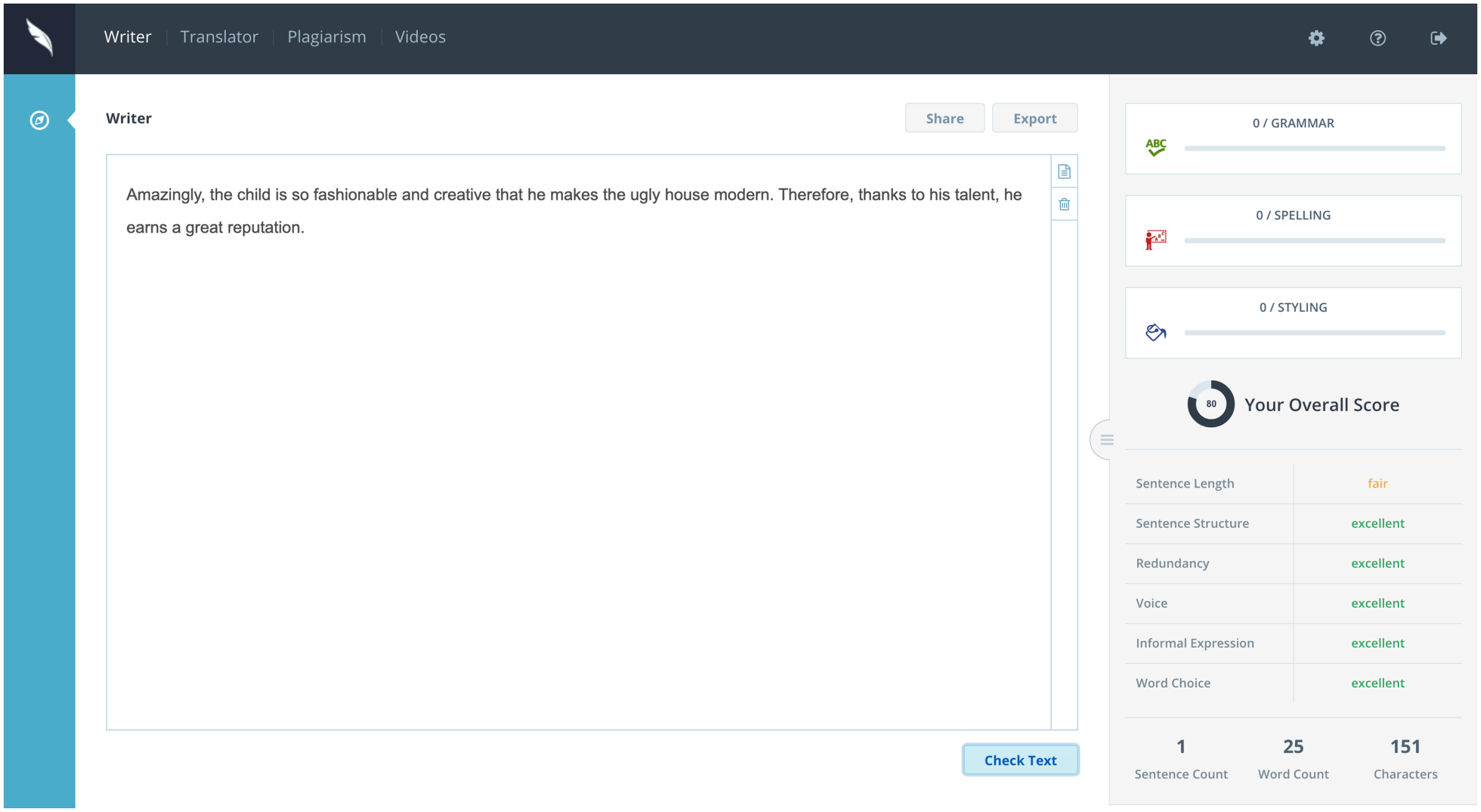
Write&Improve



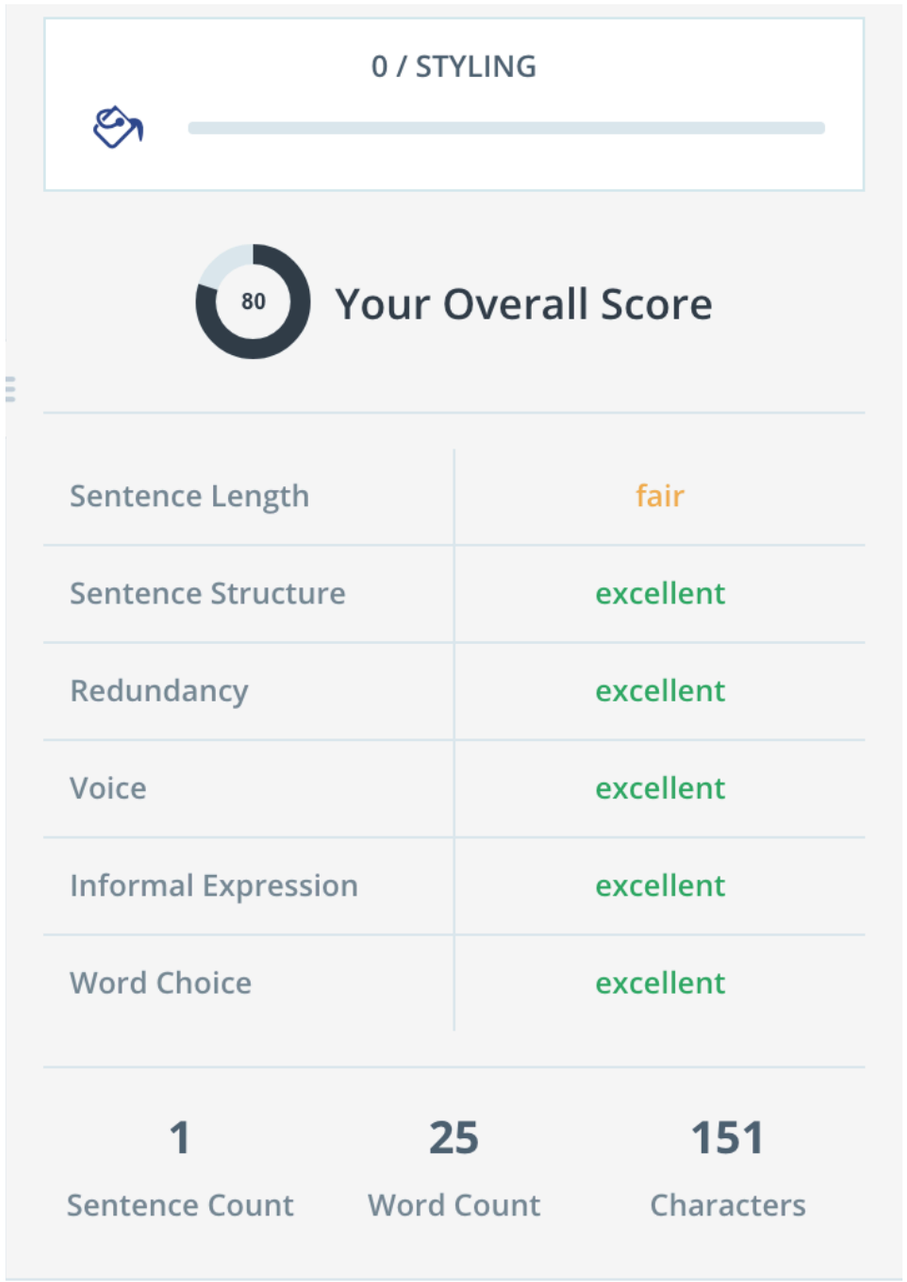
Write&Improve



WhiteSmoke


Writer
Translator
Plagiarism
Videos
Writer
Share
Export
Amazingly, the child is so fashionable and creative that he makes the ugly house modern. Therefore, thanks to his talent, he earns a great reputation.
Check Text
0 / GRAMMAR
0 / SPELLING
0 / STYLING
80
Your Overall Score
Sentence Length
fair
Sentence Structure
excellent
Redundancy
excellent
Voice
excellent
Informal Expression
excellent
Word Choice
excellent
1
Sentence Count
25
Word Count
151
Characters

WhiteSmoke


0 / STYLING
80
Your Overall Score
Sentence Length
fair
Sentence Structure
excellent
Redundancy
excellent
Voice
excellent
Informal Expression
excellent
Word Choice
excellent
1
Sentence Count
25
Word Count
151
Characters

Problems

- GEC - No feedback on improvement
- AES - Grade as a whole, no explanation
- Market - No improvement system
- Research - Not much

Grammatical Improvement

- Prototype System
  - Evaluate in the unit of sentence
  - Detect grammatical elements
  - Provide levels with explanation

Common European Framework of Reference (CEFR)

- Reference document
- Describes what learners **can do** at different stages by skill
- Language-neutral

Learn Teach Assess

CEFR Level

Level			General description	Cambridge English Exam
