



FIE 2024

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WIP: Identifying Tutorial Affordances for Interdisciplinary Learning Environments

Hannah Kim, Sergei L. Kosakovsky Pond, Stephen MacNeil



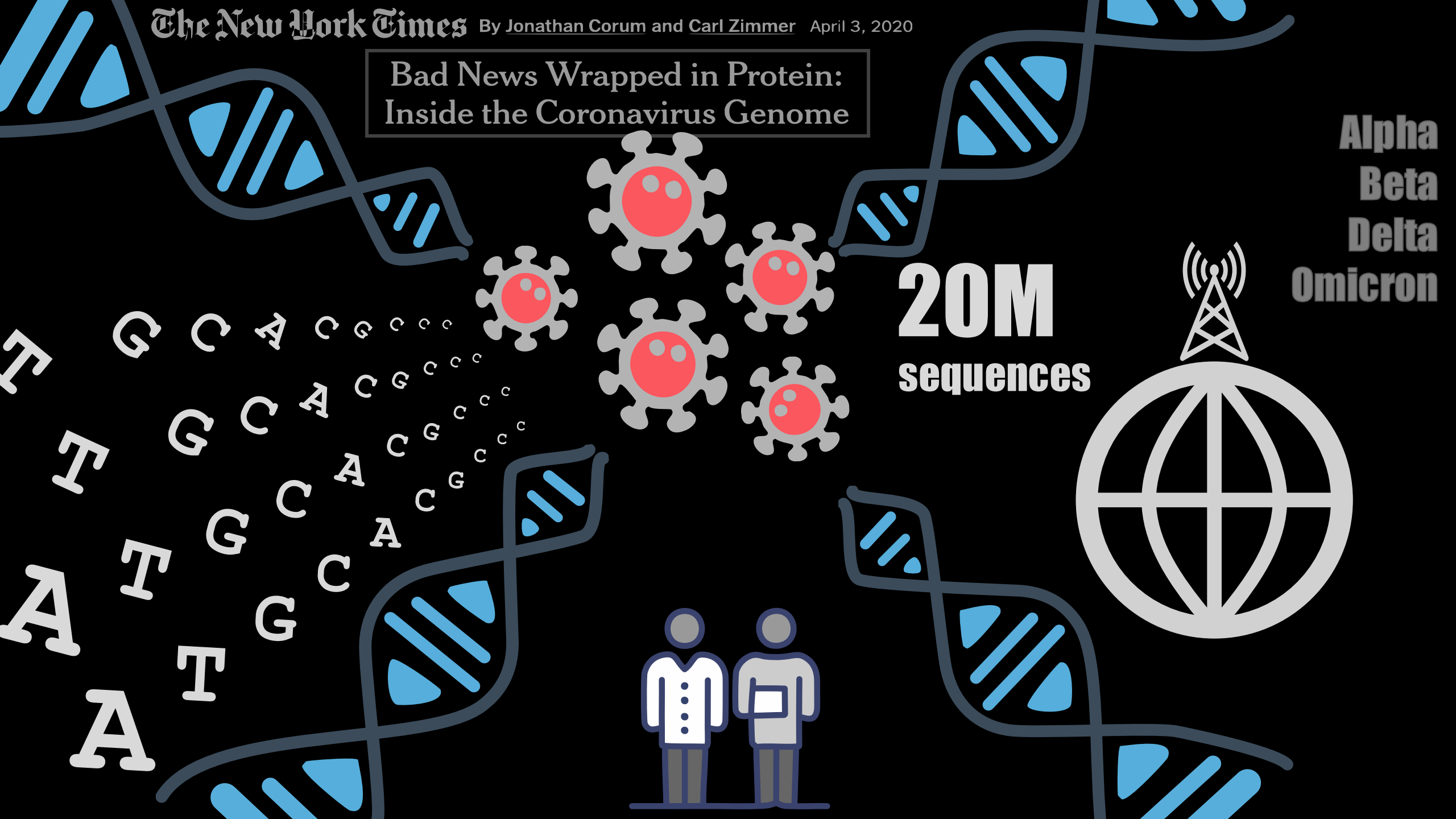
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Bad News Wrapped in Protein:
Inside the Coronavirus Genome

Alpha
Beta
Delta
Omicron

20M
sequences



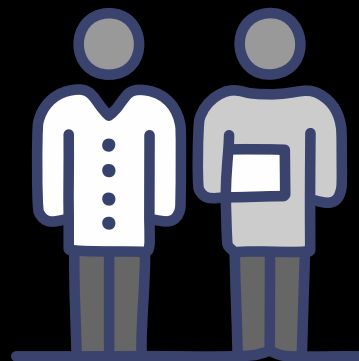
20M

sequences



Bad News Wrapped in Protein:
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**We can solve problems
by integrating ideas and approaches
from multiple disciplines.**

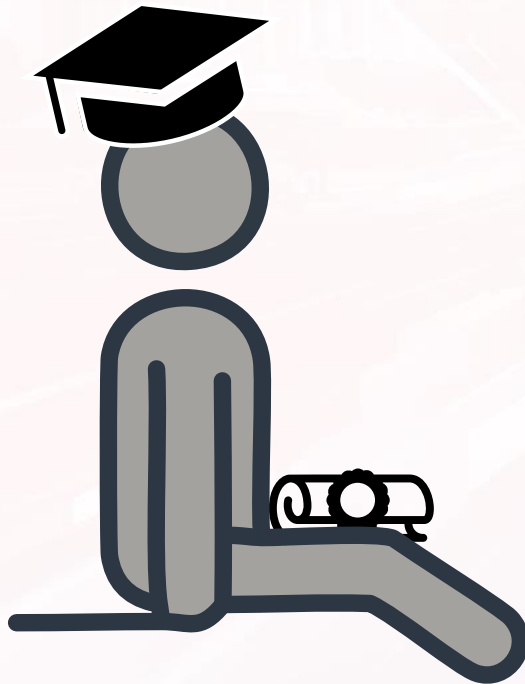


Interdisciplinarity

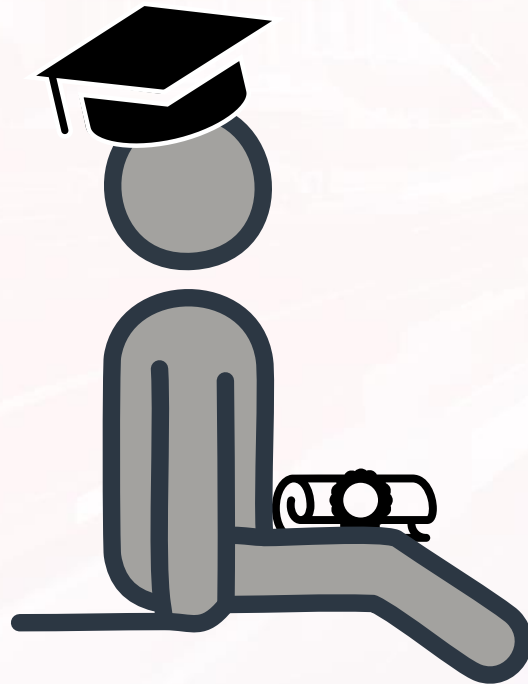
How is it currently being afforded?

