

Collaborative Approach for Teaching Information Literacy in an Introductory Plant Science Course¹

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Abstract

After an assessment of student learning outcomes indicated that information literacy (IL) was a weakness in the plant and soil science programs, instructors in the introductory plant science course collaborated with the Washington State University Libraries to incorporate IL into an existing assignment. The objectives of this paper are to describe the incorporation of an IL web-based learning environment into the course and to evaluate the effectiveness of the environment in improving students' abilities to find and use information in two consecutive classes. The environment featured a series of tutorials covering the IL standards of: needed, accessing, evaluating, and using information, followed by a quiz and an essay for each standard. The essays and a final comprehensive assignment tested the students' abilities to apply the information learned from tutorials. The class average on the pretest, taken before the online tutorials, was 59% in 2007 and 51% in 2008. The average quiz score after completing the tutorials was 89% and 80% in 2007 and 2008, respectively. Student performance on the quizzes was correlated with subsequent performance on the assignment both years, suggesting that the online learning environment shows potential as an effective tool in helping students learn and apply IL concepts.

Introduction

The need to produce information literate graduates who can effectively navigate and use information is increasingly acknowledged in response to the ever-expanding information environment. A common misconception is that today's students have grown up with the internet, are comfortable interacting with the web, and arrive at institutes of higher education fully information literate. However, a study by the Educational Testing Service of 3,000 college students and 800 high school students found only 13% of the students were information literate (Foster, 2006). We have found similar deficiencies in our plant and soil science programs at Washington State University (WSU). An assessment of student learning outcomes

in 2006 and 2007 revealed that information literacy (IL) was a weakness in these programs (Cerny-Koenig et al., 2007). Information Literacy is one of Washington State University's (WSU) six Learning Goals of the Baccalaureate; the educational goals WSU has determined our baccalaureate graduates should achieve (WSU Office of Undergraduate Education, 2005).

Information literacy (IL) can be defined as the ability to acknowledge an information need, access appropriate resources efficiently, critically evaluate the information retrieved, and use the information effectively, while understanding the legal and ethical implications surrounding its acquisition and use (American Library Association, 2000).

A key component to locating scholarly resources, particularly in the academic environment, is the ability to express an information need in the form of a search strategy. Rowlands and Nicholas (2008) reported that difficulties in developing effective search strategies for locating scholarly resources are the result of students' inadequate understanding of their information need. This tendency results in the use of natural language searches that generally produce inadequate returned resources for the information need.

A common frustration for instructors is evaluating student papers comprised mostly of open web sources, or information sources that are inappropriate for the assignment or information need. The instructors' main concern is that undergraduates use open web and secondary sources in place of primary sources (Scott and Simmons, 2006; Spackman, 2007). Spackman (2007) suggested that accessing and classifying peer-reviewed resources as primary, secondary or tertiary may be beyond the abilities of many students while Brown and Krumholz (2002) felt students motivated by convenience would find alternate less scholarly sources when full-text articles were not available locally. Using these convenient information resources is exaggerated by ease of electronic access.

The ability to critically evaluate resources is essential to successfully navigating today's informa-

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tion environment. Students tend to scan information quickly, spending little time on any one [web] page (Rowlands and Nicholas, 2008). This behavior suggests a lack of rigor in many undergraduate literature reviews (Scott and Simmons, 2006).

The extent to which a student uses proper source documentation in undergraduate papers is indicative of the understanding of the legal and ethical issues surrounding research. Brown and Krumholz (2002) noted that even after educational intervention, the lack of cited sources in student papers continued to be problematic. A failure on the part of instructors, in terms of student accountability, is also evident in student papers that show little respect for intellectual property.

Instructors who desire to include IL activities in their classes often feel overloaded with disciplinary material and struggle to find a suitable manner for relevant incorporation of IL. Instructors with this conflict often seek opportunities for self-directed learning, generally in the form of online instruction (Leckie and Fullerton, 1999). Online IL instruction has been shown to be as effective as instruction provided in person (Bridgland and Whitehead, 2004; Nichols et al., 2003). While online or face to face instruction are viable options, a blended approach of online and face- to- face instruction is preferred, often producing the most effective results (Bridgland and Whitehead, 2004; Brown and Krumholz, 2002).