Proficient user	C2	Mastery	Highly proficient – can use English very fluently, precisely and sensitively in most contexts	Cambridge English: Proficiency
	C1	Effective Operational Proficiency	Able to use English fluently and flexibly in a wide range of contexts	Cambridge English: Advanced
Independent user	B2	Vantage	Can use English effectively, with some fluency, in a range of contexts	Cambridge English: First/First for Schools
	B1	Threshold	Can communicate essential points and ideas in familiar contexts	Cambridge English: Preliminary/ Preliminary for Schools
Basic user	A2	Waystage	Can communicate in English within a limited range of contexts	Cambridge English: Key/Key for Schools Cambridge English: Flyers
	A1	Breakthrough	Can communicate in basic English with help from the listener	Cambridge English: Movers Cambridge English: Starters

English Profile (EP)

- Led by Cambridge University Press & Cambridge English Language Assessment
- Describes aspects of English learned at each level
  - English Grammar Profile (EGP)
  - English Vocabulary Profile (EVP)
- Helps teachers and educationalists understand what CEFR means for English

English Grammar Profile

- How learners develop competence in grammatical form and meaning
- 1,222 Grammatical Elements (GEs)

Adjectives - Combining - A2
Can use 'but' to join a limited range of common adjectives, after ‘be’.

