Indiana University Plagiarism Tutorials and Tests:

14 Years of Worldwide Learning Online

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Abstract

We briefly tell our story about the Indiana University Plagiarism Tutorials and Tests (IPTAT), from the original design and development in 2002 through 2016. Widespread cheating on the Certification Test in 2012-13 required us to redesign the test. The changes resulted in a structure that offered billions and trillions of test combinations for undergraduate and graduate students. These more difficult tests indicated a need for improving the tutorial and for incorporation of *First Principles of Instruction*. Next we briefly illustrate how each principle was implemented. Finally, we summarize usage of the redesigned IPTAT in 2016 and empirical findings on instructional effectiveness.

Keywords: plagiarism tutorial, student learning assessment, instructional design, student cheating, first principles of instruction, MOOC, online instruction, online testing, instructional effectiveness.

Early Years: 2002 – 2015

The tutorial and test on *How to Recognize Plagiarism* was originally developed for use by students in the Instructional Systems Technology (IST) department at Indiana University, starting in September, 2002. As other instructors and students have since discovered these online resources on the web, and by word of mouth, tutorial and test usage has been increasing each year.

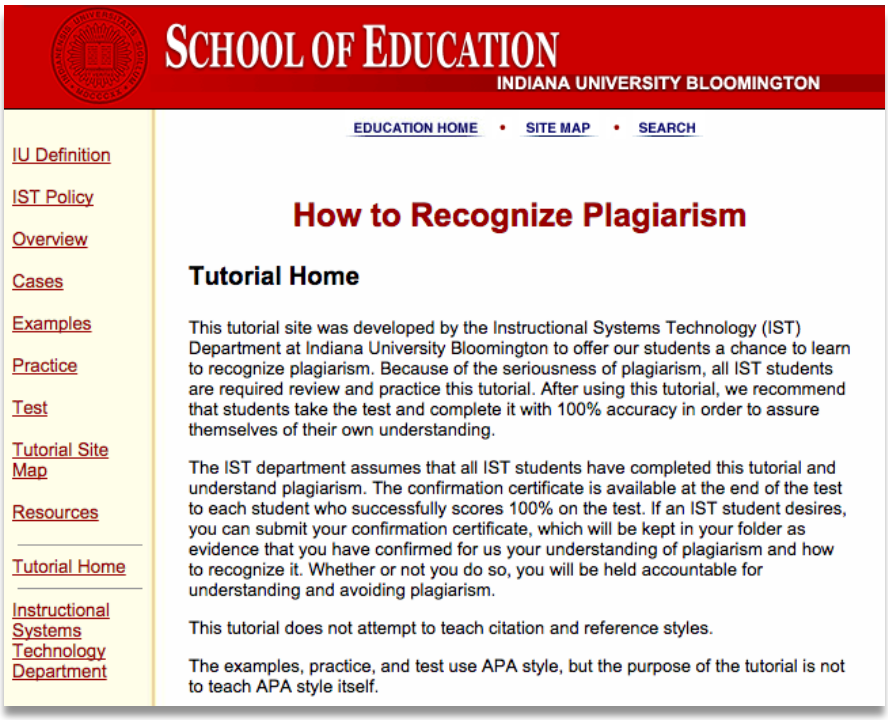

Figure 1. Home page of the original tutorial, circa 2003.

Usage of the tutorial has been increasing almost exponentially. See Figure 2.