Although it is clear that IL seems to be a deficiency in many curricula, it is unclear who should be teaching IL: course instructors, librarians, or both. There also is confusion about the type of assistance available from libraries and some librarians feel many teaching faculty lack an understanding of the IL skills necessary in today's world (Leckie and Fullerton, 1999). Therefore, a collaborative approach is becoming the favored method of instruction (D'Angelo and Maid, 2004; Spackman, 2007; Sult and Mills, 2006).

At WSU, students majoring in applied plant sciences (e.g. Horticulture, Crop Science, and students from many other agricultural majors) are required to take an introductory plant science class entitled "Cultivated Plants" (Crops/Hort 102). This course provides an excellent opportunity for explicitly incorporating IL instruction to 'close the loop' on the weakness in IL determined in our program assessment. Therefore, instructors in the introductory Crops/Hort 102 course collaborated with WSU librarians to incorporate IL instruction through development of an additional component into an

existing course project. Research suggests learning is improved when students are immersed in a project requiring IL skills (Brown et al., 2003; Leckie and Fullerton, 1999). The objectives of this paper are 1) to describe the incorporation of an IL focused, web-based learning environment into an introductory applied plant science class, and 2) to evaluate the effectiveness of the environment in improving students' abilities to find and use information during two consecutive Crops/Hort 102 classes.

Materials and Methods

Plant science course. The IL instruction was initially incorporated into the cross-listed Crops/Hort 102 "Cultivated Plants" course at WSU in fall 2007. The course is required for all Crop Science, Agricultural Business and Technology Systems, Agricultural Education, Organic Agriculture Systems, Pest Management Systems, and Plant and Soil Systems majors and is also taken by many Horticulture majors. It is co-taught by faculty from Crop Science and Horticulture. The goal of the course is to introduce students to the importance of agronomic and horticultural plants in Washington by highlighting the production, innovative research practices, processing, and utilization of the state's

Table 1. Example of the Crop Report Assignment from the Course Syllabus

- Crop report (100 points)
- Choose an important Washington crop of interest to you. (It cannot be one of the crops listed on the lecture part of the syllabus).
 - Write a 3 - 4 page double-spaced, type written paper² on the crop's production requirements, including a general production schedule for the crop.
 - Report on the major processing and/or use of the crop in the state
 - Summarize the findings of a current (published after 2000) research project involving the crop.
 - Report the current statistics on production acreage and value.
 - Use at least 4 information sources but no more than one of each of the following: scholarly journals, newspapers, books, personal communication, trade journals, and websites.
 - Create an additional 1-page section of the paper discussing the different types of information found in each of the sources you used. Describe how each was useful in creating your paper.

²In 2008, students were required to do a 15 to 20 minute presentation instead of a written report but the same required information was communicated.

Table 2. Example of the Rubrics Used for Grading the Crop Report

2007 Written Report (100 points)	
Mechanics (50 points)	
	Proper format and length of paper
	Accuracy of information
	Proper completion of annotated bibliography
	Completed on time
Writing quality (30 points)	
	No spelling or grammatical errors
	Well organized
Overall quality of the paper (20 points)	
	Informative, interesting and easy to follow
	<u>Completed all required information</u>
2008 Oral Presentation (100 points)	
Mechanics (60 points)	
	Proper format and length of presentation
	Accuracy of information
	Proper completion of annotated bibliography
	Completed on time
Presentation quality (20 points)	
	Effectiveness of slides
	Speaking ability
Overall quality of the presentation (20 points)	
	Informative, interesting and easy to follow
	<u>Completed all required information</u>

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major crops. One of the primary course assignments traditionally has been a report on an important Washington crop. In 2007, the report was in the form of a written paper and in 2008, a 15 to 20 minute presentation. This assignment was identified as being the most appropriate for incorporating an IL component. The requirements for the crop report assignments are in Table 1. The rubrics used to grade the assignments are shown in Table 2. In fall 2007, the course had 43 students enrolled: six freshman, 13 sophomores, 13 juniors, and 11 seniors. In fall 2008, the course had 41 students enrolled: 16 freshmen, nine sophomores, ten juniors, and six seniors.

