

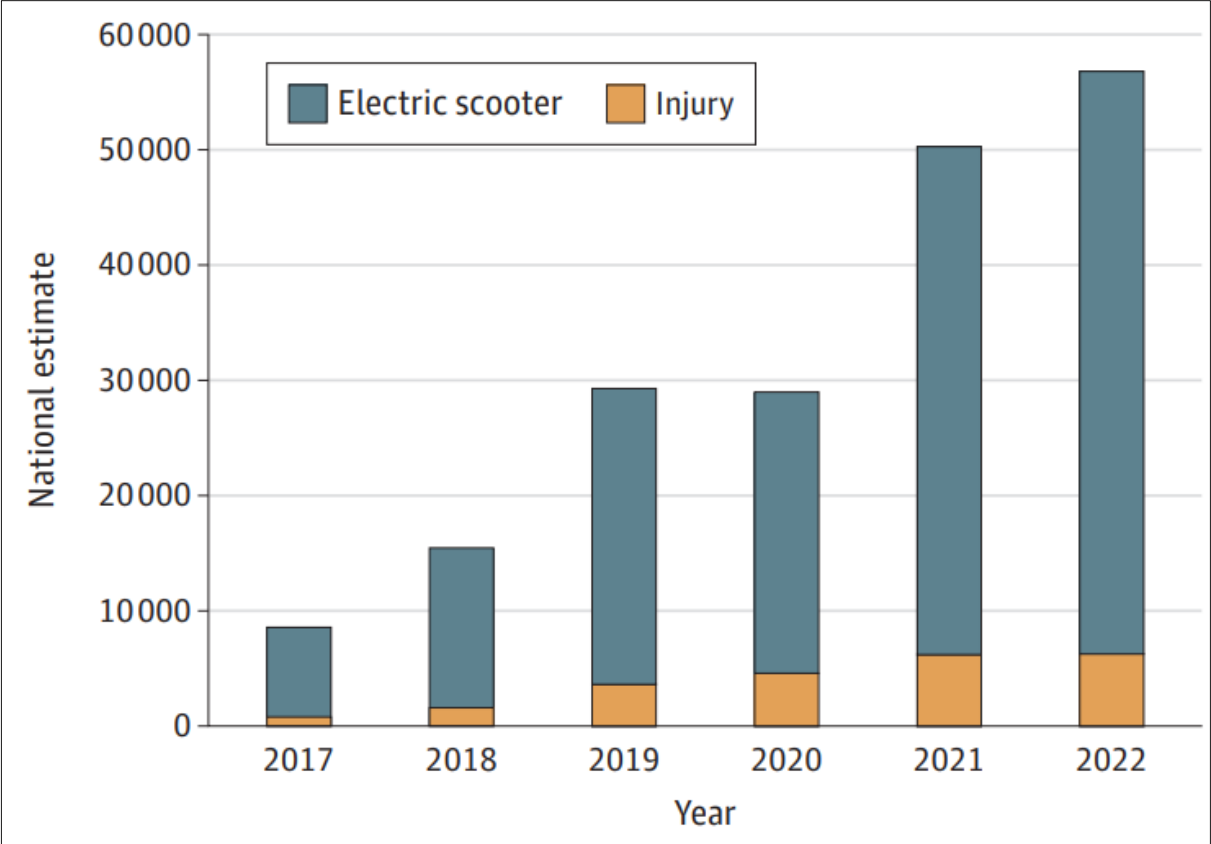
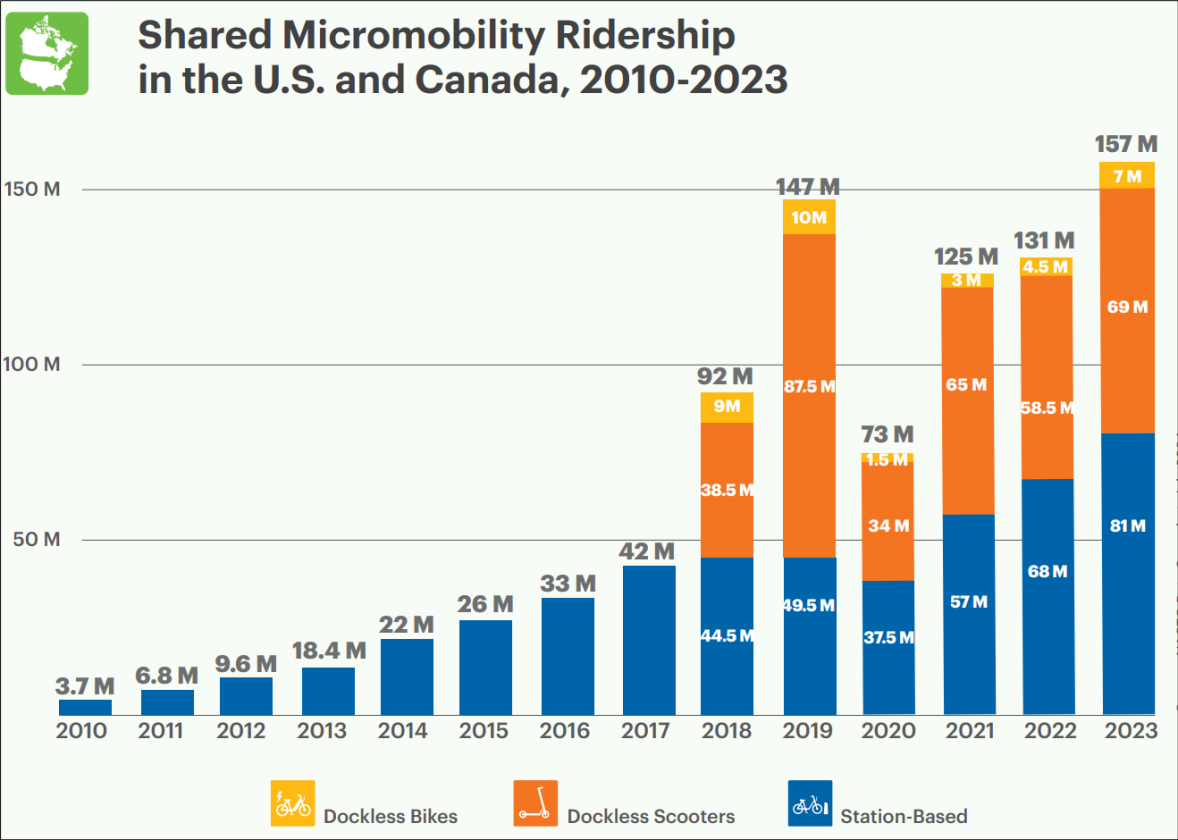
Mining E-Scooter Safety Policies and Plans Using GPT-4o and Latent Dirichlet Allocation (LDA) Modeling