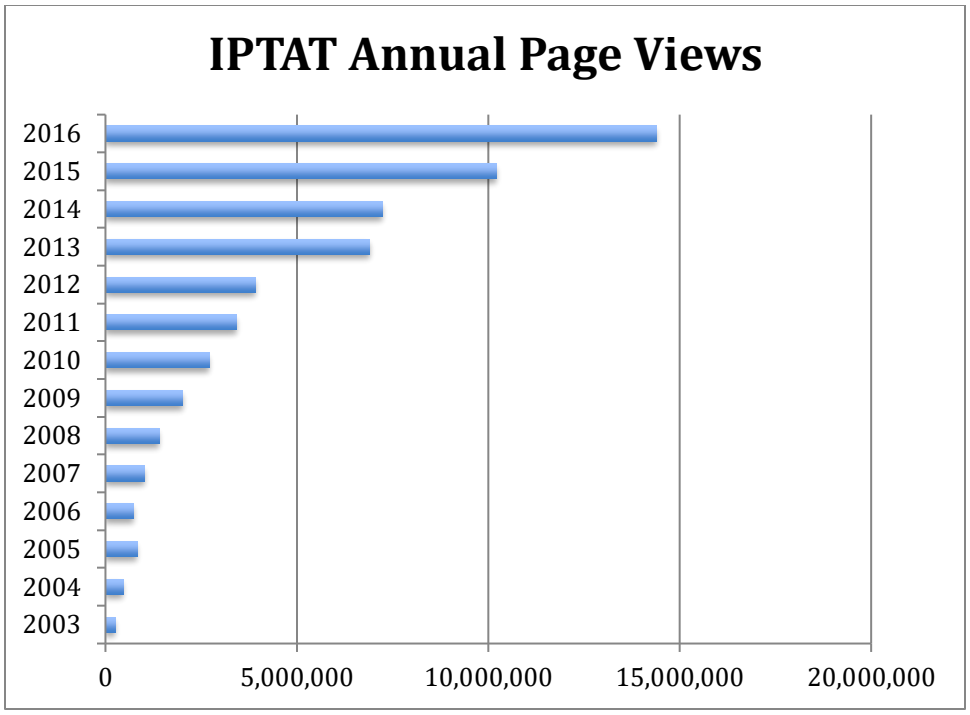

Figure 2. Annual page views (i.e., total web requests) of the Indiana University Plagiarism Tutorial and Tests, 2003 through 2016.

Throughout the 14 years of design, development, modification, and usability testing, the plagiarism tutorial design team has consisted of a variety of members. We refer to the changing group as the plagiarism tutorial *design team* in telling our story. A link to the major contributors is provided at:

https://www.indiana.edu/~academy/firstPrinciples/credits.html.

The plagiarism tutorial and tests have undergone numerous changes over the years. To simplify matters, we refer here to the IPTAT: Indiana University Plagiarism Tutorials and Tests. The current version of IPTAT is located at:

https://www.indiana.edu/~academy/firstPrinciples/index.html.

The design team has learned through correspondence initiated by instructors that many now require their students to take this test. We have no control over who uses our

tests and for what purposes. Our goal is to help people understand what plagiarism is, so that they do not commit plagiarism in their writing and presentations. At this time, anyone is welcome to use our learning resources and tests for free.

Aside from minor corrections and modifications, the original tutorial and 10-item test remained largely the same between 2002 and 2012.

Recent Improvements in the Plagiarism Tutorial and Tests

Based on feedback the design team has received from college and high school instructors whose students use our online tutorial, we describe major changes between 2013 and 2015. Users normally contact us by clicking on a link provided at the bottom of nearly every web page in the tutorial. This link goes to a simple web form to complete, and when submitted sends e-mail to a hidden address, which we monitor regularly. This primary feedback loop with users, combined with web logs on tutorial access, provides impetus for making changes to improve the tutorial and tests.

Defeating the cheating: Major changes in 2013

Several instructors had sent e-mail in 2013 who were highly concerned about the validity of the 10-item test in the IPTAT. They suspected widespread cheating was going on, and thus certificates granted were highly questionable. They provided a link to a YouTube video, where the answer key was contained in the video. The creator of that video also mocked the test as a useless waste of time, initially posted in late 2012.

In mid-July, 2013, Frick changed the order of the 10 test items and renumbered them. Within a few days, comments posted below the YouTube video indicated frustration that the answer key no longer worked. A new post subsequently provided the new answer key, followed by further comments expressing gratitude.

A week later, the test items were scrambled again, and within 24 hours, a new answer key was posted. After several more repetitions of this pattern, Frick decided that something different was needed. Meanwhile, access to the YouTube video literally doubled by mid-August and kept increasing daily as the fall semester began.

Developing a better test. The plagiarism tutorial design team met and planned for how to minimize this kind of cheating. First, a much larger item pool needed to be developed. Second, a PHP script was necessary to present items in a random order, judge the answers, and provide feedback. This was accomplished in about 3 weeks, and implemented in early September. There were now billions of unique combinations of 10-item tests.

Not surprisingly, the design team received a lot of e-mail from students who complained about "how hard" the test was, and also from instructors who were unaware of the sudden changes and who had told their students about the previous test. So the design team added explanations on the website which informed users of the changes.

Defeating test answer guessing and use of the 'Back' button. A further strategy for passing a test that had been in use (even before the new randomized tests) was to just guess answers to the 10 items, to get feedback on the numbers of right and wrong answers. Then a student would click the 'Back' button in their web browser, change an answer, resubmit their test for evaluation, and get further feedback on the number of right answers. Basically, through this trial-and-error strategy, students could improve their results until they passed. In fact, the design team already knew about this strategy, which was confirmed by examination of web logs on test attempts and passing rates.

The solution to this problem was not simple. Once a web page is accessed via a user's web browser, that page is cached locally on their device. When the 'Back' button is clicked, the browser just displays the cached page and does not need to make a new request for the page on the website. Scripting a solution to this problem was extremely vexing. Even JavaScript code did not solve the problem, because all a user had to do was to turn off JavaScript in their web browser. This 'cat-and-mouse' game continued between the design team and student users. The motivation for passing a test and earning a certificate was largely due to instructors who required their students to present their certificates for credit in classes they were taking. And students apparently were less interested in learning about plagiarism than they were about finding an easy way to get their assignment completed without spending a lot of time.