What can we do better?

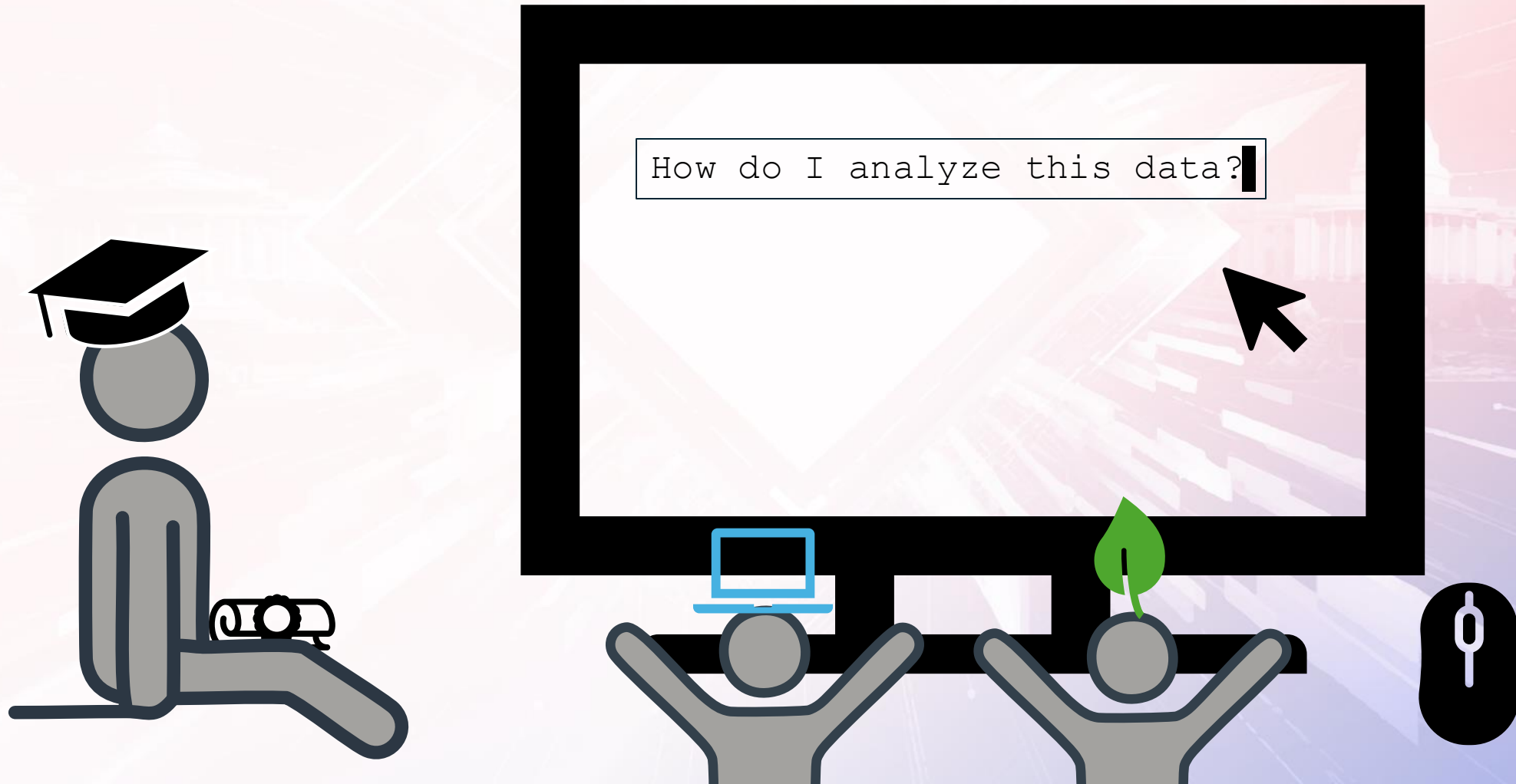
Informal Learning Via Bioinformatics Software Tutorials



Informal Learning Via Bioinformatics Software Tutorials



Informal Learning Via Bioinformatics Software Tutorials



Borrego and Newswander. *The Review of Higher Education* 2010

Interdisciplinarity

(1) Grounding in traditional disciplines

(2) Synergistic integration of disciplinary insights

(3) Communication and translation across boundaries to reconcile disciplinary differences

(4) Critical awareness of achievable scopes and limitations

(5) Teamwork among researchers

Context Behind Definition of a Tutorial



- Existing taxonomy of users ('new', 'experienced', 'power', and 'all') does not reflect diverse user disciplinary backgrounds.

1

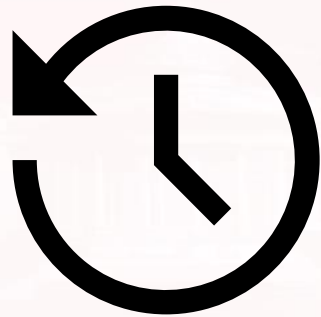
Context Behind Definition of a Tutorial



- The static nature of academic publications does not reflect the dynamic nature of software development expected in successful tools.

2

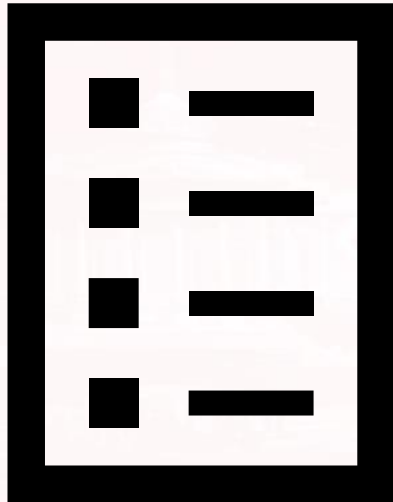
Context Behind Definition of a Tutorial



- Academic publications are not always open access and therefore not always accessible to users.