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Background: Rising Popularity and Growing Safety Concerns



Source: https://nacto.org/wp-content/uploads/2024/08/Shared-micro-in-2023-snapshot_FINAL_July22-2024.pdf

Fernandez, et al. 2024

Municipal Responses to E-scooter – Unprepared

“Throw the baby out with the bathwater”?

Austin rolls out new regulations, limits on e-scooters in city

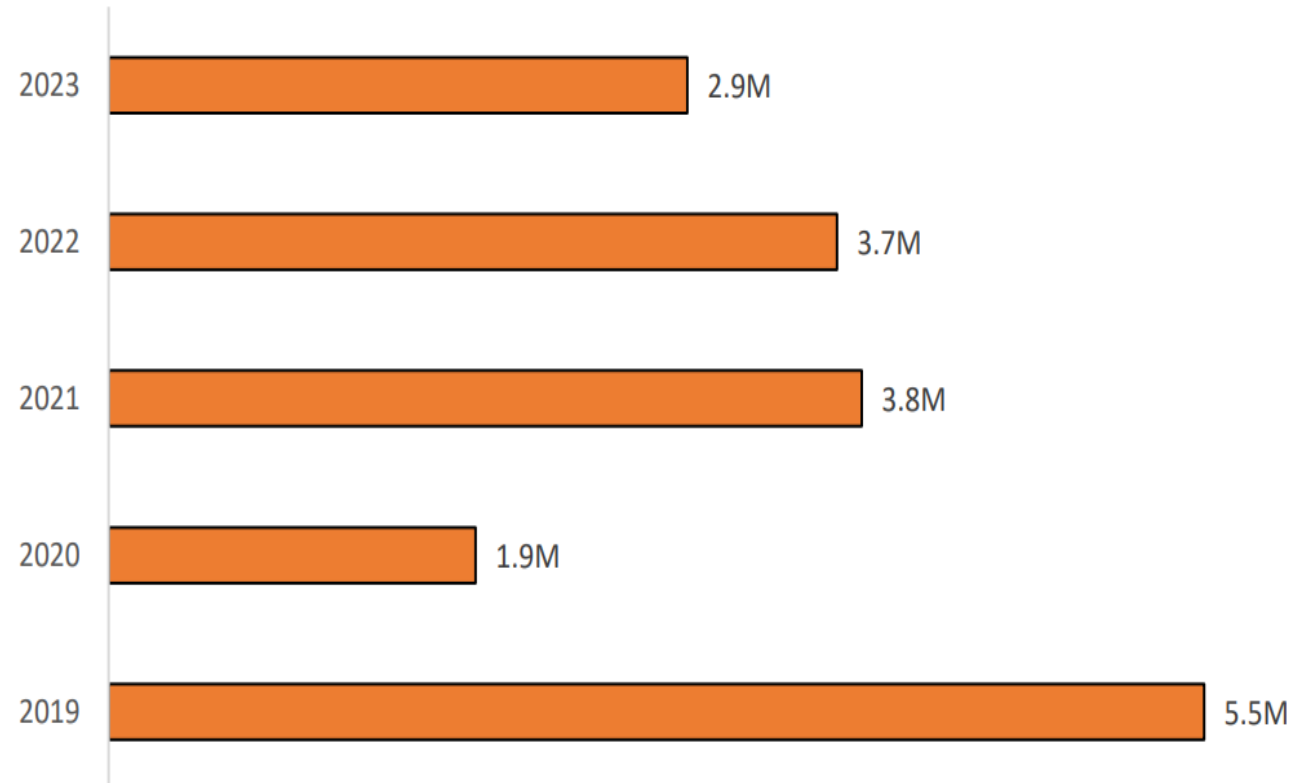
[Olivia Dilley](#), Senior News Reporter

April 12, 2024



<https://thedailytexan.com/2024/04/12/austin-rolls-out-new-regulations-limits-on-e-scooters-in-city/>

E-Scooter Trips in Austin, TX



https://www.austintexas.gov/sites/default/files/files/Auditor/Audit_Reports/Electric_Scooter_Enforcement_Program_August_2024.pdf

Study Question, Methods, and Tasks

Question: What are the essential elements concerning e-scooter safety for municipal plans or policies?

Methods: Meta-study of e-scooter-related plans or policies in the U.S. cities

Tasks and Work Process:

1. Identify cities that operate e-scooter services (excluding e-scooters owned and used by individuals)
2. Explore and download (if available) documents related to e-scooter plans and regulations/policies
3. Study the contents of the documents and extract essential information about e-scooter safety
4. Synthesize study findings and develop guidelines or provide references for cities on What and How to Do concerning e-scooter safety

Study Question, Methods, and Tasks

1. Identify cities that operate e-scooter services (excluding e-scooters owned and used by individuals)
 - Focus on the cities with services provided by six major e-scooter operators (Bird, Lime, Spin, Veo, Lyft, and Wheels)
 - 167 cities from 35 states



2. Explore and download (if available) documents related to e-scooter plans and regulations/policies
 - Write Python scripts to search
 - 270 documents

Study Question, Methods, and Tasks

3. **Study the contents of the documents and extract essential information about e-scooter safety**
 - 3.1 **Develop a questionnaire containing questions related to e-scooter safety**
 - 3.2 **Use GPT-4o as an “Artificial Investigator” to examine the contents of the documents, report the location (chapter #, page #, and line #) of the matched contents /texts**
 - 3.3 **Download the matched contents /texts**
 - 3.4 **Create a datafile storing the downloaded contents /texts**
 - 3.5 **Run Latent Dirichlet Allocation (LDA) models to identify key topics (with keywords) concerning e-scooter safety**

4. **Synthesize study findings and develop guidelines or provide references for cities on What and How to Do concerning e-scooter safety**

Factors Related to E-Scooter Safety

GPT-4o helped provide a comprehensive list of factors, but the information on the sources is unreliable.