The ultimate solution to the problem involved creation of unique test IDs associated with each test attempt. It also required storing a unique file (on the web host site) for each test attempt that contained the sequence of test items and the number of correct answers whenever someone failed a test. Thus, if the 'Back' button strategy was attempted, the PHP script would check to see if a file existed with the unique test ID with the exact sequence of test items attempted. If so, no further feedback was provided. That user's only option was to take a new test, with 10 new questions randomly selected from the large pool.

This solution created a very large number of unique test attempt files on the website host, and further required a daily maintenance strategy. Literally, as many as 3,000 new files were created daily during peak usage times. To prevent very large

numbers of files accumulating rapidly, a Linux ‘crontab’ job was automatically run at midnight to remove each day’s new files.

A further strategy students used to cheat was via collaboration. One student would pass a randomized 10-item Certification Test, and receive the customized certificate sent to him or her. Then another student would use the same computer, click the ‘Back’ button several times, enter their unique information (name and e-mail address), click the ‘Submit’ button, and receive their own certificate *without taking and passing a new test*. The design team confirmed this by viewing the web log of certificates granted, where the design team would see a sequence of certificates with different student names and e-mail addresses, but with identical time stamps, IP numbers, dates, and test durations. There was not much the design team could do about this at the time, other than warn instructors to look out for certificates that were the same except for the students’ names (the IPTAT had inserted IP numbers, etc. on each certificate).

One indicator of our success in defeating the kinds of cheating described above was the number of complaints the design team was receiving from students who were unable to pass a test, and who were “sure” that the testing system was broken. Our stock answer was that the tests were operating properly, and asked whether or not they had done any of the tutorial and practice tests. Most of the time, the design team just ignored these complaints.

After implementing these changes early in 2013 fall semester, the design team also received more e-mail from college and high school instructors who were getting complaints from their students about the new tests. Many instructors were unaware of

the changes the design team had recently made. The design team added a link to the web page that described the changes, dates made, and reasons why.

A few highly frustrated students did e-mail us who said they completed the entire tutorial and passed 10-20 practice tests, but they *still* were not able to pass an IPTAT Certification Test. Practice tests were similar to Certification Tests but included specific feedback on right and wrong answers, unlike Certification Tests that only indicated whether or not a test was passed.

Overall, the most frequent complaint was: "Why don't you tell us which questions we missed and why? How are we supposed to learn from the test?" And the design team knew from web logs that the tutorial pages were accessed relatively infrequently in comparison to the astronomical numbers of test attempts. Students apparently were convinced that if they tried enough times, they would eventually pass. This is not true. They must take time to learn from the tutorial. The design team also knew from web logs of test attempts that the passing rate was under 10%. The design team also could observe logs in real time, where the same IP number was repeated in succession over a short period of time, resulting in failures until that individual passed a test.

Improving instructional feedback from a test: Major changes in 2014

The biggest problem that remained with the new 10-item tests, selected at random from a large inventory, was that feedback after failing a test was not helpful to students. Starting in fall 2013, the IPTAT no longer told them which questions were answered correctly and which were missed. This was done on purpose in order to protect the test item pool and to minimize cheating via use of answer keys that were prevalent in the past. From our perspective, the tests were much more valid than previously. From a

student perspective, the tests were "too hard". The IPTAT was violating their expectations for feedback by not telling them about their mistakes and how to correct them. From their perspective, the IPTAT was providing poor instruction, or worse, that the instructional designers were incompetent, lousy teachers. A frequent question: "Why does it [the IPTAT] not tell me how many questions I missed and what the right answers are, so I can learn from the test?"

Identifying patterns of plagiarism. The solution for providing better feedback without compromising the item pool and to discourage cheating was by identifying patterns of plagiarism in the test for undergraduate and high school students. Frick identified 15 different patterns of plagiarism, in addition to 2 patterns of non-plagiarism. See: https://www.indiana.edu/~academy/firstPrinciples/plagiarismPatterns/. Each item in the inventory was coded as to type of plagiarism. Each pattern was given a catchy name such as: "clueless quote", "crafty cover-up", "devious dupe", "severed cite", etc.). New web pages were developed for each pattern. Each pattern page provided a prototypical example illustrating the pattern, a detailed explanation of why it is plagiarism, and very importantly modeled how to fix the plagiarism.