3

Definition of a Bioinformatics Software Tutorial



“A standalone set of documentation containing information about the biological and methodological significance and design that supports new users”

Research Questions

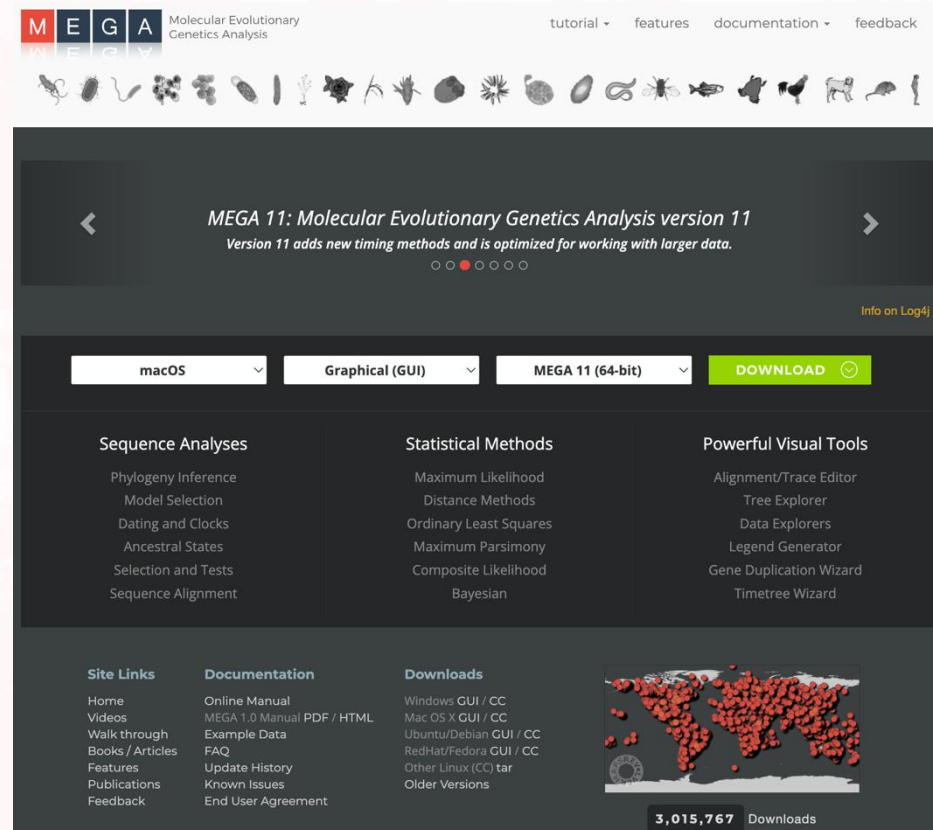
Research Questions

- RQ1. What **features** do bioinformatics software tutorials have?

Research Questions

- RQ1. What **features** do bioinformatics software tutorials have?
- RQ2. What do the tutorial designs **achieve** in the interdisciplinary learning environment?

Sample Collection



22 Representative tutorials

from a highly cited prior literature

Collected between
05/01/2024 and 05/12/2024

The main coder was a
bioinformatics researcher with a
background in

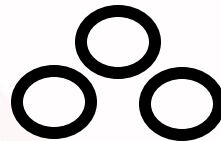
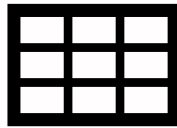
chemistry,
computational biology, and
higher education teaching



Mixed Methods & Interdisciplinarity Assessment

Qualitative

- Open coding to capture themes in the form of a table
- Axial coding to identify relationships among codes



Quantitative

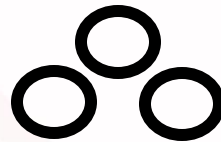
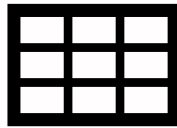
- Frequency
- Mean
- Standard deviation
- Correlation



Mixed Methods & Interdisciplinarity Assessment

Qualitative

- Open coding to capture themes in the form of a table
- Axial coding to identify relationships among codes



Interdisciplinarity

Quantitative

- Frequency
- Mean
- Standard deviation
- Correlation
- Codes assigned to each criterion with redundancy and signs (+/ -)
- Arithmetic mean of the code frequencies

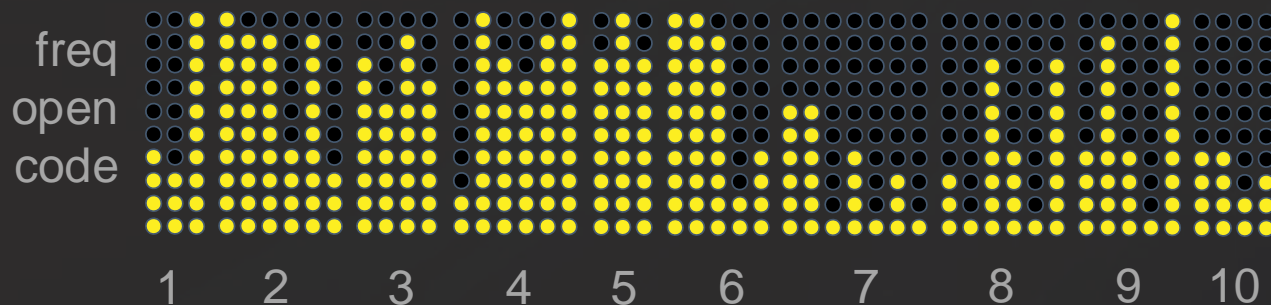


What We Found

- 56 open codes & 10 axial codes
- 5 interdisciplinarity scores

What We Found

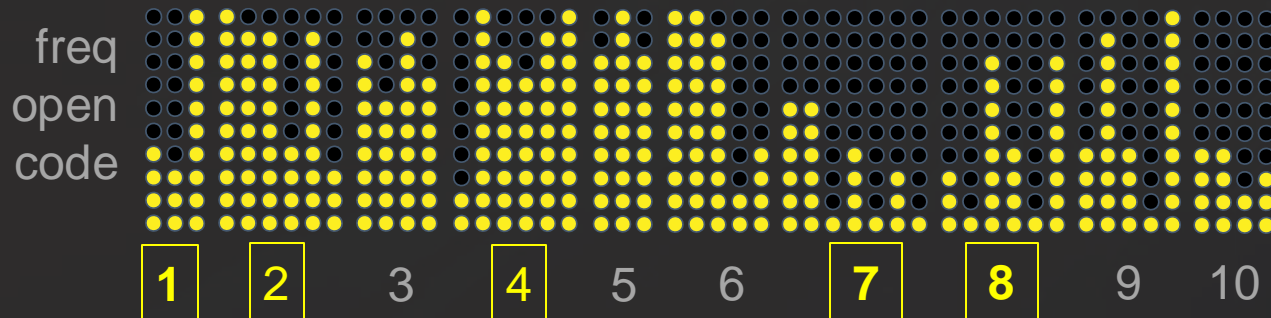
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1. User Interface
2. Installation
3. Data Specification
4. Format
5. Relevance
6. Maintenance
7. Resilience
8. Promotion of Community
9. Willingness to Collaborate
10. Marketing