Adjectives - Combining - B1
Can use a comma to combine two adjectives used before the noun, following the usual order of adjective types.

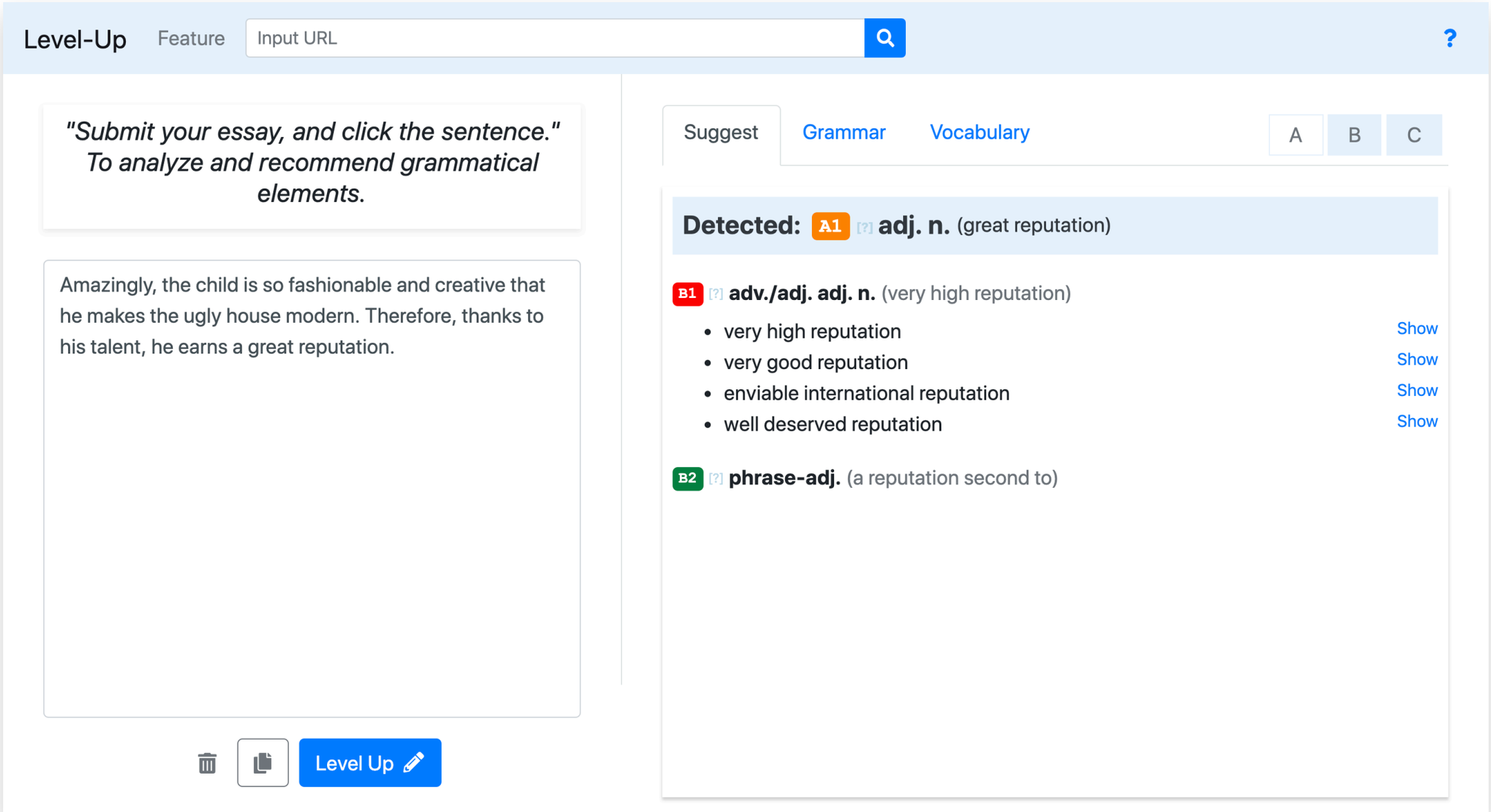
Adverbs - adverbs as modifiers - B2
Can use a wide range of adverbs and adverb phrases to refer to the timing of an event.