This solution not only provided many more examples as part of the tutorial, but also gave us a way to provide better feedback if a Certification Test was not passed. While the IPTAT still did not provide specific feedback on which questions were missed, it instead provided feedback on the *types of mistakes* being made. This was accomplished by providing one or more links to respective patterns of plagiarism on web pages during test feedback. If a pattern was repeated in the test, only one link was provided. In general, students could roughly guess how many items were missed

according to how many pattern links were provided in Certification Test feedback, but it was not an exact count. In a randomly selected 10-item test it was very likely that one or more patterns would be repeated.

The consequence of this improvement in Certification Test feedback was to double the passing rate, from about 8% to 15% at the time this change was implemented.

*Creating separate tests for graduate students***.** As part of his dissertation research, Andrew Barrett (2015) created a new, even larger item pool designed for master's and doctoral level students. His dissertation, available online in ProQuest, describes his work in detail. This test was administered on a different web site. Test length was not fixed, but depended on adaptive testing algorithms for computerized classification testing. Thus, items were presented one at a time, unlike the undergraduate and advanced high school student tests, which each consisted of 10 randomly selected questions presented on a single web page.

Feedback on the graduate-level test was different also. Instead of identifying patterns of plagiarism, this test indicated how many questions were missed according to failure to identify plagiarism when it was in fact word-for-word, when it was paraphrasing, and failure to identify non-plagiarism when in fact it was.

For the graduate-level Certification Test, users complained that, on rare occasions an error occurred, abruptly terminating their test with no feedback, and requiring them to start a new test. After numerous efforts to trace and correct this problem, the design team concluded that it was likely dependent on the device and web browser being used (often corrected by changing their device or restarting it), or a session timeout occurred because of too long a time interval between answering one question and the next.

Certification Test registration added in 2015

Registration for the Certification Test for undergraduate and high school students was implemented in August, 2015. This made it easier for test takers to retrieve their certificates by later logging in with their e-mail address and password created during registration. Furthermore, registration before taking a test made it no longer possible to receive spoofed certificates via collaboration and use of the 'Back' button. Information entered when registering (name and e-mail address) could no longer be changed after a test was passed. Finally, a spoofed certificate could not be validated as legitimate.

Instructors could also view certificates, as before, by entering the unique test ID provided by the test taker, and either the IP address or user e-mail address to confirm the validity of the certificate.

One surprising and interesting finding: about 5% of users had difficulty registering because of errors in their e-mail address. Part of the registration process required them to confirm their identity by going to their e-mail account, open the message sent from the IPTAT, and then click on a link that returned them to the IPTAT. This also explained why some users in the past never received their certificates for passing—they mistyped their e-mail address! And then blamed the IPTAT for failing to send them the certificate they had worked so hard to earn.

A detailed list of the history of changes to improve the IPTAT is provided at: https://www.indiana.edu/~academy/firstPrinciples/recentChanges.html .

Major Redesign of IPTAT in 2015

The design team redesigned the IPTAT for several reasons: First and foremost, the design team wanted to improve the effectiveness of the tutorial. The new design implemented *First Principles of Instruction* (Merrill, 2002; 2013). Merrill (2002) had claimed that—regardless of specific content, teaching methods, or programmatic subject matter—student learning would be promoted to the extent that each of the *First Principles* is implemented in design of instruction. In addition to using *First Principles*, the design team wanted to carry out research to evaluate how these five principles of instruction affect student learning. In particular, is Merrill's claim supported by empirical evidence on student usage of parts of the IPTAT and successful learning as indicated by passing a Certification Test?

First Principles include:

1. *Provision of authentic tasks or problems*, sequenced from simple to complex,
2. *Activation* to help students connect what they already know with what is to be newly learned,
3. *Demonstration* of what is to be learned,
4. *Application*, where students try to do the tasks or solve problems with instructor guidance and feedback, and
5. *Integration* of what is learned into students' own lives.

A variety of pedagogical methods can be used to implement each principle, depending on the types of learning objectives, content being taught, and levels of schooling (elementary, secondary, postsecondary). See Merrill (2013) for in-depth description and numerous examples of *First Principles of Instruction*.

The redesign process took place over a period of about 9 months, with the bulk of the development and production completed in late 2015.

Authentic problems principle

This required us to design a series of authentic problems in recognizing plagiarism, arranged from simple to complex. We did so, as indicated on the menu at: https://www.indiana.edu/~academy/firstPrinciples/tutorials/index.html. As can be seen in Figure 4, problems are arranged at 5 levels of difficulty in recognizing plagiarism: basic, novice, intermediate, advanced, and expert. At each level of difficulty, we provide activation, demonstration, application, integration, and a practice test.

