

Teaching with



for Prep for General Chemistry

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ALEKS Corporation

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1 The ALEKS Educational Paradigm

ALEKS is based on the realization that students learn science in different ways, at differing speeds. Starting from an accurate assessment of their current knowledge, students in ALEKS are only offered what they have shown themselves ready to learn. They therefore experience less frustration (from material that is too hard for them) and boredom (from material that is too easy for them). Learning is more efficient and more rapid. Students have “ownership” of their learning process, and grow in confidence and independence. If a student forgets what was once learned, ALEKS smoothly and efficiently guides the student through all necessary review and reinforcement. The student will not be “lost.” With time and persistence, every ALEKS student will progress toward mastery; this progress will be clearly visible to both student and instructor.

It is normal for students to be in disparate knowledge states; this would be the case in any event, but ALEKS puts this information clearly at the instructor’s disposal. The relative mastery attained by students appears clearly from the “Learning Progress Since Latest Assessment” Report in the Instructor Module. ALEKS does not require the students to progress as a unified group. ALEKS will permit a student to work on any topic in the category “ready to learn,” a well-chosen list of topics which the student has not yet learned, but has demonstrated (within ALEKS) the readiness to begin learning.

Students using ALEKS will experience new independence in learning, to which some may be unaccustomed. Many will find this difference exhilarating. Instructors also may find different opportunities for optimizing their role in the learning process, with a greatly expanded ability to accurately monitor and effectively promote their students’ learning. The role of the instructor is critical in providing structure, support, and reward for the students’ effective use of ALEKS. If ALEKS is used properly, the instructor’s scope for individual coaching and small-group instruction will be greatly expanded, as will the freedom to teach a broader and richer science culture (to some or all students, time permitting).

In other words, ALEKS turns the instructor from a footsoldier in the trenches into a field commander, possessed of powerful resources, surveying a broad landscape of information, able to make effective strategic decisions. The point is that ALEKS puts the instructor in command; among other things, the instructor can take more or less of

ALEKS, give it a greater or lesser position among other course requirements and activities. Various styles of use are possible. The following should be understood as mere suggestions, designed to give instructors a sense of the possibilities offered by ALEKS's substantial library of tools.

2 The Instructor and ALEKS

Not every way of using ALEKS involves supervised classroom sessions. When this is sensible, however, it provides a new dimension to the students' learning.

The instructor in an ALEKS course need not be collecting, correcting, or distributing papers, struggling with discipline issues, organizing groups, managing materials, giving instructions, or supervising activities. The instructor in an ALEKS course may be just as busy teaching chemistry to individual learners: getting one student started on a new topic, checking another student's work, responding to questions, suggesting alternate methods and explanations, making or reinforcing connections among concepts, congratulating those who "add an item to their pie." ALEKS provides comprehensive support to the student in every phase of its use; yet the instructor will find that the additional direct support given this way is unexpectedly welcome and productive. Suddenly the relation of teacher and student is based on knowledge and discovery, not management and sanction. No one is "behind" in ALEKS; setbacks are readily addressed and overcome; every student can expect to make progress and be recognized.

It is important, especially in the early stages of an ALEKS course, that the instructor be generous in recognizing student progress. Students need to understand that when they add an item to their pie, or show progress in a new assessment, it is an achievement, and the proper use of ALEKS. Soon this will become second nature and learning will be its own motivation. At the same time, formal rewards for the effective use of ALEKS need to be built into the course structure and made clear from the outset (See Sec. 3.).

Students will be assessed at the beginning of their use of ALEKS (following Registration and the Tutorial), and at regular intervals thereafter. The instructor does not need to supervise all ALEKS assessments; normally, students will be using ALEKS outside as well as in

the lab or classroom, and taking assessments at various times and locations. Once the students realize that the purpose of the ALEKS assessment is to provide appropriate material in the Learning Mode, there will be little reason to get help, use the textbook or calculator inappropriately, or in any other way achieve incorrect assessment results.

We recommend that the initial assessment be supervised. The students may need assistance in their first use of the system, they will need to be reassured that the assessment is not for a grade, and it is important that the results of this initial assessment be valid, so that that the students' work in the Learning Mode be productive from the start. For the instructor's own information, other supervised assessments may also be held at regular intervals to provide accurate "snapshots" of overall progress by the course (See Sec. 10). We suggest that such supervised assessments be scheduled at the midpoint and end of the course. Also, any assessment results which may be used as a component in the students' grades should, of course, be obtained from assessments performed with the level of supervision required by the educational institution for final exams (See Sec. 14).

NOTE. In cases where students do not seem to be making adequate progress in ALEKS, the cause may be found in help that the student received on an unsupervised assessment from a person or inappropriately used calculator, skewing the assessment results and leading to inappropriate material in the Learning Mode.