English Vocabulary Profile

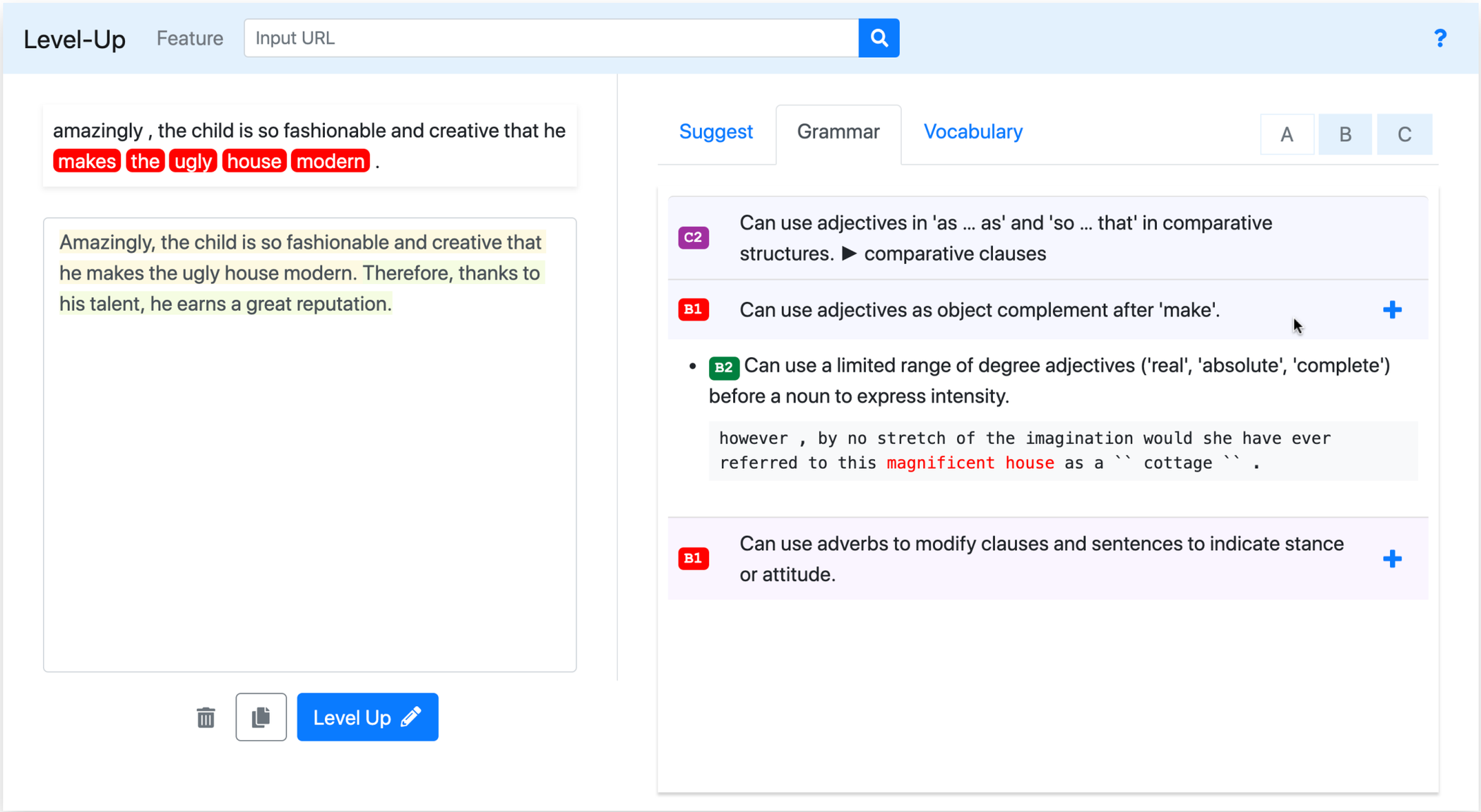
- Offers the meaning of words (phrases) at each CEFR level

Word / Phrase	POS tag	Level	Meaning
fly	verb	A1	travel
fly	verb	A2	move through air
fly	verb	B2	control aircraft
fly	verb	C2	time
fly	verb	C2	take/send
fly	noun	B1	
with flying colors		C1	
fly in the face of		C2	