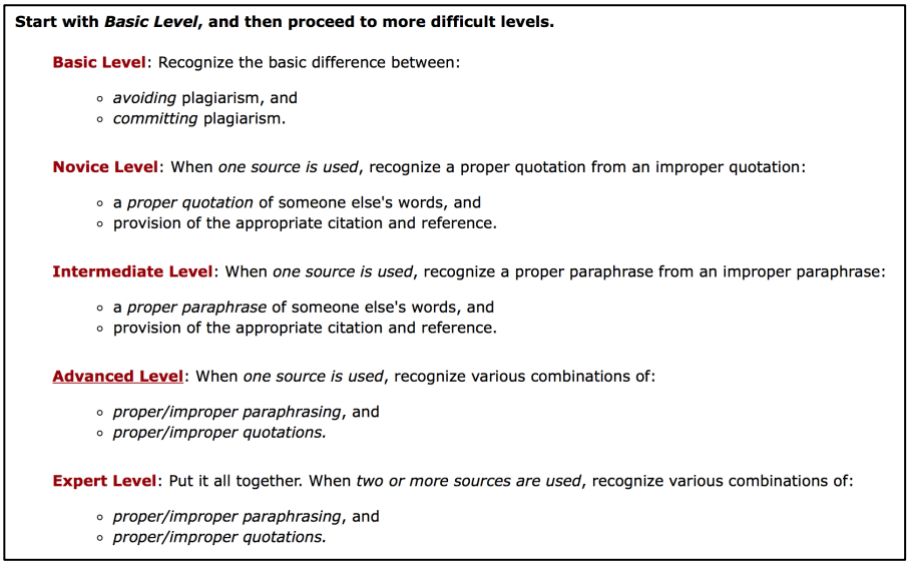

Figure 4. Five levels of difficulty in recognizing plagiarism.

Activation principle

We decided to design and develop 10 video cases as a means of student activation—providing real-world cases for students to experience vicariously. Storytelling is an instructional method which we implemented in our new design to

embody the *activation* principle (e.g., see Andrews, Hull & Donahue, 2009). View an example of a video case at: https://www.indiana.edu/~academy/firstPrinciples/tutorials/task1/activation.html. Similar video cases that tell stories are provided at each of the 5 levels of task difficulty.

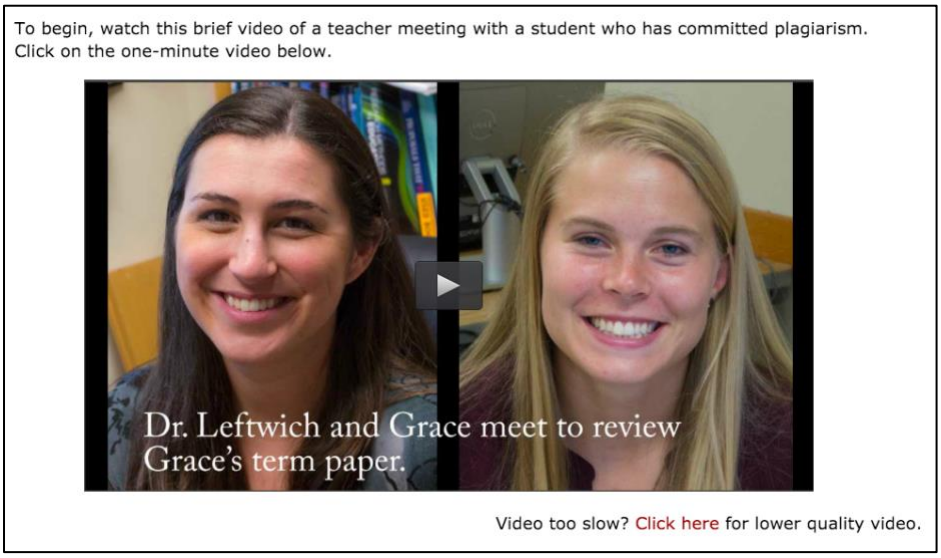

Figure 5. Initial video case in the IPTAT on the starting page, for the activation principle.

Demonstration principle

Here we chose to design 12 screencasts that dynamically portray the writing of a whole, short paper (overlaid with audio explanation of ongoing visual changes in the paper and why they were being made). Examples dynamically show the author committing plagiarism and how he fixes it in order to avoid plagiarism. See, for example, demonstrations at task level 2: https://www.indiana.edu/~academy/firstPrinciples/tutorials/task2/demonstration.html.