Incorporating the IL web-based learning environment. In fall 2007, an additional course objective was added to the syllabus: “evaluating and properly using quality information sources that are relevant, balanced and current.” To help accomplish this objective, course instructors collaborated with the WSU Libraries Instruction Department to incorporate an additional component into the crop report assignment. This new facet of the assignment directly addressed the standard IL elements required to complete the assignment using the Libraries' Information Literacy Education (ILE) learning environment. ILE is designed to deconstruct a research project and focus on critical IL components rarely addressed in the classroom (e.g. database search skills, evaluating resources, distinguishing between popular and scholarly sources). Using ILE, students learn how to 1) determine the extent and type of information needed for their assignment [needed information], 2) access scholarly information in a variety of formats effectively and efficiently [accessing information], 3) critically evaluate information quality [evaluating information], 4) use the information to accomplish a specific task and produce better final products [using information], and 5) understand the legal, ethical, and social issues surrounding the use of information [understanding information use] within the context of their assignment.

The ILE learning environment was introduced at the beginning of each semester by the senior author (Borrelli), an instructional design librarian, who gave two introductory lectures on the importance of finding and using information efficiently regardless of discipline. Prior to the lectures, a written pretest was distributed to each of the students to determine their baseline knowledge of IL. The pretest included 15 true/false or multiple-choice questions on the topics covered in the IL standards. Students were told that their pretest scores would not count toward their grade, but their participation in the pretest was calculated as a portion of their total participation points for the course.

The students were directed to the WSU Libraries' ILE learning environment (<http://www.wsulibs.wsu.edu/ile/>) and instructed to choose the Crops/Hort 102 course in the dropdown menu. The Crops/Hort 102 ILE assignment page was comprised of an

introduction, a short series of online tutorials, and two assessment sections. The assessment sections tested the students' learning of the information in the tutorials and their ability to transfer the concepts learned to their assignment for each of the five IL standards: needed information, accessing information, evaluating information, using information, and understanding information use. The using information and understanding information use standards were combined into one module in ILE and will be referred to as using information throughout the remainder of this paper. The web application was designed and maintained by the collaborating librarians.

After completing the tutorials for each IL standard, students logged onto a password-protected screen to take a short multiple-choice quiz to test their learning; each quiz had six to fourteen questions. They could repeat the quiz a second time to improve their score and the higher of the two scores was recorded.

Students were then asked to apply the information learned in the tutorials to elements in their crop report in the Assignment Specific Assessments (ASAs) section of ILE. The ASAs offered students the opportunity to focus on a component of the crop report related to a specific IL standard. Examples of the ASAs for each standard are provided in Table 3. The dates for completion of the tutorials, online quizzes, and ASAs were listed in the syllabus, with students having one to two weeks between deadlines for each phase of the assignment. During both semesters, the crop report was introduced to the class during week two of the semester, and the final crop report was due during week 10.

The crop report accounted for 100 of the total points for the course. The quizzes and ASAs were worth 80 points; ten points for each of the four IL quizzes and ten points for each of the four ASAs. The other points for the course included weekly quizzes on each of the crops covered in the course, a written paper on a student's interview with a grower, and class participation. In 2007, there were 650 total points and in 2008 there were 570 total points for the class. The ILE quizzes were graded electronically and the grades automatically posted in a password-protected section for instructors. Individual students received their results electronically immediately after completing each quiz. Instructors' comments on the ASAs and scores could be returned electronically to the students. Timely feedback from the instructors was especially critical for the ASAs since each was designed to help navigate students through to the next stage of their crop report. In 2007, after the four standards were completed, students submitted a hard copy of their crop report to the instructors. The 2008 class gave their presentations during the last two weeks of the semester. Pearson Correlation Coefficients among scores were determined with SAS (SAS, 1999).

Evaluating effectiveness of the IL learning environment. At the end of the semester, students completed a self-report survey regarding their perceptions of the effectiveness of the online learning environment. The first question asked how helpful the environment was in completing the crop report using a 4-point scale, ranging from 1 (“not helpful”) to 4 (“very helpful”). Four other questions asked the students to rate how various issues affected their ability to use the IL standards effectively. The questions used a 4-point scale, ranging from 1 (“strongly disagree”) to 4 (“strongly agree”).