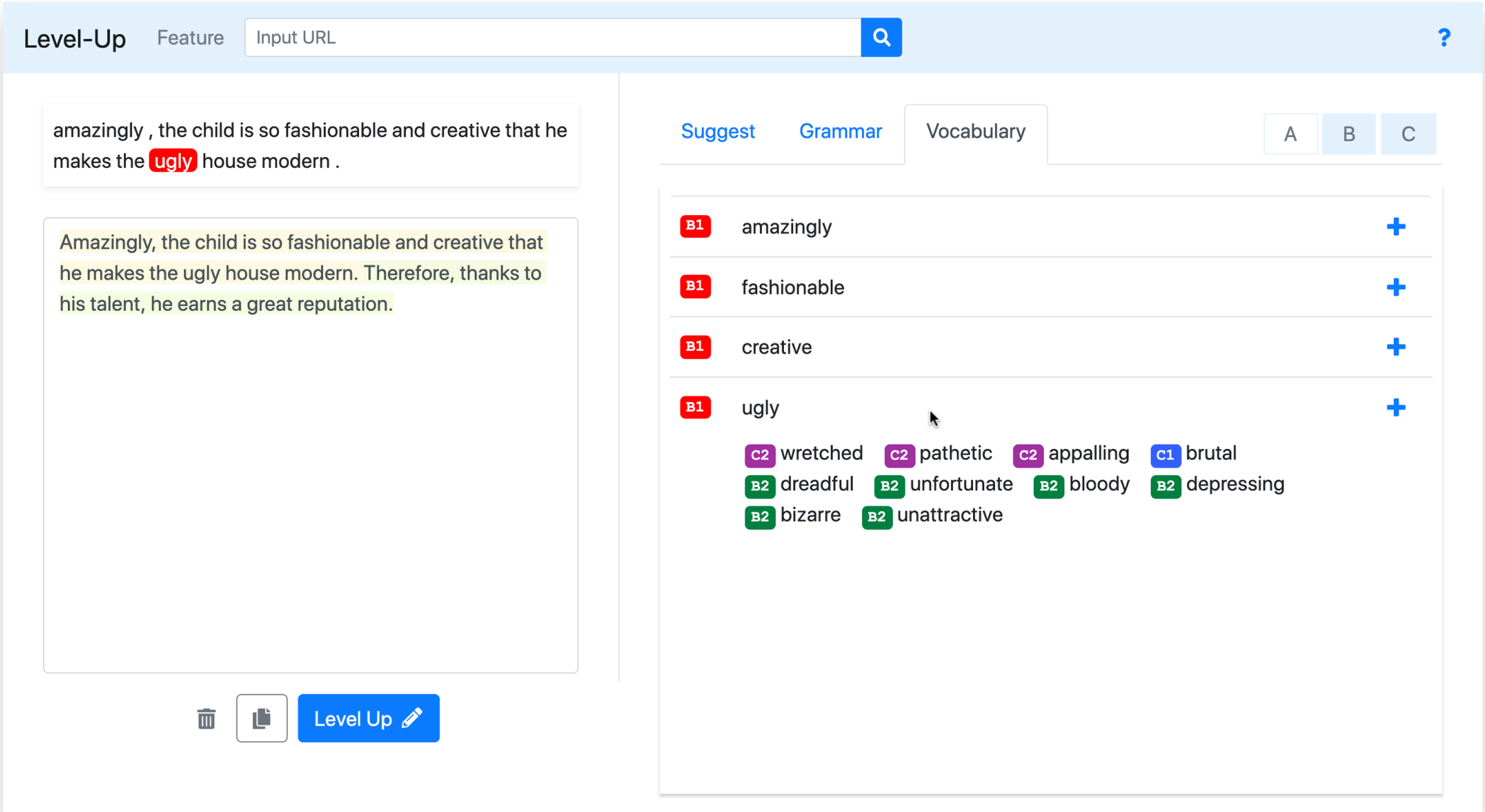
Prototype System



Prototype System



Prototype System



2. Related Work

Level Detection

- Hancke and Meurers (2013)
  - Use lexical, syntactic, and morphological features to classify readability for German
- Vajjala (2014)
  - Predict a learner's language proficiency in Estonian in CEFR scale
  - Use morphological and POS tag information extracted from the texts
- Pila´n et al. (2016)
  - Cope with high cost of collecting learners' data
  - Use texts from language learning coursebooks to train classifiers for predicting proficiency levels

Level Detection

- Vajjala (2017) and Tack et al. (2017)
  - Identify the linguistic variables indicative of writing quality to evaluate language proficiency
- Bartning et al. (2019)
  - Use CEFR to assess proficiency
- Our work
  - Utilize CEFR criteria to evaluate essays,
  - Focus specifically on grammatical elements (e.g., EGP)

Automated Essay Scoring

- Attali and Burstein (2006); Chen and He (2013); Andersen et al. (2013b)
  - Statistical approach to evaluate the essays as a whole
- Taghipour and Ng (2016)
  - Use word-level LSTM model
  - Outperform previous work using CNN and RNN
- Dong et al. (2017)
  - Add attention mechanism to determine either words or sentences are more important

Write&Improve

- Andersen et al. (2013); Yannakoudakis et al. (2018)
  - Correct common errors
  - Return an overall score
  - Indicate potentially worst sentences
- Our work
  - Focus on providing specific information
  - Raise the proficiency level

Real-time Systems

- Hearst, 2015
  - Supply suggestions during writing is more helpful
- WriteAhead (Yen et al., 2015)
  - Provides writing suggestions on grammar patterns with sentences
- ColloCaid (Lew et al., 2018)
  - Checks the usage of collocation
  - Provides frequent collocates
- Our work
  - Provide grammatical elements with example ngrams during writing

3. Proposed Method

EGP Outline

- Setup phase
  - Convert GEs into rules
  - Collect specific words
- Training phase
  - Detect GEs
  - Extract detected ngrams
- Run-time phase
  - Generate writing suggestions
  - Suggest GEs at higher levels

Convert GEs into Rules

- Input
  - Description of grammatical elements
- Output
  - Regular expression for rules

Convert GEs into Rules

- Convert elements into rules

  Can use 'but' to join a limited range of common adjectives, after ‘be’.