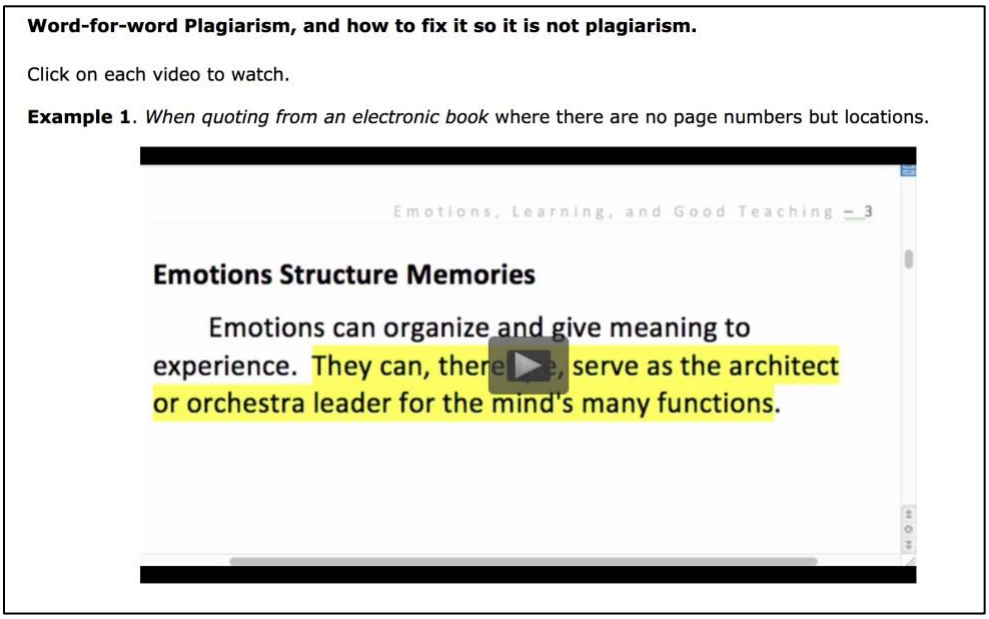

Figure 6. One of 12 screencasts that illustrate plagiarism and how to fix it, for the demonstration principle.

Application principle

Here we developed questions similar to those on the IPTAT Certification Tests, but with two differences. Question difficulty matches the level of task difficulty at each of the 5 levels. Immediate feedback on the correctness of each answer is provided. In addition, if the answer is incorrect, a detailed explanation of why it is incorrect is provided. Also if needed, explanation is provided on how to correctly fix the student version to avoid plagiarism. For example, see task level 3 practice items: https://www.indiana.edu/~academy/firstPrinciples/practiceTest.php?task=3&item=1.