Researchers conducted additional desktop search and lit review

Category	Element
Rider Behavior Factors	Helmet Usage
	Riding in Designated Areas
	Education and Skill Training
	Age Limitation
	Adherence to Traffic Laws
	Avoiding Risky Behaviors
	Avoiding Risky Behaviors (Alcohol and Drug)
	Yield of Way
	Proper Parking
	Others
Vehicle Factors	Vehicle Design and Stability
	Braking Systems
	Caution Devices
	Lighting and Visibility
	Speed Limiting Features
	Durable and High-Quality Tires
	Regular Maintenance and Inspections
	Others

Category	Element
Roadway Infrastructure Factors	Dedicated Scooter Lanes
	Smooth and Well-Maintained Surfaces
	Adequate Signage and Traffic Signals
	Parking Infrastructure
	Protected Intersections
	Lighting and Visibility
	Traffic Calming Measures
	Others
	External Environment Factors
Time of Day	
Visibility	
Urban Built Environment (Specific Places)	
Urban Built Environment	
Traffic Density and Direction/Flow	
Supervision	Others
	Supervise and <u>Regulate</u>
	Data Collection
	Responsible Department

Questionnaire for GPT

Questionnaire Preface

Please note that all answers should be based on the provided text. You do not need to search for information from other sources. If the text does not contain relevant information, please respond with **"No relevant information found."** If the answer is yes, please **make specific elaboration and cite the original regulation with the chapter/page/section number**. Sometimes, scooter policies are included in the micro-mobility policy; please also check that carefully.

1. General Question

1.1 Does the document contain chapters or sections explicitly for scooter plans or policies? (If Yes, please provide the page numbers of the chapters and sections.)

1.2 What keywords relevant to scooter safety appear in the document?

2. Scooter Safety Questions

2.1 Rider Behavior Factors Section (This section includes driver behavior and conditions such as speeding, violating traffic laws, driving under the influence of alcohol or drugs, inattention, and age, etc.)

2.1.0 The literature suggests the following key elements of rider behavior contribute to scooter safety: Helmet Usage, Riding in Designated Areas, Education and Skill Training, Adherence to Traffic Laws, Avoiding Risky Behaviors, Understanding and Respecting Road Conditions, Use of Reflective Gear and Lights, Proper Parking. Does this document contain any of these words? (If Yes, please retrieve the sentences and paragraphs containing the keywords. Please retrieve any tables containing the keywords. Please provide the page number and figure number of the figures that contain the keywords.)

2.1.1 Are users required to use protective gear, such as a helmet? Who provides it?

2.1.2 Is there any requirement for riding a scooter in designated areas in the document?

2.1.3 Are users required to attend safety education or skills training before riding a scooter?

2.1.4 Is there an age limitation for scooter use?

2.1.5 Does the document provide education and emphasize scooter traffic signals and rules?

2.1.6 Does the document emphasize avoiding risky behaviors such as rider distraction, speeding, failure to yield, riding in groups, and against-flow riding?

2.1.7 How does the city deal with the alcohol and drug issues of the scooter?

2.1.8 How does the city deal with the interactions (right of way) between scooters, pedestrians, and other vehicles?

2.1.9 What are the city's regulations regarding scooter-safe parking?

2.1.10 Are there any other policies related to this section that have not been mentioned?

Pay GPT-4o as an “Artificial Investigator”

GPT-4o reads 270 documents from 167 cities and responds to the survey

Sample GPT-4o responses

1. General Question

1.1 Does the document contain chapters or sections explicitly for scooter plans or policies? (If Yes, please provide the page numbers of the chapters and sections.)

New York City_New York

Policy name: Article 34-D Operation of Electric Scooters

1.1 Yes, the document contains sections explicitly addressing scooter regulations.
Some of the relevant sections include:

Vehicle & Traffic Law Section 1280: Effect of regulations

Vehicle & Traffic Law Section 1281: Traffic laws apply to persons operating electric scooters

Vehicle & Traffic Law Section 1282: Operating electric scooters

Vehicle & Traffic Law Section 1284: Riding on roadways, shoulders, and lanes reserved for non-motorized vehicles and devices

Vehicle & Traffic Law Section 1285: Lamps and other equipment

Vehicle & Traffic Law Section 1286: Operators to wear protective headgear

Vehicle & Traffic Law Section 1289: Operation of an electric scooter while under the influence of alcohol or drugs

Pay GPT-4o as an “Artificial Investigator”

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Sample GPT-4o responses

2.1.0 The literature suggests the following key elements of rider behavior contribute to scooter safety: Helmet Usage, Riding in Designated Areas, Education and Skill Training, Adherence to Traffic Laws, Avoiding Risky Behaviors, Understanding and Respecting Road Conditions, Use of Reflective Gear and Lights, Proper Parking. Does this document contain any of these words? (If Yes, please **retrieve** the sentences and paragraphs containing the keywords. Please retrieve any tables containing the keywords. Please **provide the page number and figure number** of the figures that contain the keywords.)