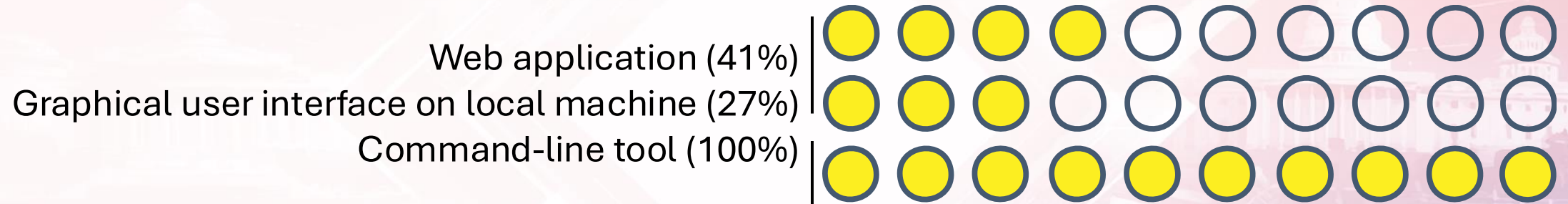
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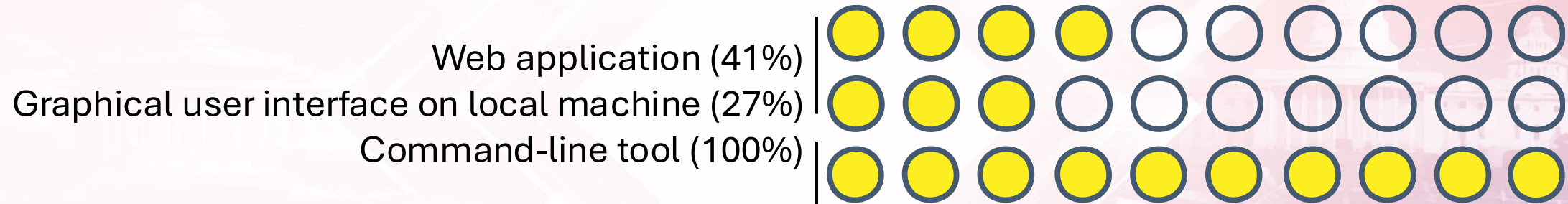
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User Interface



User Interface

SEARCH

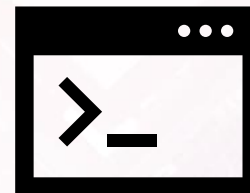
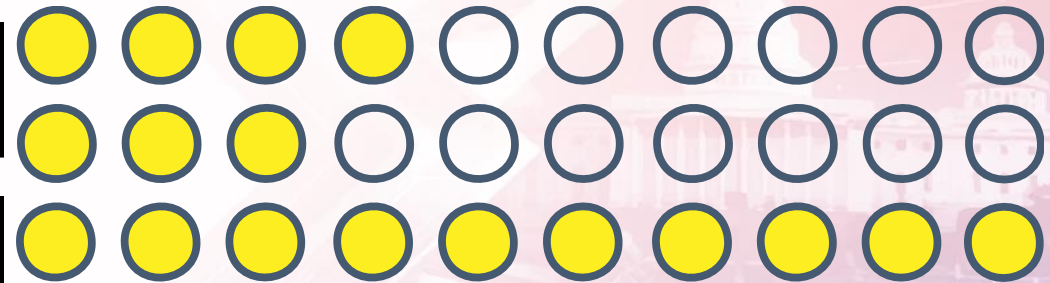


User Interface

SEARCH

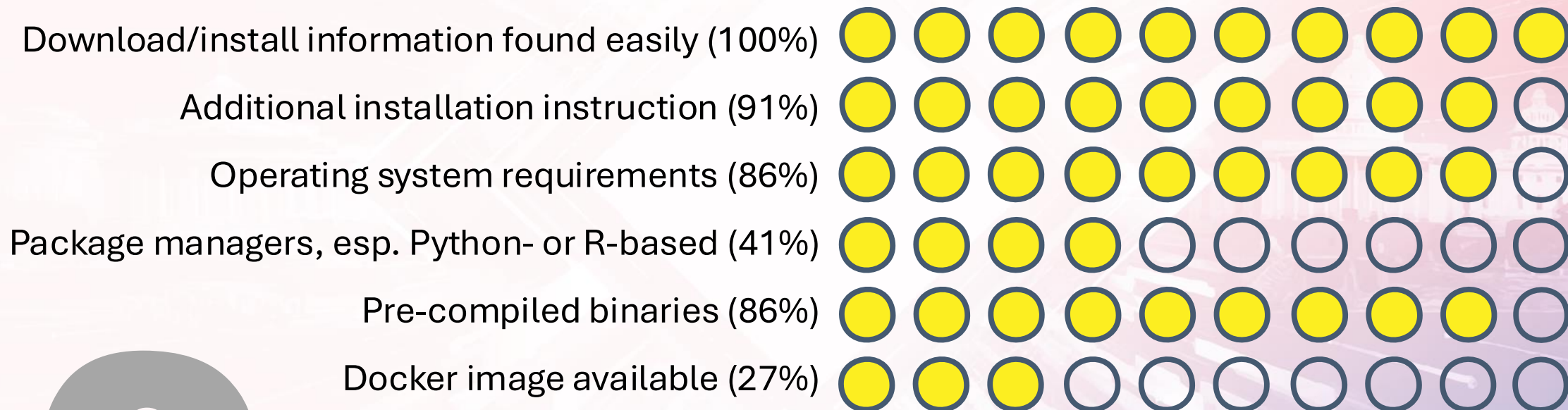


Web application (41%)
Graphical user interface on local machine (27%)
Command-line tool (100%)



```
$ echo 'Hello, World!'
```

Installation



2

Installation



2



Installation



2



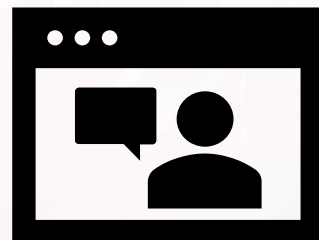
Format

Link to video tutorials (18%)	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clear list of tasks & options in tutorial (95%)	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Tutorial curated by topic (82%)	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Step-by-step instruction (73%)	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Github or source code (86%)	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Software release notes (95%)	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