Based on the comments from students in Crops/Hort 102 during fall 2007, ILE was improved for use in the same course in 2008. To further document improved student learning in IL in the course, quiz questions were reworded to focus on concepts and applied scenarios, and a new pretest was designed that more effectively coordinated with the information in the tutorials and crop report.

science course, along with six other courses, was chosen to use in the pilot study.

The course instructors worked with the librarians to develop an assignment that would be appropriate for the ILE learning environment. The crop report assignment was selected due to the project's potential focus on IL and, being a phased assignment, provided multiple opportunities for students to receive feedback throughout the semester.

One of the librarians, (Borrelli) guest lectured during two class sessions to introduce the ILE learning environment project to the class, administer the pretest, and discuss IL related topics. The librarians developed, or selected from the open web the most appropriate tutorials to use for the class assignment, wrote the quizzes, and created the password protected grading section for the instructors. Students reported any technical problems to the librarians.

The course instructors were responsible for

introducing the plant science related aspects of the project, for grading and providing feedback on the students' ASAs, and for managing student grades. In 2008, the librarians also helped provide feedback on search strategies and potential information sources to explore for the ASA on accessing information.

Approval was obtained from the WSU Institutional Review Board to report and assess the students' scores and survey responses.

Information literacy pretest. The class average on the pretest, taken by the students before IL instruction, was 59% and 51% in 2007 and 2008, respectively. There were no significant correlations between scores on the pretest and average scores on the quizzes, ASAs, or the crop report for either

2007 or 2008 (data not shown). The low pretest scores may be attributed to the diversity of interdisciplinary concepts presented in the questions. Although the pretest was not a good predictor of future student performance, the low scores on the pretest demonstrated to the students how much they did not know about IL. Several authors have pointed to the dangers of assuming IL competency in students (Rowlands and Nicholas, 2008; Foster, 2006; Gross and Latham, 2007; Williams et al., 2006). Competency theory, as described by Kruger and Dunning (1999), suggests

Table 3. Examples of the four Assignment Specific Assessments (ASAs) Found at the End of the Online Learning Tutorials

ASA 1: Needed information

Identifying your information needs is an excellent place to begin approaching any assignment. By identifying the information needed one can begin to address each component individually and progress through the assignment efficiently.

1. Select an important Washington crop.
2. Provide an outline of the information you will need to complete your crop report.

ASA 2: Accessing information

For your crop report it is necessary to use library resources to gain access to information not freely available on the web using library databases.

1. Indicate which database(s) and catalogs you intend to use in your information research process.
2. Develop a search statement using the techniques described in the tutorials (Boolean operators, phrase searching, clustering, and truncation) to find a current research project (preferably one from Washington State University) involving your crop.

ASA 3: Evaluating information

Your crop report necessitates your ability to distinguish between types of periodicals and the information contained within each variety.

1. Find four information sources comprised of no more than one of each of the following: scholarly journals, newspapers, books, personal communication, trade journals, and websites.
2. For each of your four sources, identify two characteristics that indicate that the source you have selected is scholarly or popular.

ASA 4: Using/Understanding information

Your crop report will require incorporating outside sources to convey authority of the information included.

1. Provide an example of how you will cite a resource in the appropriate format:
 - In text example
 - In the bibliography (create a bibliographic citation for one source)
 Including a quotation in a paper necessitates the introduction of the quote as well as original scholarship (your thought /s) to be included.
2. Provide an example of how you may introduce a quotation in your paper including author's name and work.
3. Provide an example of how you will support the quote in your paper by providing an additional sentence or two of original scholarship.

Results and Discussion

Initiation of the collaboration and roles of collaborators. When IL was determined to be a weakness during our program level assessment of learning outcomes (Cerny-Koenig et al., 2007), instructors in the Crops/Hort 102 course contacted the design librarians in the WSU Libraries Instruction Department to help address the issue. The librarians were in the process of piloting a web-based IL learning environment in introductory science courses at WSU. The introductory plant

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that one's own incompetence in an area may prevent a person from realizing that they are in fact incompetent and may cause them to overestimate their ability. Scott and Simmons (2006) suggest that assessing student abilities before an intervention will assist in demonstrating a need for, and in adapting, instruction.

