Towards Enriched Controllability for Educational Question Generation
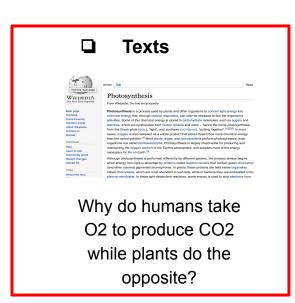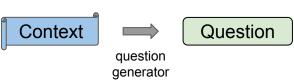
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Introduction → Background

What is Question Generation (QG)?

Context → Question

question generator

❏ **Texts**

Why do humans take O_2 to produce CO_2 while plants do the opposite?

❏ **Knowledge Graphs**

Were Bill Gates and Satya Nadella once colleagues?
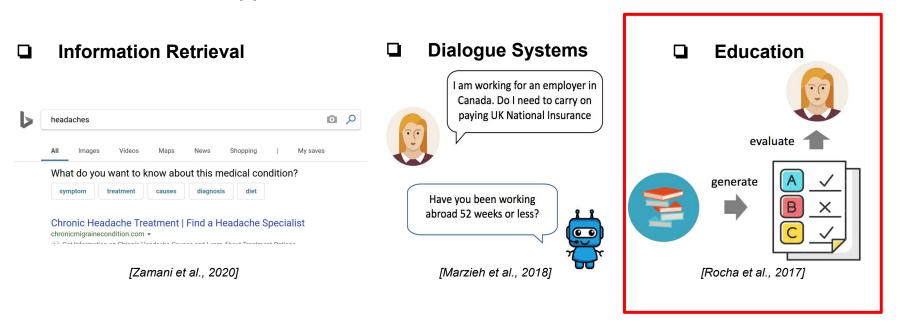
❏ **Images**

Who is having a birthday party?

based on slides: Towards Generating Human-like Deep Questions by Liangming Pan

Introduction → Background

What are the main applications of Question Generation?

Information Retrieval

Dialogue Systems

Education

[Zamani et al., 2020]

[Marzieh et al., 2018]

[Rocha et al., 2017]

based on slides: Towards Generating Human-like Deep Questions by Liangming Pan

Introduction → Motivation

Advantages of Question Generation (QG) for Education
- Time-saving
- Resource augmentation

However…

- the adoption of QG systems in classrooms is **low** [*Kurdi et al., 2020*] [*Wang et al., 2022*]

Why is this so?

Introduction → Motivation

Why are QG tools **not** widely used in classrooms?

- Generated questions are generally limited in types and difficulty levels
  [*Kurdi et al., 2020*] [*Wang et al., 2022*]

Strong desire for
user control

Background & Related Work → Controllability for QG

Controllable Attributes

- ○ Question Reading Comprehension Skills [Ghanem et al., 2022]
- ○ Question Narrative Elements [Zhao et al., 2022]
- ○ Question Bloom's Taxonomy [Elkins et al., 2023]
- ○ **+** Question Explicitness (**our contribution**)

➔ **Explicit** questions ask for answers that can be directly found in the stories
➔ **Implicit** questions rely on summarizing and drawing inferences from text

Balanced difficulty [Raphael, 1986] [Zucker et al., 2010]

Data → FairytaleQA dataset

> *"Once there were a hare and a turtle. The hare was proud of his speed. He asked the turtle to race. The turtle was slow, but he agreed. The hare ran very fast, and the turtle was left behind. The hare thought he should take some rest and fell asleep. The turtle reached the goal and won the race."*

source: http://simpleessaywriting.blogspot.com/2017/09/a-short-story-on-hare-and-tortoise.html