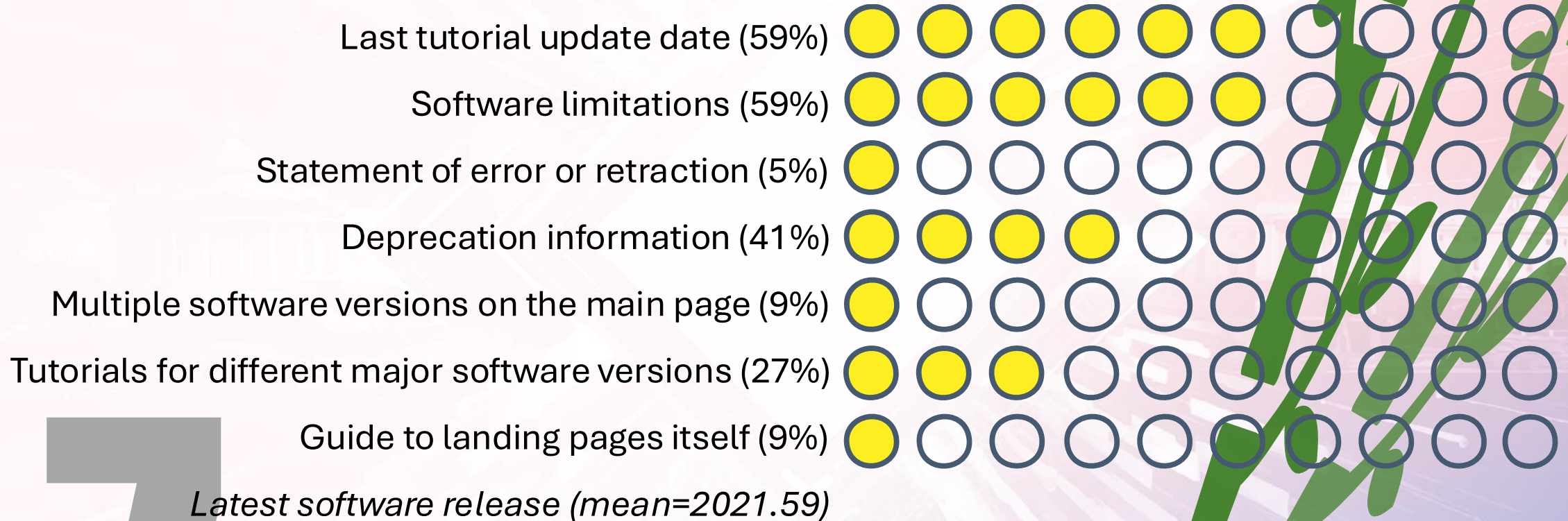
Format

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4



Resilience



Promotion of Community

Instructions written by community members (32%)



User rating (14%)



User feedback form (77%)



Use cases via featuring user work (41%)



Developer-organized social events (14%)

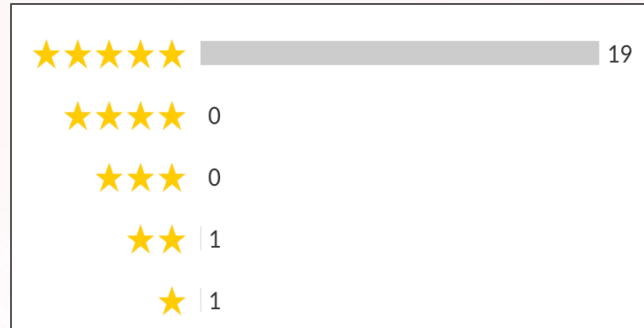


Developer-promoted discussion group (77%)



8

Promotion of Community



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EMBOSS Meetings

Contents

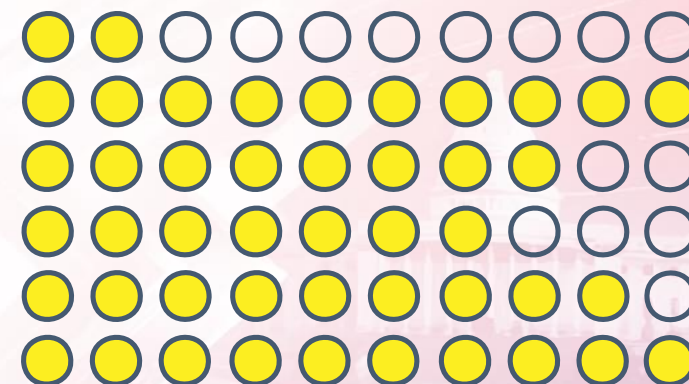
- Forthcoming meetings & events
- EMBOSS Software Development Course
- Coordination meetings
- Colloquia

1

Web application (41%)	●	●	●	●	○	○	○	○	○	○
Graphical user interface on local machine (27%)	●	●	●	○	○	○	○	○	○	○
Command-line tool (100%)	●	●	●	●	●	●	●	●	●	●

Link to video tutorials (18%)	○	○	○	○	○	○	○	○	○	○
Clear list of tasks & options in tutorial (95%)	●	●	●	●	●	●	●	●	●	●
Tutorial curated by topic (82%)	●	●	●	●	●	●	●	○	○	○
Step-by-step instruction (73%)	●	●	●	●	●	●	○	○	○	○
Github or source code (86%)	●	●	●	●	●	●	●	●	○	○
Software release notes (95%)	●	●	●	●	●	●	●	●	●	●

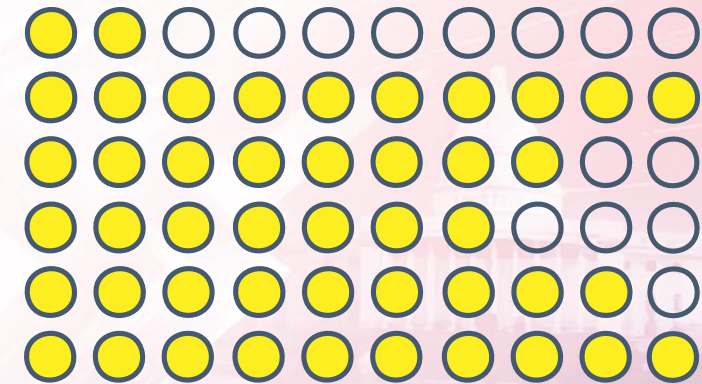
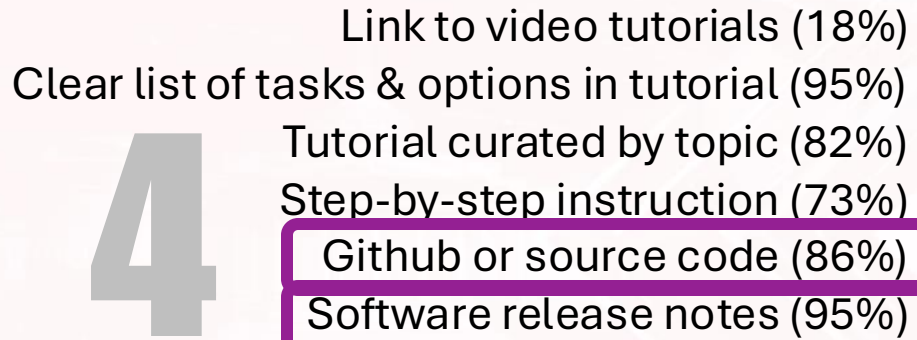
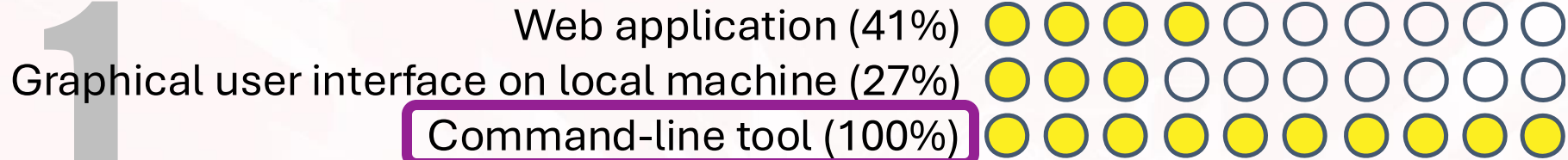
4