2.1.0 Yes, the document contains several of these keywords. Below are examples with citations:

Helmet Usage:

"No person sixteen or seventeen years of age shall ride upon, propel, or otherwise operate an electric scooter unless such person is wearing a helmet..." (Vehicle & Traffic Law Section 1286, p. 1286.1)

Adherence to Traffic Laws:

"Every person riding an electric scooter upon a roadway shall be granted all of the rights and shall be subject to all of the duties applicable to the driver of a vehicle..." (Vehicle & Traffic Law Section 1281, p. 1281.1)

Yielding Right of Way:

"Every person operating an electric scooter shall yield the right of way to pedestrians." (Vehicle & Traffic Law Section 1282, p. 1282.3)

Assess Data Quantity and Quality

Section	Element	Question	with Content	with Content Proportion (%)
Rider Behavior Factors	Helmet Usage	2.1.1	115	55.83%
	Riding in Designated Areas	2.1.2	127	61.65%
	Education and Skill Training	2.1.3	20	9.71%
	Age Limitation	2.1.4	94	45.63%
	Adherence to Traffic Laws	2.1.5	60	29.13%
	Avoiding Risky Behaviors	2.1.6	124	60.19%
	Avoiding Risky Behaviors (Alcohol and Drug)	2.1.7	37	17.96%
	Yield of Way	2.1.8	106	51.46%
	Proper Parking	2.1.9	85	41.26%
	Others	2.1.10	14	6.80%
Vehicle Factors	Vehicle Design and Stability	2.2.1	14	6.80%
	Braking Systems	2.2.2	52	25.24%
	Caution Devices	2.2.3	10	4.85%
	Lighting and Visibility	2.2.4	72	34.95%
	Speed Limiting Features	2.2.5	72	34.95%
	Durable and High-Quality Tires	2.2.6	5	2.43%
	Regular Maintenance and Inspections	2.2.7	20	9.71%
	Others	2.2.8	5	2.43%

Section	Element	Question	with Content	with Content Proportion (%)	
Roadway Infrastructure Factors	Dedicated Scooter Lanes	2.3.1	88	42.72%	
	Smooth and Well-Maintained Surfaces	2.3.2	12	5.83%	
	Adequate Signage and Traffic Signals	2.3.3	19	9.22%	
	Parking Infrastructure	2.3.4	88	42.72%	
	Protected Intersections	2.3.5	19	9.22%	
	Lighting and Visibility	2.3.6	26	12.62%	
	Traffic Calming Measures	2.3.7	11	5.34%	
	Others	2.3.8	2	0.97%	
	External Environment Factors	Season and Weather Conditions	2.4.1	11	5.34%
		Time of Day	2.4.2	38	18.45%
Visibility		2.4.3	63	30.58%	
Urban Built Environment (Specific Places)		2.4.4	28	13.59%	
Urban Built Environment		2.4.5	20	9.71%	
Traffic Density and Direction/Flow		2.4.6	27	13.11%	
Others		2.4.7	2	0.97%	
Supervision	Supervise and Regulate	3.1	99	48.06%	
	Data Collection	3.2	35	16.99%	
	Responsible Department	3.3	61	29.61%	