FairytaleQA
(Xu et al., 2022)
Simplistic Example

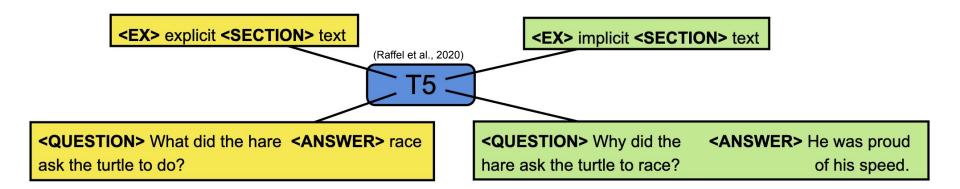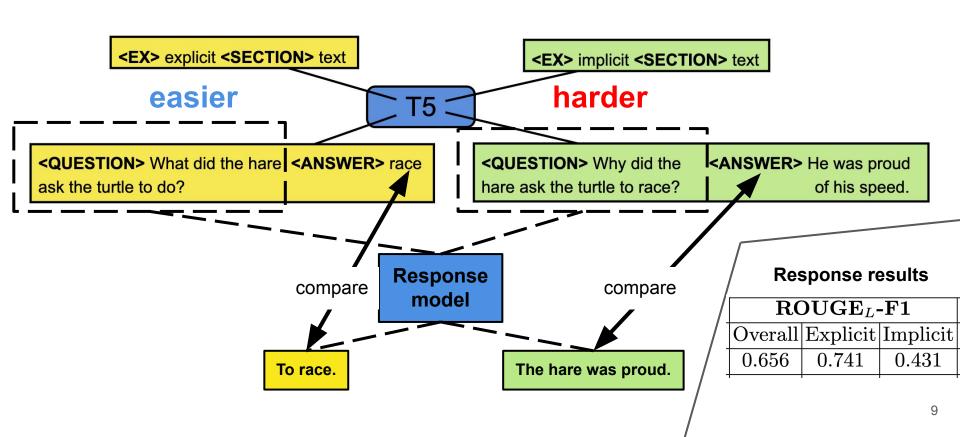| Question	Answer	Explicitness Label	Narrative Label
Who challenged the turtle to a race?	The hare.	Explicit	Character
(...)	(...)	(...)	(...)
Why did the hare decide to take some rest?	The turtle was far behind.	Implicit	Causal Relation

Proposal → Controlling Question's Explicitness

> *"Once there were a hare and a turtle. The hare was proud of his speed. He asked the turtle to race. The turtle was slow, but he agreed. The hare ran very fast, and the turtle was left behind. The hare thought he should take some rest and fell asleep. The turtle reached the goal and won the race."*

<EX> explicit **<SECTION>** text
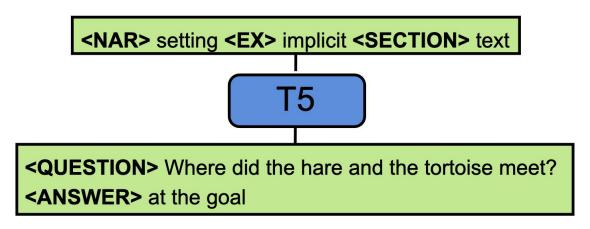
<EX> implicit **<SECTION>** text

(Raffel et al., 2020)

T5

<QUESTION> What did the hare **<ANSWER>** race ask the turtle to do?

<QUESTION> Why did the **<ANSWER>** He was proud hare ask the turtle to race? of his speed.

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Evaluation → Controlling Question's Explicitness

Response results

ROUGE$_L$-F1		
Overall	Explicit	Implicit
0.656	0.741	0.431

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Evaluation → Controlling Question's Explicitness

Response results

$\text{ROUGE}_L\text{-F1}$		
Overall	Explicit	Implicit
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Controlling Question's Explicitness **+** Narratives

<NAR> setting **<EX>** implicit **<SECTION>** text

T5

<QUESTION> Where did the hare and the tortoise meet?
<ANSWER> at the goal

Response results

ROUGE$_L$-F1		
Overall	Explicit	Implicit
0.671	0.730	0.514

Similarity to human-authored questions

	ROUGE$_L$-F1	BLEURT
text	0.305	0.370
text + ex + nar	0.432	0.424

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Conclusions and Future Directions

- ## Conclusions
  - Question Generation controllability is a must for Education
  - We show evidence of controlling Question Explicitness

- ## Future Work 🔭
  - Additional educational relevant attributes
  - Additional control mechanisms
  - Human evaluation

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Code: github.com/bernardoleite/question-generation-control