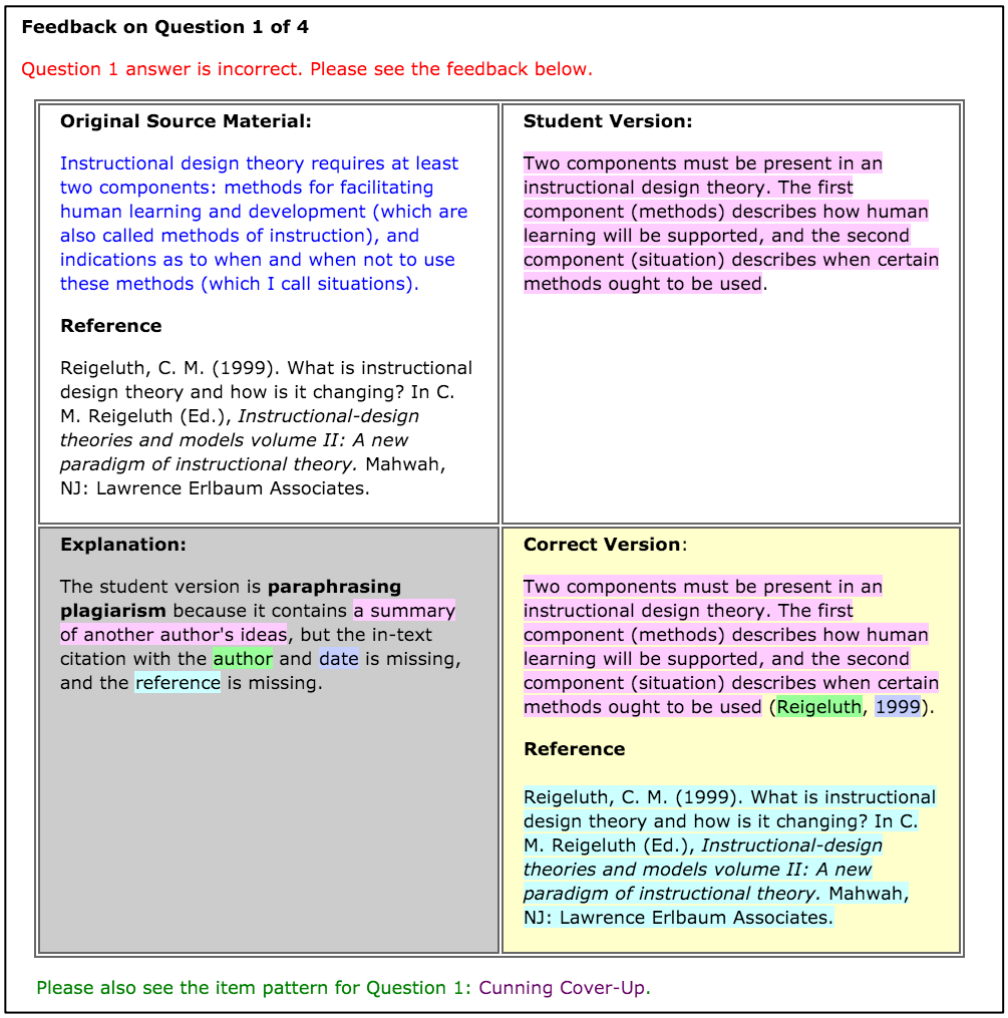

Figure 7. An example of feedback to an incorrect answer on a practice question, for the application principle.

Integration principle

This was perhaps the most challenging principle of instruction to implement in an online tutorial with no human instructor regularly available. We decided to do this by giving students an opportunity to reflect on what they just learned and how it might be used in their own lives. See for example the integration activity at the task 4 level of difficulty: https://www.indiana.edu/~academy/firstPrinciples/tutorials/task4/integration.html. Here

we do not provide feedback on what students write in the text input box, but we do store their comments for later qualitative content analysis to be done as part of research studies.

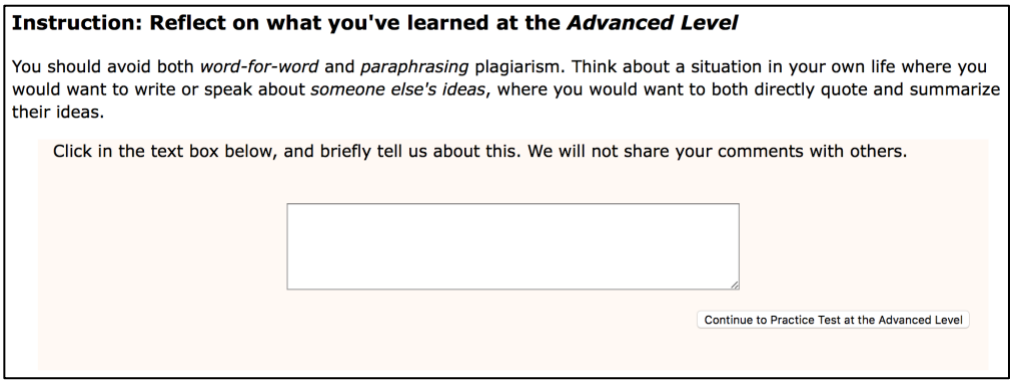

Figure 8. Example of a reflection activity, for the integration principle.

The production version of the IPTAT is now available at https://www.indiana.edu/~academy/firstPrinciples/. A summary of differences between the original and the new design are provided at: https://www.indiana.edu/~academy/firstPrinciples/choice.html.

Use of the Redesigned Indiana University Tutorials and Tests (IPTAT)

Access to the IPTAT in 2016

For the new redesigned version of the IPTAT, the design team has been using Google Analytics to track and report usage. After the new IPTAT was implemented, Google Analytics indicated data as follows from January 2 through December 30, 2016:

- 725,874 user sessions, 373,877 users, with each session lasting about 24 minutes, with 48% return visitors, about 86% whom are from the U.S., 4% from China, 3% Canada, and the remaining 7% from 192 other countries.

- About 14.4 million page views of which 8.8 million are unique.
- 494,172 video stories have been viewed to completion (within activation and demonstration phases).
- At peak usage times there are typically 250-300 concurrent user sessions occurring in real time. Peak usage times were typically Monday through Thursday, and much higher early in spring and fall semesters.
- The most frequently accessed pages are those which provide individual feedback with explanations of right/wrong answers after each practice question (in the application phase), with 1,926,928 page views.

Student learning outcomes in 2016

Results from record keeping done via the IPTAT indicated that between January 2 and December 30, 2016, there were 178,386 users who successfully registered; and 145,229 unique individuals had passed a Certification Test. That is, 81% of registrants had learned to recognize plagiarism at a high level of mastery. That is a very good success rate; overall, about 4 out of 5 students successfully learned via the IPTAT to recognize word-for-word and paraphrasing plagiarism, as well as non-plagiarism.

Results further indicated that *graduate* students were about 5 times more likely to *pass* a Certification Test when they *agreed* before taking their first Certification Test that they experienced *First Principles of Instruction* and *Academic Learning Time* (ALT), when compared with those who *disagreed* that they experienced *First Principles* and ALT.