Run Latent Dirichlet Allocation (LDA) Models

Identify central topics and keywords relevant to e-scooter safety

Category	Element	Highest Coherence Score	Topic	Probability
Rider Behavior Factors	Helmet Usage	number of topics=1, 0.522	Topic: 0 Word: 0.083*"helmet" + 0.057*"users" + 0.055*"wear" + 0.047*"require" + 0.040*"helmets" + 0.032*"provide" + 0.029*"encourage" + 0.027*"bicycle" + 0.023*"age" + 0.022*"use"	1.000
	Riding in Designated Areas	number of topics=1, 0.595	Topic: 0 Word: 0.053*"scooters" + 0.036*"areas" + 0.030*"designate" + 0.029*"lanes" + 0.028*"bike" + 0.025*"sidewalks" + 0.023*"operate" + 0.022*"ride" + 0.021*"speed" + 0.021*"use"	1.000
	Education and Skill Training	number of topics=8, 0.506	<p>Topic: 0 Word: 0.172*"users" + 0.097*"educate" + 0.096*"must" + 0.059*"operation" + 0.059*"share" + 0.059*"permittees" + 0.032*"emphasize" + 0.027*"user" + 0.027*"language" + 0.027*"quiz"</p> <p>Topic: 1 Word: 0.270*"education" + 0.076*"implement" + 0.074*"mecklenburg" + 0.074*"local" + 0.074*"curriculum" + 0.074*"county" + 0.055*"program" + 0.009*"traffic" + 0.005*"offense" + 0.005*"pedestrians"</p> <p>Topic: 4 Word: 0.199*"safe" + 0.107*"scooter" + 0.102*"rid" + 0.085*"require" + 0.079*"train" + 0.055*"include" + 0.034*"commercial" + 0.026*"cyclists" + 0.013*"rider" + 0.007*"rout"</p> <p>Topic: 6 Word: 0.154*"safety" + 0.134*"school" + 0.109*"attend" + 0.094*"skills" + 0.088*"bicycle" + 0.037*"seminars" + 0.037*"helmet" + 0.037*"fit" + 0.020*"operators" + 0.020*"requirement"</p>	<p>Topic 0 : 0.133</p> <p>Topic 1 : 0.130</p> <p>Topic 4 : 0.132</p> <p>Topic 6 : 0.130</p>

Run Latent Dirichlet Allocation (LDA) Models

Interpret results to inform planning/policymaking concerning e-scooter safety

Element	Question	Highest Coherence Score	Topic	Probability
Helmet Usage	2.1.1	number of topics=1, 0.522	Topic: 0 Word: 0.083*"helmet" + 0.057*"users" + 0.055*"wear" + 0.047*"require" + 0.040*"helmets" + 0.032*"provide" + 0.029*"encourage" + 0.027*"bicycle" + 0.023*"age" + 0.022*"use"	1.000

Out of 227 documents

- 115 contain terms pertaining to 'helmet' or 'helmets'
- 21 contain terms pertaining to 'age'
- 83 "require"
- 1 "encourage"

Helmet policies conditional to age, e.g., 15, 16, 18, or adults in general

Run Latent Dirichlet Allocation (LDA) Models

Interpret results to inform planning/policymaking concerning e-scooter safety

Element	Question	Highest Coherence Score	Topic	Probability
Proper Parking	2.1.9	number of topics=4, 0.614	Topic: 0 Word: 0.082*"bike" + 0.055*"street" + 0.049*"sidewalk" + 0.031*"zone" + 0.031*"driveways" + 0.027*"ramp" + 0.021*"outline" + 0.021*"curb" + 0.019*"regulations" + 0.016*"cannot" (<i>Infrastructure related</i>)	Topic 0 : 0.219
			Topic: 1 Word: 0.118*"park" + 0.086*"scooters" + 0.074*"must" + 0.049*"pedestrian" + 0.043*"block" + 0.033*"access" + 0.030*"build" + 0.029*"sidewalks" + 0.025*"manner" + 0.023*"impede" (<i>pedestrian related</i>)	Topic 1 : 0.332
			Topic: 2 Word: 0.088*"park" + 0.053*"bicycle" + 0.053*"upright" + 0.051*"designate" + 0.047*"electric" + 0.044*"areas" + 0.032*"scooter" + 0.027*"various" + 0.019*"page" + 0.019*"28" (<i>bicycle related</i>)	Topic 2 : 0.237
			Topic: 3 Word: 0.065*"park" + 0.037*"proper" + 0.036*"locations" + 0.031*"detail" + 0.030*"emphasis" + 0.030*"increase" + 0.030*"provide" + 0.027*"city" + 0.019*"dockless" + 0.018*"specify" (<i>location related</i>)	Topic 3 : 0.223

Concluding Remarks

- **Artificial Intelligence (AI) offers a great potential to assist research and practice**
→ *A great Artificial investigator in this project*
- **While embracing the power of AI, avoid falling into the trap embedded in AI?**
→ *AI (GPT) fabricates answers. Verification and validation are necessary and essential.*
- **GPT is not free; could become too expensive to use**

Document Group	Time (minutes)		Cost (\$)	
	<i>API</i>	<i>Website</i>	<i>API</i>	<i>Website</i>
Group 1 (10 docs)	3:18	12:50	0.78	20/month
Group 2 (10 docs)	3:26	8:50	0.44	
Group 3 (10 docs)	3:05	10:40	0.51	
Group 4 (10 docs)	2:30	13:30	0.37	
Group 5 (10 docs)	2:52	13:00	0.54	

Thank you!

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