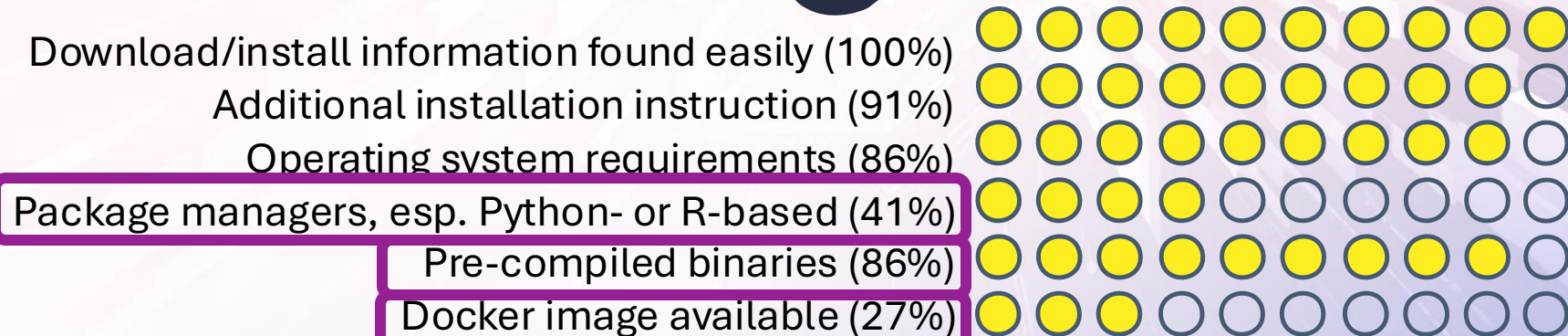
2

Download/install information found easily (100%)	●	●	●	●	●	●	●	●	●	●
Additional installation instruction (91%)	●	●	●	●	●	●	●	●	○	○
Operating system requirements (86%)	●	●	●	●	●	●	●	○	○	○
Package managers, esp. Python- or R-based (41%)	●	●	●	○	○	○	○	○	○	○
Pre-compiled binaries (86%)	●	●	●	●	●	●	●	○	○	○
Docker image available (27%)	●	●	●	○	○	○	○	○	○	○

1



2



(1) Grounding

(2) Integration

Interdisciplinarity

(3) Communication and translation

(4) Critical awareness

(5) Teamwork

Score

(1) Grounding

(2) Integration

Interdisciplinarity

(3) Communication and translation

(4) Critical awareness

(5) Teamwork

Score**(1) Grounding****73%****(2) Integration****NA****Interdisciplinarity****(3) Communication and translation****58%****(4) Critical awareness****17%****(5) Teamwork****54%**

Score**Cardinality****(1) Grounding****73%** $n(+): 6$ $n(-): 0$ **(2) Integration****NA** $n(+): 0$ $n(-): 0$ **Interdisciplinarity****(3) Communication and translation****58%** $n(+): 29$ $n(-): 2$ **(4) Critical awareness****17%** $n(+): 4$ $n(-): 3$ **(5) Teamwork****54%** $n(+): 5$ $n(-): 0$

Grounding

n (+) : 6

n (-) : 0

- (100%) Command-line tool
- (41%) Package managers, esp. Python- or R-based
- (86%) Pre-compiled binaries
- (27%) Docker image available
- (86%) Github or source code
- (95%) Software release notes

73%

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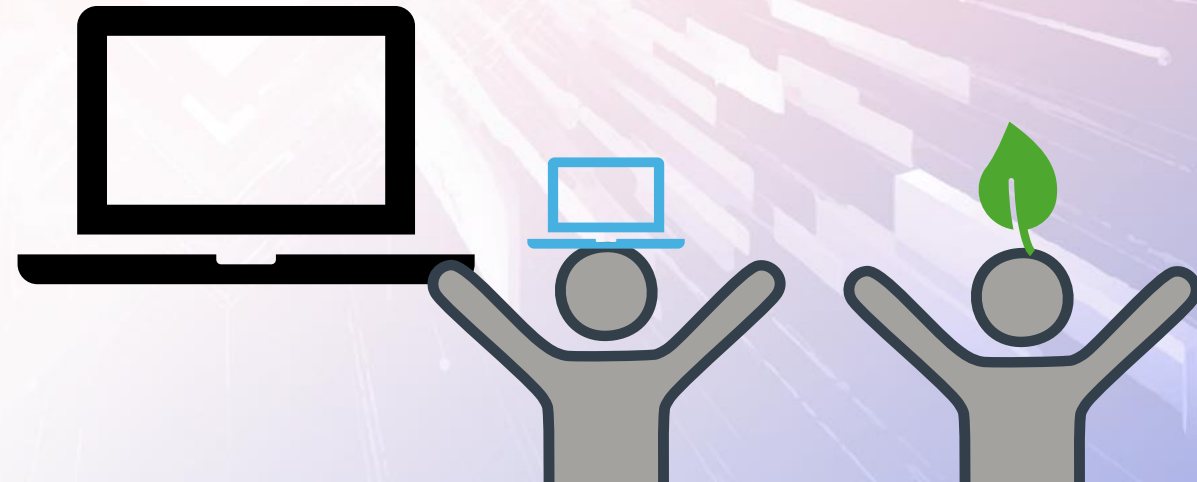
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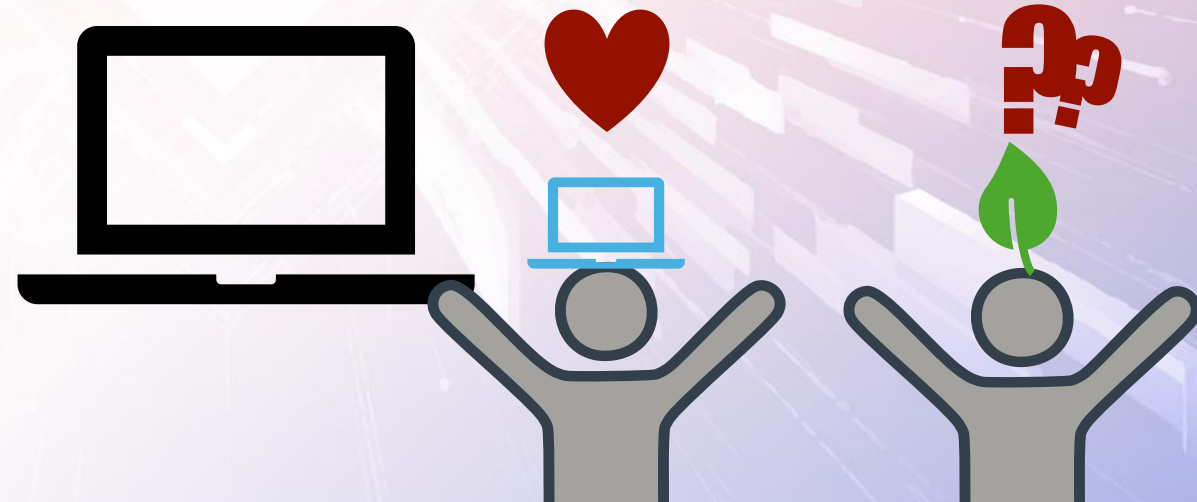