Assignment assessment: Quizzes. Individual student scores on the quizzes ranged from a low of 40% for evaluating information to 100% earned by some students on all standards. Students earned the lowest quiz scores on the accessing information standard both years (Table 4). This suggests that our students are not comfortable using the library website to successfully search for and find information. This is consistent with research showing that 89% of college students use search engines to begin an information search while only 2% start from a library website (Rowlands and Nicholas, 2008). Students appear to be more familiar with these simple interfaces than complex interfaces in library databases. The average quiz score on the evaluating information standard was the second lowest of the four quiz scores; 89% in 2007 and 81% in 2008. The speed of students' web searching indicates little time is spent in evaluating information for relevance, accuracy, or authority (Rowlands and Nicholas, 2008). There is also a lack of understanding of different resource types (Leckie and Fullerton, 1999) and a tendency for students to use open web searches and secondary sources instead of primary sources (Scott and Simmons, 2006).

We suspect that the quiz questions used in 2007 reinforced the concepts of the tutorials more than they assessed learning, so questions were rewritten for the fall 2008 course. The revised quiz questions focused on the students' understanding of information sources and on more applied concepts than those in 2007 (Table 5). Therefore, lower quiz scores in

2008 may be attributed to the revised focus of the questions.

Assignment specific assessments: ASAs. In 2007, students scored the lowest on the using information standard (Table 4). Although students appear to have understood the tutorials on using information (average quiz score of 96%), based on their ASA average score of 77%, they had difficulty in properly applying that knowledge. This result is consistent with previous program assessment findings that the least improvement between the sophomore and senior levels in relation to IL skills was in the documentation of sources (Cerny-Koenig et al., 2007). It again has been our experience that properly citing references in the text and in the bibliography is challenging for students. Higher quiz scores in the using information area may be attributed to the students' understanding of such IL concepts as copyright and fair use which were included in the quizzes, but did not necessarily transfer to the crop report assignment. Assessment of the crop report in relation to using information was focused more on appropriate integration and citation of sources. However, in 2008, student scores on the using information ASA were higher (82%) than in 2007 (77%) suggesting the instructors may have done a more effective job of explaining this aspect and its application to the project.

Students performed best on the needed information ASA both years (Table 4). They seemed to be comfortable with outlining and determining the type of information they needed to complete their assignment.

Correlation of student performance among assignments. Student performance on the quizzes was correlated with subsequent performance on the crop report both years (in 2007, $r = 0.60$; $p \leq 0.001$ and in 2008 $r = 0.34$; $p \leq 0.05$). Students who performed better on the quizzes tended to score higher on the

crop report, suggesting that the learning environment was effective in helping students learn, build upon, retain, and apply information literacy concepts. Similar correlations were observed between performance on the ASAs and the crop report in 2007 ($r = 0.37$; $p \leq 0.05$). However, these results must be interpreted with caution, since this study did not utilize a control group. All students completed the IL tutorials; we cannot compare their performance with that of students who did not complete the tutorials. Furthermore, it is possible

Table 4. Description of the four Information Literacy (IL) Standards, Average Quiz Score, and Average Assignment Specific Assessments (ASAs) Score for each of the Standards

IL standard description	Average score			
	Quiz		ASA	
	Year			
	2007	2008	2007	2008
1. <i>Needed information</i> - determine the extent and type of information needed for the assignment	91%	89%	90%	89%
2. <i>Accessing information</i> - access scholarly information in a variety of formats effectively and efficiently	79%	74%	85%	84%
3. <i>Evaluating information</i> - critically evaluate information quality ethically and legally	89%	81%	89%	80%
4. <i>Using information</i> - use the information to accomplish a specific task and produce better final products	96%	81%	77%	82%

that better students will tend to score higher on quizzes, ASAs, and the crop report than poorer students, regardless of the instruction. The results have not been analyzed by student ability.

The final crop reports from students in the fall 2007 and 2008 classes appear to contrast noticeably with the crop reports from students in previous years when ILE was not used (data not shown). In previous reports, students tended to include only the first five information sources found in a search, regardless of quality. Students in the fall 2007 and 2008 provided sources that were more current, relevant, and of a higher quality than those used in previous crop reports.