  Can use a comma to combine two adjectives used before the noun, following the usual order of adjective types.

Convert GEs into Rules

- Convert elements into rules

Can use 'but' to join a limited range of common adjectives, after ‘be’.

Can use a comma to combine two adjectives used before the noun, following the usual order of adjective types.

Convert GEs into Rules

- Convert elements into rules

  Can use 'but' to join a limited range of common adjectives, after ‘be’.

  JJ but JJ

  Can use a comma to combine two adjectives used before the noun, following the usual order of adjective types.

  JJ , JJ

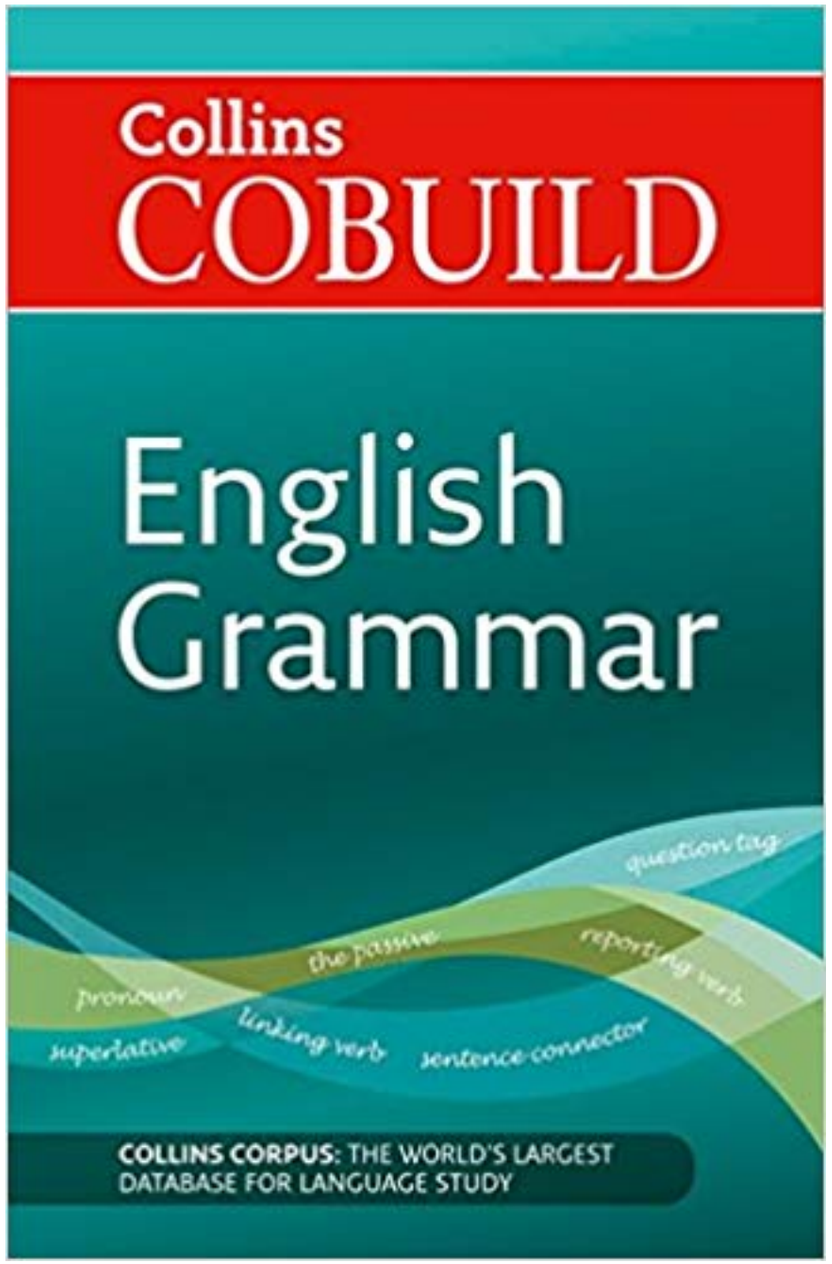
Convert GEs into Rules

- Convert elements into rules

Adj. Regex
JJ and JJ
JJ but JJ
JJ , JJ
JJR and JJR
(JJ ,)+JJ (,|and) JJ
…

Collect Specific Words

DEGREE ADJ	CERTAINTY ADV
perfect	hopefully
entire	really
complete	obviously
utter	unofficially
outright	surely
true	potentially
absolute	supposedly
real	possibly
total	actually
pure	certainly
major	maybe
magnificent	undoubtedly



Detect GEs

- Input
  - A sentence
- Output
  - A set of grammatical elements

Detect GEs

- Normalize sentence
    1. Remove multiple spaces
    2. Lowercase
    3. Reverse abbreviation
    4. Recover subjective “I”

Detect GEs

- Parse the sentence into POS tags and keywords

Amazingly	,	the	child	is	so	fashionable	and	creative
RB	,	DT	NN	be	RB	JJ	and	JJ

that	he	makes	the	ugly	house	modern	.
IN	PRP	VBZ	DT	JJ	NN	JJ	.