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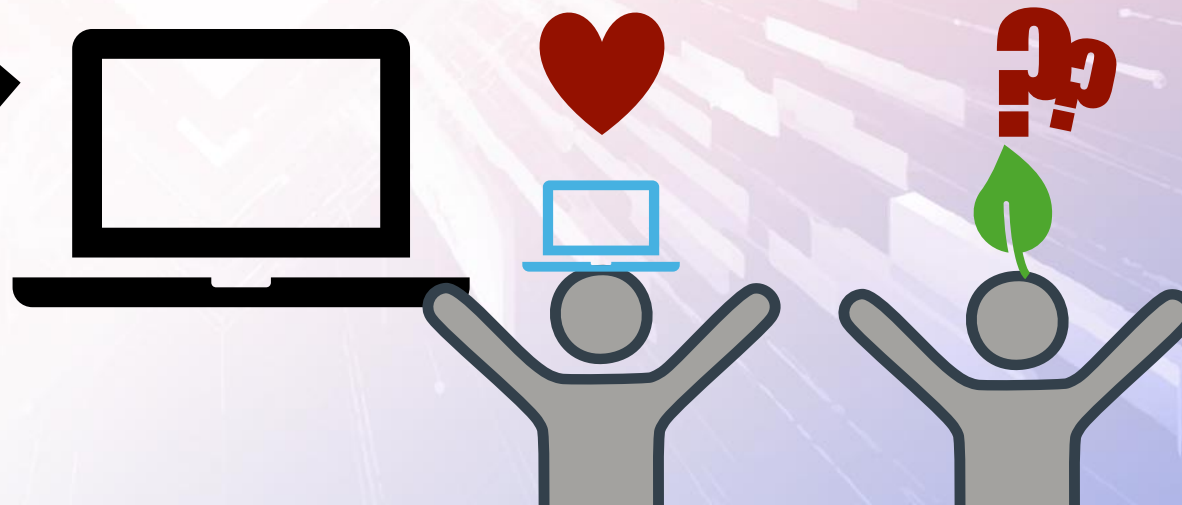
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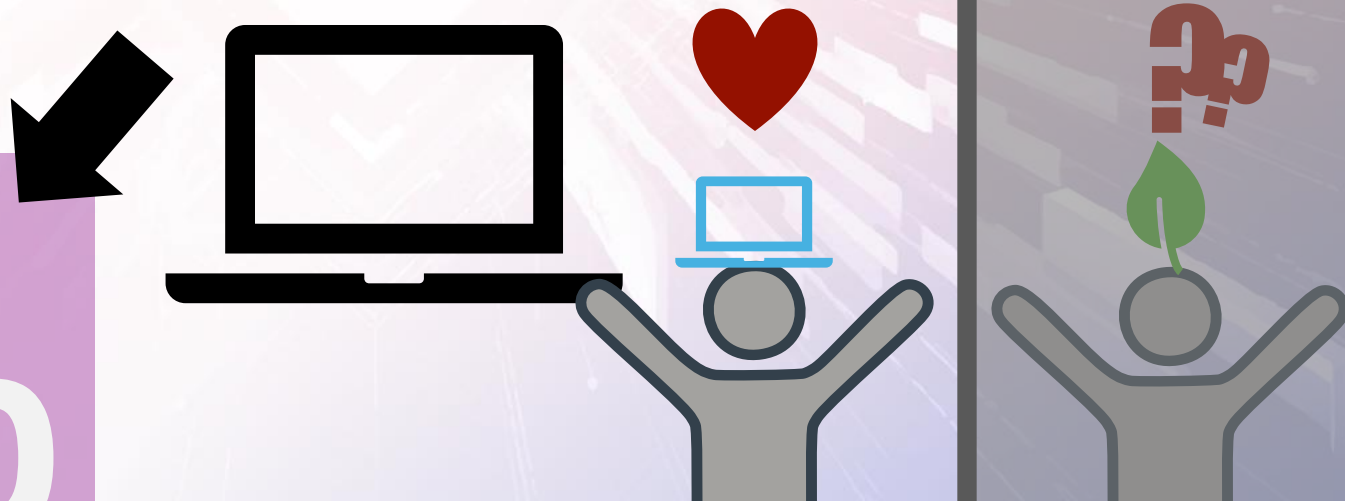
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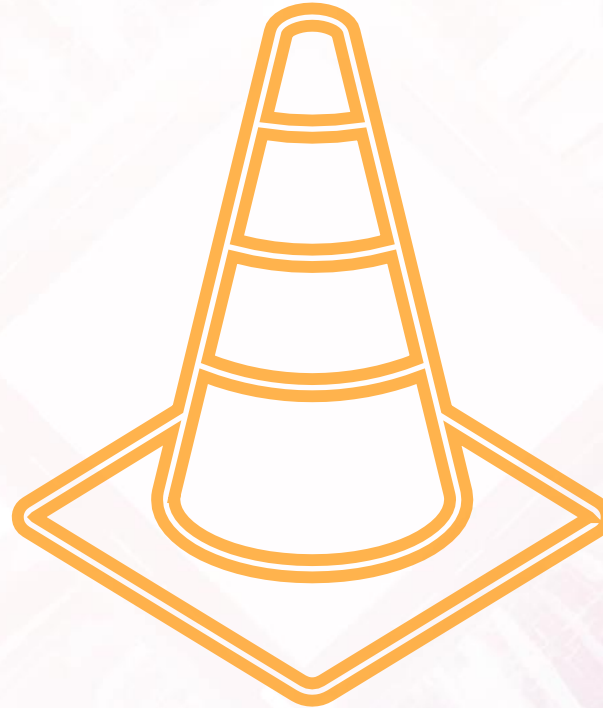
73%



Integration

$n(+): 0$

$n(-): 0$



NA

Communication and Translation

n (+) : 29
n (-) : 2



(41%)	Web application
(27%)	Graphical user interface on local machine
(100%)	Download/install information found easily
(91%)	Additional installation instruction
(86%)	Operating system requirements
(82%)	Sample data
(55%)	Raw sample data with reference
(91%)	Input data format
(68%)	Output description
(18%)	Link to video tutorials
(95%)	Clear list of tasks & options in tutorial
(82%)	Tutorial curated by topic
(73%)	Step-by-step instruction
(77%)	Software name explained
(100%)	General software significance explained
(82%)	General software method explained
(100%)	Instructions written by the developers
(100%)	Current version information
(91%)	Citation information conspicuous
(-18%)	Citation info less accessible e.g., in FAQ
(-41%)	Page link not working
(32%)	Instructions written by community members
(14%)	User rating
(77%)	User feedback form
(41%)	Use cases via featuring user work
(14%)	Developer-organized social events
(77%)	Developer-promoted discussion group
(41%)	Ad/news
(41%)	Logo
(18%)	Performance comparison with competitors
(32%)	Summary statistics of download

Critical Awareness

n (+) : 4

n (-) : 3

- (59%) Last tutorial update date
- (59%) Software limitations
- (5%) Statement of error or retraction
- (41%) Deprecation information
- (-9%) Multiple software versions on the main page
- (-27%) Tutorials for different major software versions
- (-9%) Guide to landing pages itself