Student responses. Survey responses suggested that the IL tutorials and ASAs were 'somewhat helpful' to the students in completing their crop reports (Table 6). Students also 'somewhat agree' that they had adequate time to complete the tutorials, that the tutorials were easy to understand, and that there was a strong connection between the tutorials and the assignments. However, they 'somewhat disagree' that there were no technical issues with the learning environment in 2007. Technical issues with logging into the system and submitting the ASAs were encountered by some of the students the first year. However, since the collaborating librarians had designed the system, it was easy for both students and instructors to work with the design librarians directly

to determine the cause of the problems. Students' responses improved for this issue on the 2008 survey.

Written comments from the students indicated they felt IL should be taught in an English course and they did not see the relevancy of learning about it in a plant science course. Williams et al. (2006) documented similar attitudes in academia, noting a scarcity of IL integration in disciplines other than library science and education. Therefore students' views are a reflection of the culture of the institution they are a product of and instruction in information research is currently being provided primarily in composition courses. However, the idea of using an IL component as part of an existing course assignment has been found to be more popular than teaching an entire course on IL (Leckie and Fullerton, 1999). In 2008, 34 evaluations were submitted, of those, 26 (76%) 'somewhat agreed' or 'strongly agreed' that there was a strong connection between the tutorials and the assignments. As IL becomes a focus in courses throughout the university, hopefully, students will find the relevance of IL due to its interdisciplinary nature.

Table 5. Examples of Quiz/Pretest Questions Used in 2007 and Improved for 2008

Quiz question used in 2007

Which of the following is not an example of a primary source in the sciences?

- A. Published results of a research trial
- B. Review of the results of several experiments or trials
- C. Published results of a research study
- D. Proceedings of conferences or meetings

Quiz question improved for 2008

While researching a paper you're writing for your plant science class, you come across an article comprised of a discussion of several research projects on the same topic. Is this paper a primary or secondary source?

- A. Primary
- B. Secondary

Quiz question used in 2007

All of the following are examples of plagiarism except:

- A. Asserting ideas of others without acknowledging their sources
- B. Reordering words or clauses from someone else's work without attribution
- C. Copying an entire document and presenting it as your own
- D. Paraphrasing another's writings including a parenthetical reference

Quiz question improved for 2008

Analyze the statement below and compare it to the original source to determine if it has been plagiarized.

Statement to Analyze:

Because email communication does not involve direct human contact, survey respondents may have only classified in-person communication as human help (Johnson, 2003).

The Original Source:

"Survey respondents may have only viewed face-to-face communication as human help, while not considering email as human help because of its technological mask" (Corey Johnson, published 2003, page 58).

- A. Plagiarized
- B. Not plagiarized

Table 6. Questions and Responses from Student Survey after Completing the Online Learning Tutorials, Assignments, and Crop Report (using four-point scale from 1 = disagree/ not helpful to 4 = strongly agree / very helpful)

Question	Mean response (standard dev.)	
	2007	2008
1. How helpful do you feel the information literacy tutorials and assignment specific assessments were in completing your crop report?	2.6 (0.87) ^z	2.7 (0.73) ^z
2. Rate the following issues on how much each affected your ability to use the online learning tool:		
a. The length of time required to complete the tutorials was adequate.	3.3 (0.71) ^y	3.4 (0.65) ^y
b. There were no technical issues with the computer.	2.4 (0.95) ^y	3.1 (1.03) ^y
c. The tutorials were easy to understand.	3.0 (0.81) ^y	2.9 (0.74) ^y
d. There was a strong connection between the tutorials and the assignment.	3.0 (0.76) ^y	2.9 (0.77) ^y

^z Response values range from 1 to 4, where 1 = "not helpful" and 4 = "very helpful."

^y Response values range from 1 to 4, where 1 = "strongly disagree" and 4 = "strongly agree."

Summary

The incorporation of the ILE environment into the plant science course contextualized instruction by helping students learn, build upon, and retain IL concepts in a practical crop assignment. Sources incorporated in students' work were more current, relevant, and of a higher quality than those used in previous semesters. The asynchronous nature of online learning afforded the students the opportunity to work through the tutorials at their own pace and on their own time. The environment also provided opportunities for instructors to give feedback to the students as they progressed through each of the four standards. The ILE learning environment has been substantially revised and is scheduled to be released as an open source product in early 2010.

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