3 Planning the ALEKS Course

In some ways, planning a course in which ALEKS is to be used is simpler than planning other kinds of courses. The instructor may assume complete freedom in planning lectures, lessons, and assignments, while ALEKS ensures that students can progress toward mastery regardless of their level of preparation. It is neither necessary nor helpful for the instructor to attempt to constrain the interactions of the ALEKS system with individual students. To the extent that students will be working independently in ALEKS, the content of lab classes is provided by their work in ALEKS, and need not be planned separately. Instructors wishing to give their students the greatest possible benefit from using ALEKS, however, can use its features to plan focused small-group instruction from week to week (See Sec. 5).

At the same time, it is extremely important to make ALEKS an integral part of the course requirements and grading scheme. There is no other single factor which influences the success of students using ALEKS so much as the time that they spend on the system, along with the regularity of their use. This means that the students must be required to spend a suitable amount of time in ALEKS on a weekly basis, say 2-4 hours, that they must be informed of this at the very beginning of the course, and that the instructor must monitor their fulfillment of this obligation. Moreover, the amount of time required must be carefully determined to be reasonable, and in balance with other requirements for the course. The instructor should not simply include an ALEKS requirement without reducing in corresponding measure the other requirements that the students would have had to fulfill without ALEKS. For example, the quantity of homework problems may be reduced, as the students will be solving problems in their ALEKS sessions. In a sense, the ALEKS requirement is stricter than others, since the instructor knows exactly what time the students have spent, and the students will naturally be sensitive to this. With time, students will realize the benefit that they receive from ALEKS, and its effect on their overall grades. At first, however, it will be simply another requirement, one whose communication requires particular thoughtfulness on the instructor's part.

Obviously these are only suggestions, and experienced instructors may well choose approaches that will be more effective with their own students. The underlying idea is that there must be clear, formal support for the use of ALEKS, however that support is best implemented in a particular setting.

Many instructors have found that in order for the ALEKS requirement to be meaningful, it may beneficially be made part of the grading system or system of rewards for the course. The simplest approach is to provide a certain number of points toward the final grade for each week that the student fulfills their required hours. It is advisable to reward each week, so that the student does not fall into the expectation that all of the required hours can be done at the end; consistency should be rewarded, along with total hours. If a student falls short of the specified hours during a particular week, that week is not rewarded, but neither is the "deficit" carried forward; the next week begins with a clean slate (the primary concern is regular use of the system; for this reason a surplus is also not carried forward). Proportional rewards are also possible; each hour spent has a point value, up to the required minimum.

In order to effectively monitor the students' use, the instructor should check the hours on the "Learning progress since latest assessment" page (under "Reporting"). This page can be printed out every week for record-keeping. In very rare cases, students will try to fool ALEKS by logging on to their accounts and doing something else; this can be detected by noticing that the number of items gained per hour is far too low (or null). ALEKS will log the student off if there is no activity after a certain amount of time. Instructors can obtain a precise record of a student's actual work in ALEKS by viewing the student's Report ("Reporting"/"Report for a single student in this course (pie chart)"), under "Learning Log."

The students' achievement in ALEKS (as opposed to their use of the system) may also be used as a component in their final grade. For information on how to do this please see Sec. 14.

4 Preparing Your Students

The following considerations may be useful in preparing your students to begin to use ALEKS.

Computer Skills

Some students who have had little experience with computers may need assistance with the use of the mouse and, in particular, with "scrolling" the window of a web browser. We recommend that you demonstrate these skills to the students before beginning their use of ALEKS. If possible, additional staff should be on hand for the first session to assist the students as necessary.

Difficulty of Assessment Questions

The ALEKS assessment is always comprehensive in order to achieve the highest degree of accuracy and reliability. In the course of the assessment, some questions may be too easy or too difficult for some students. The students should be told to click the "I don't know" button if a question is completely unfamiliar to them, but otherwise that they should do their best to answer. As the assessment proceeds, the questions will focus more and more closely on the outer limits of the student's actual knowledge. In Learning Mode (following the assessment), students will be provided only material that they are ideally prepared to learn.

Length of Assessments

The number of questions asked in an ALEKS assessment varies. Normally an assessment in Prep for General Chemistry requires between 20 and 30 questions. Occasionally, the number of questions asked may be greater than this.

No Help in Assessments

Explain to the students that they will need to use paper and pencil for answering assessment questions, but that no help or collaboration whatsoever is permitted during assessment. If the teacher or anyone else helps the student during assessment, even to the extent of explaining or rephrasing a question, assessment results may be inaccurate and the student's learning in ALEKS may initially be hindered. Be sure they understand that the purpose of the initial assessment is to give ALEKS a precise, detailed understanding of what a student knows, so as to render learning very efficient by focusing on what the student is ready to learn. It is not a "test" that one can pass or fail. They will not receive a grade on an ALEKS assessment unless the instructor deliberately chooses to use grades.