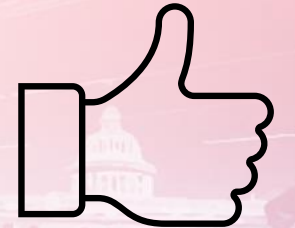
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Critical Awareness

Resilience

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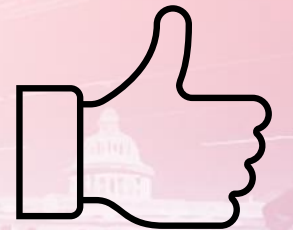
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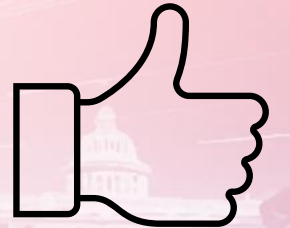
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Teamwork

n (+) : 5

n (-) : 0

- (36%) Software dependency on other tools
- (91%) Link to references other than its own
- (36%) Instructions for other developers
- (9%) Instructions for administrators
- (100%) Copyright Information

54%

Teamwork

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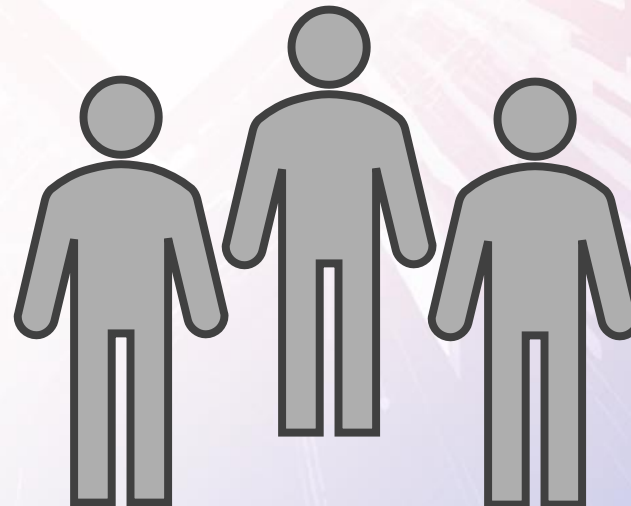
Teamwork

Willingness to Collaborate

n (+) : 5

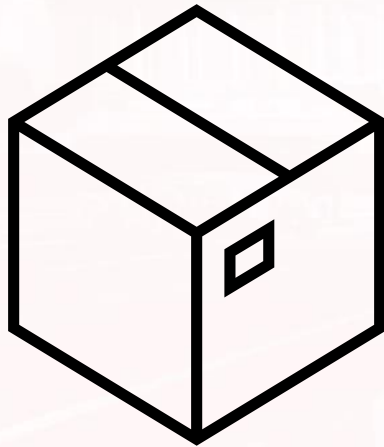
n (-) : 0

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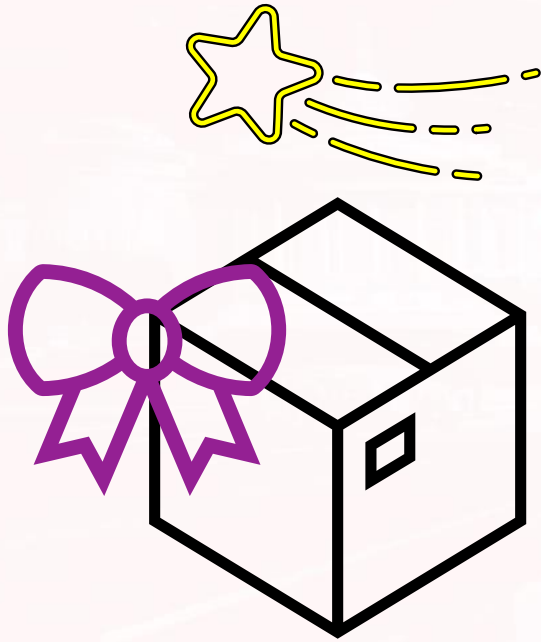


54%

Key Takeaways

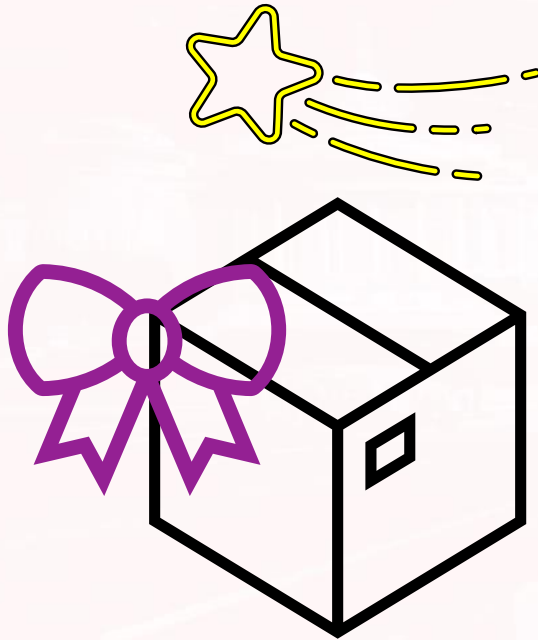


Key Takeaways

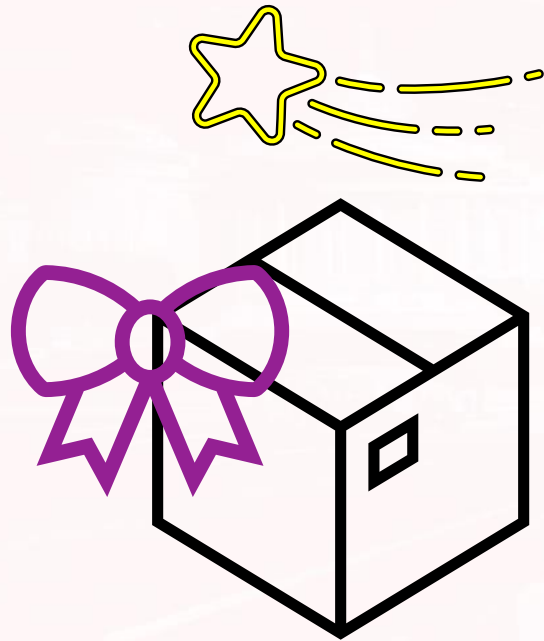


Key Takeaways

- Tutorials serve more than just step-by-step instructions in interdisciplinary learning environments.



Key Takeaways



- Tutorials serve more than just step-by-step instructions in interdisciplinary learning environments.
- The lens of interdisciplinarity reminds us to consider the “why” of the diverse user presence.

Acknowledgement



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Dr. Stephen MacNeil



Dr. Sergei L. Kosakovsky Pond

Hyangeun Ji
Minjeong Yeon, PhD
Cindy Zastudil
Seth Bernstein
Kenneth Angelikas
Christine Kapp
Rahad Arman Nabid

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Seth Bernstein
Kenneth Angelikas
Christine Kapp
Rahad Arman Nabid

And all the communities that have given us inspirations.

Thank you!
Questions or Comments?