Prior to taking a Certification Test, students optionally completed a short survey on their perceptions of Teaching and Learning Quality (TALQ scales) (Frick, et al., 2009, 2010). Students were also asked about which parts of the tutorials they completed. Likert-scale responses to TALQ scales were reclassified as to whether a given student agreed or disagreed with statements which comprise scales that respectively measure *First Principles of Instruction* and *Academic Learning Time* (ALT, or successful student engagement in learning activities). TALQ items had been slightly modified for use with MOOCs (Massive Open Online Courses), where instruction is delivered online and no human instructor is present (Frick & Dagli, 2016). Modified TALQ scales (referred to as MOO-TALQ) were highly reliable. Cronbach *alpha* coefficients ranged from 0.74 to 0.94.

Students were classified according to whether they passed or failed the Certification Test they immediately took after completing the TALQ survey. Correctly answering at least 9 out of 10 randomly selected questions from large item pools was required for passing a test. We conducted a variant of Analysis of Patterns in Time (APT) to form likelihood ratios to determine odds of each pattern occurring (see Frick, 1990; Frick, et al., 2009, 2010). Results below are based on data collected over 20 days in January, 2016, only for students who agreed to participate in this study and who optionally completed the TALQ survey prior to taking their initial Certification Test.

For graduate students, 119 out of 300 (0.397) who completed the TALQ survey agreed that they experienced *First Principles* and ALT, and of those, 35 students passed the immediately following Certification Test (35/119 = 0.294). Of those 17 who did *not* agree with experiencing both *First Principles* and ALT, only one student passed a

Certification Test (1/17 = 0.059). Thus, the odds of passing for those who agreed vs. disagreed were 0.294/0.059 = 4.98, or approximately 5 to 1. Another way of viewing this is that 16 out of 17 students who disagreed with experiencing *First Principles* and ALT failed their first Certification Test (16/17 = 0.941). Thus, graduate students were about 16 times more likely to fail the test when they reported that they had not experienced *First Principles of Instruction* and ALT (0.941/0.059 = 15.95).

For *undergraduate and high school students*, the odds of passing were about 3 to 1 for the first pattern. There were 1,716 of these students who completed the TALQ immediately before taking their first Certification Test. Of the 510 students who agreed that they experienced both *First Principles* and ALT, 146 passed their first Certification Test (146/510 = 0.286). There were 192 students who disagreed with both kinds of experiences, and 19 of those passed (19/192 = 0.099). The odds ratio is 0.286/.099, or about 2.89 to 1, which means that undergraduate and advanced high school students were about 3 times more likely to pass their first Certification Test if they agreed that they experienced both *First Principles* and ALT in the IPTAT, when compared with those who disagreed with both kinds of experiences. In a similar vein, 173 out of 192 who disagreed that they experienced both *First Principles* and ALT failed the test (173/192 = 0.901). These students who disagreed were about 9 times more likely to fail than to pass their first Certification Test (0.901/0.099 = 9.1). See Dagli (2017, in progress) for further details.

Conclusion

Overall, our findings indicate that when students reportedly do *not* successfully engage in most or all of the tutorials (which were specifically designed to implement *First Principles of Instruction*), those students are between 9 and 16 times more likely to *fail* the first Certification Test they take. If they persist with the IPTAT, approximately 81 percent of them eventually do pass a test.

Approximately 13.4% of Certification Tests taken in 2016 were passed, roughly one out of 7. While multiple tests are taken by most students, pattern analysis indicates that the odds of passing a test are between 3 to 5 times more likely when students report that they have experienced both *First Principles* and ALT in the IPTAT.

Thus, empirical evidence that we have collected on worldwide use of the newly designed IPTAT in 2016 supports Merrill's (2002, 2013) claim that student learning is promoted when *First Principles of Instruction* are present.

Afterword

Millions of students worldwide have used our online tutorials and tests, and have learned to recognize plagiarism. We have told our story here in some detail, so that readers can appreciate what has taken place over the past 14 years. As described above, modifications of the original tutorial and test on how to recognize plagiarism have been incremental, mostly based on user feedback. Changes became more frequent during 2013-14, after cheating on the test was reported by instructors who found an answer key on YouTube in 2012. A major redesign of the instruction occurred in 2015, based on Merrill's *First Principles of Instruction*.

Design and development over 14 years has been largely carried out by Frick and his graduate students in Instructional Systems Technology. Through participation in this effort, our doctoral and master's degree students have gained hands-on experience in design and development of online instruction and assessment. Some members of the Frick Research Group have also been using the Indiana University Plagiarism Tutorials and Tests (IPTAT) very recently for collecting data to study the effectiveness of instructional strategies and patterns of student learning that lead to mastery as determined by IPTAT Certification Tests.

To experience IPTAT, go to:

https://www.indiana.edu/~academy/firstPrinciples/index.html.

For details on contributors, go to:

https://www.indiana.edu/~academy/firstPrinciples/credits.html.

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