Detect GEs

- … nice and really friendly …

  JJ and JJ

- … the other apple …

  DT NN

- Not flexible
- Not pratical to list all Regex

Detect GEs

- Generate phrasal elements based on parse tree

1. is
2. Amazingly , child is fashionable .
3. Amazingly , the child is so fashionable and creative makes .
4. Amazingly , the child is so fashionable and creative that he makes modern .
5. Amazingly , the child is so fashionable and creative that he makes house modern .
6. Amazingly , the child is so fashionable and creative that he makes the ugly house modern .

Detect GEs

- Match candidates against all the rules

```
ugly house
(JJ NN)
fashionable and creative
(JJ and JJ)
so fashionable
(RB JJ)
makes the ugly house modern
(make DT JJ NN JJ)
so fashionable and creative that
(so JJ CC JJ that)
```

Detect GEs

- Remove overlapped GEs with lower levels.

```
C2   so fashionable and creative that
A2      ~~fashionable and creative~~

B1   makes the ugly house modern
A1             ~~ugly house~~
```

Detect GEs

- Extract these matches of GEs and ngrams.

C2 so fashionable and creative that
(so JJ CC JJ that)

B1 makes the ugly house modern
(make DT JJ NN JJ)

Identify GEs

- Input
  - A sentence
- Output
  - A set of grammatical elements

3.5 Method

Generate Writing Suggestions

- Input
  - A unfinished sentence
- Output
  - A set of grammatical elements with example ngrams

Generate Writing Suggestions

- Take the last word and the POS tag as query

```
Those students are friendly …
    Query: friendly, JJ
With slightly, …
    Query: slightly, RB
```

Generate Writing Suggestions

- Retrieve GEs by inverted index given the query

```
Those students are friendly
```

```
friendly (JJ)
be JJ
be more JJ
make PRP JJ
JJ and JJ
RB JJ
as JJ as
so JJ that
```

Generate Writing Suggestions

- Remove GEs that have lower level than the level of identified elements in the unfinished sentence

Those students are friendly	
A1	be JJ
A2	be more JJ
A2	make PRP JJ
A2	JJ and JJ
B1	RB JJ
C2	as JJ as
C2	so JJ that

Generate Writing Suggestions

- Extract ngrams containing the query in each element

Those students are friendly

A1 be JJ
A2 be more JJ
A2 make PRP JJ
A2 JJ and JJ
B1 RB JJ
C2 as JJ as
C2 so JJ that

RB JJ
so friendly
quite friendly
extremely friendly
perfectly friendly
terribly friendly
…

3.5 Method

Generate Writing Suggestions

- Calculate the score of language model
- Retain top 10 as candidates

Those students are

RB JJ	LM
so friendly	-11.83
quite friendly	-12.76
extremely friendly	-12.85
perfectly friendly	-13.99
terribly friendly	-15.89
…	…

Top-10

Generate Writing Suggestions

- Calculate the average word level of each ngram

	RB JJ	Avg	LM
A1 1	extremely friendly	2.5	-12.85
A2 2	perfectly friendly	2.5	-13.99
B1 3	terribly friendly	2.5	-15.89
B2 4	so friendly	2.0	-11.83
C1 5	quite friendly	2.0	-12.76
C2 6	…	…	…

Generate Writing Suggestions

- Select the Top-5 to exemplify the corresponding GE

RB JJ	Avg	LM	
extremely friendly	2.5	-12.85	
perfectly friendly	2.5	-13.99	
terribly friendly	2.5	-15.89	Top-5
so friendly	2.0	-11.83	
quite friendly	2.0	-12.76	

Suggest Level-up GEs

- Input
  - A grammatical element
- Output
  - A level-up grammatical element with example

Suggest Level-up GEs

- Retrieve all GEs in the same subcategory

Detected: friendly and nice

Category	Subcategory	GEs
Adjectives	Combining	Can use 'and' to join a limited range of common adj
		Can use 'but' to join a limited range of common adj
	Modifying	…
	Superlatives	Can use 'the' with a limited range of superlative a

Suggest Level-up GEs

- Retrieve all GEs in the same subcategory

Detected: friendly and nice

Combining

Can use 'and' to join a limited range of common adjectives.

Can use 'but' to join a limited range of common adjectives, a

Can use a comma to combine two adjectives used before the nou

Can use commas and 'and' to join more than two adjectives, af

…

Suggest Level-up GEs

- Keep higher-level elements than the identified element

Detected: friendly and nice

Combining

Can use 'and' to join a limited range of common adjectives.

Can use 'but' to join a limited range of common adjectives, a

Can use a comma to combine two adjectives used before the nou

Can use commas and 'and' to join more than two adjectives, af

…

Suggest Level-up GEs

- Keep higher-level elements than the identified element

Detected: friendly and nice

Combining

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Can use 'but' to join a limited range of common adjectives, a
Can use a comma to combine two adjectives used before the nou
Can use commas and 'and' to join more than two adjectives, af
…

Suggest Level-up GEs

- Select the first one as level-up recommendation
- Provide a sentence using identified ngram as query

Detected: friendly and nice

Combining

Can use 'and' to join a limited range of common adjectives.
Can use 'but' to join a limited range of common adjectives, a
Can use a comma to combine two adjectives used before the nou
Can use commas and 'and' to join more than two adjectives, af
…

He bent and kissed her cheek in a friendly , brotherly way.

EVP Outline

- Setup phase
  - Collect dictionary from EVP website
- Run-time phase
  - Identify vocabulary profile
  - Suggest level-up words

Crawl Dictionary from EVP Website

British English | American English

Choose level:

- A1
- A1-A2
- A1-B1
- A1-B2
- A1-C1
- A1-C2
- A2 only
- B1 only
- B2 only
- C1 only
- C2 only

Browse A-Z

OR

Enter a word or phrase

fly

ADVANCED SEARCH

Hide culturally sensitive words

Search

English Profile Home
About English Vocabulary Profile
Word of the Week
Help
Feedback

Search results for A1-C2 (8 matches)

Number of results per page: 100

Core results:

- **fly** verb **TRAVEL** A1
- **fly** verb **MOVE THROUGH AIR** A2
- **fly** verb **CONTROL AIRCRAFT** B2
- **with flying colors** C1
- **fly** verb **TIME** C2
- **fly** verb **TAKE/SEND** C2
- **fly in the face of** C2
- **fly** noun B1

Identify Vocabulary Profile

- Input
  - Word
- Output
  - Level of the word

Identify Vocabulary Profile

- Parse the sentence
- Lemmatize all tokens
- Look up the word in EVP
- Gain the lowest level

Suggest Level-up Words

- Input
  - Word
- Output
  - Words at higher levels

Suggest Level-up Words

- Calculate similarity between target word and other words
- Select top k similar words as candidates

friendly	freindly Friendly unfriendly friendlier friendliest hospitable friendliness Petney_observed sociable easygoing pleasant

Suggest Level-up Words

- Remove candidates not in EVP or at lower level

friendly (A2)

~~freindly~~	None
~~Friendly~~	None
unfriendly	B1
~~friendlier~~	None
~~friendliest~~	None
hospitable	C1
friendliness	B2
~~Petney_observed~~	None
sociable	B1
easygoing	B1
~~pleasant~~	A2

Suggest Level-up Words

- Get the POS tags from EVP
- Retain k candidates that own same POS tag

friendly (Adj.)

unfriendly	Adj.
hospitable	Adj.
~~friendliness~~	Noun
sociable	Adj.
easygoing	Adj.

4. Experiments

Related Data

- Common European Framework of Reference (CEFR)
- The Corpus of Contemporary American English (COCA)
- Language model trained on COCA

Corpus	Sentences	# of GEs
COCA	28,267,232	8,267,170

Experimental Settings

Category	Pilot Study	
Subcategory	Adjectives	Adverbs
GEs	5	4
	79	69

Programmatic Settings

- Pre-complied Regex to boost computing perfomance
- SpaCy
- KenLM
- Gensim
- Google pre-trained 300d word2vec

Evaluation

- 50 sentences from EFCAMDAT

Suggestion	Count	Percentage
1st suggestion	22	0.44
2nd suggestion	13	0.26
3rd suggestion	6	0.12
Top-3 suggestions	41	0.82
Not in Top-3	9	0.18

Discussion

- Unsuitable ngrams for the sentence
  - Ngram candidates extracted from the corpus doesn’t cover many situations
    - Uncommon or long ngrams usually get lower LM scores
    - SpaCy may parse the dataset incorrectly
- Use larger data to get more ngram candidates
  - Web1T used in Linggle
- Set threshold to filter

Discussion

- Do not require patterns as query to get ngrams
- Level-Up
  - Provide a more convenient way to get professional ngrams (e.g., as adj. as)
- Raise awareness of proficiency levels

5. Conclusion and Future Work

Conclusion

- Proposed a method for
  - analyzing GEs
  - suggesting level-up GEs
    - Recommending level-up words
- Have potential in assisting writing in a way different from existing commercial writing services
- Teachers can assess students' essays more efficiently using Level-Up

Future Work

- Handle other parts of speech in EGP
- Improve ranking by considering the relevancy of each ngram to learner's sentence
- Recommend well-spoken words or phrases to level up essays lexically
  - almost a week -> the better part of a week
  - happening -> in the making
- Evaluate an essay as a whole based on the detected GEs

Demo