5 Focused Instruction with ALEKS

The features of the Instructor Module make it possible to prepare students for specific topics that they are going to work on, and to reinforce and expand on knowledge that students have recently acquired. This involves either guiding lectures or focused instruction to small groups of students based on data obtained from ALEKS. From the instructor's viewpoint, these are powerful features of ALEKS, and their use constitutes a proactive integration of ALEKS with the course structure.

The two kinds of "teaching opportunities" cued by ALEKS come from two types of information maintained by the system for students over the entire time that they use it: the set of items a student is "ready to learn" (or "outer fringe" of the student's knowledge state), and the set of items most recently learned ("what students can do," the "highest" topics in the student's knowledge state, called the "inner fringe") (See Sec. ??). The items "ready to learn" are the topics a student may normally choose to work on in ALEKS; the items recently learned ("what a student can do") are considered the least secure and most likely to need review or reinforcement. (These items may be made available for review by clicking "Review.") When the students are logged on to

ALEKS these two kinds of information are used automatically to guide and manage their learning. The instructor, however, can also view the inner and outer fringes in a convenient format to plan focused instruction that will parallel, supplement, and enhance the individual work that their students are doing in ALEKS.

To find this information for a course, the instructor should enter the Instructor Module and click “Reporting,” the name of the course, then “Average report (pie chart).” The piechart in Average report represents the average student in the given course, and displays the weaknesses and strengths of the course as a whole. To see the outer and inner fringes of the group we need to use options from the “Display mode” menu: “Ready to learn,” and “What students can do.”

Suppose we choose the option “Ready to learn (learning)” from the menu “Display Mode.” This will summarize the topics that all of the students in the course are currently ready to learn; the parenthesis “(learning)” indicates that the information is based on their most recent work in the Learning Mode, and so completely current. For each topic the number of students ready to learn that topic appears to the right (e.g., “12 students”); clicking on that phrase displays the students’ names, whereas clicking on “Open All” displays all the students’ names for all of the topics. For each topic-list, there is a link to send a message to precisely those students. The purpose of this analysis is that the instructor may pick one or more topics from the list and schedule small-group sessions preparing the named students to learn them more effectively.

Now suppose we choose “What students can do (learning)” from the menu “Display Mode.” Another list of topics will be produced; the students listed for these topics, however, are those who have recently worked on and, at least tentatively, learned the topics. Thus, the instructor can schedule focused sessions with these groups of students to reinforce or expand on material that is fresh in the students’ minds, on which they are likely to have the most questions and ideas.

This gives the instructor the possibility of always teaching to students who are ideally prepared. It suggests a mode of teaching to the moment of opportunity, and generalizes individual learning to small groups of learners at specific times; obviously, the data obtained for this purpose from ALEKS on one day will be of considerably less value if used a week later.

It may be useful to look at some examples illustrating how these features may be used. If you have not used the ALEKS Instructor Module

extensively, it will make more sense as you have more experience using ALEKS as a teaching tool.

Example 1: Basic

On a Friday evening, the instructor sits down to plan lessons for the following week. He or she logs onto ALEKS, selects the reporting feature and the name of a course in Prep for General Chemistry, and clicks “Average Report.” A pie chart appears showing the average profile of mastery in the course.

The “slice” of the pie chart for Random Variables is full to about 90 percent; the slices for Inferential Statistics, Distributions, and Descriptive Statistics are filled much less, ranging between 20 and 40 percent. This indicates that lessons for the week may focus profitably on Inferential Statistics, Distributions, and Descriptive Statistics.

Example 2: Intermediate

On a weekend afternoon, the instructor logs on to ALEKS, clicks “Reporting,” then the name of a course in Prep for General Chemistry, and then “Average report (pie chart).” After a look at the pie chart, the instructor selects “Ready to learn (learning)” from the “Display Mode” menu, and clicks “OK.” When the list of topics appears, the instructor scans this list for items of particular difficulty. There it is! “Calculating molarity using solute moles” has 16 students currently able to choose this topic from their pie charts. The instructor notes this topic down for class discussion early in the week. With the benefit of some timely preparation, the students can be expected to master this troublesome topic with little or no difficulty.

Example 3: Advanced

On a Monday morning, the instructor logs on to his or her ALEKS account, clicks “Reporting,” then the name of a course in Prep for General Chemistry, and then “Average report (pie chart).” Following this the instructor switches, first, to the option for “Ready to learn (learning)” and clicks the ALEKS Print button. Even if “Open All” was not clicked the page will be displayed with all lists of students’ names displayed. Then, the instructor switches to the option for “What students can do (learning),” and, again, clicks the Print button. With these two printouts in hand, the experience and expertise of the instructor are used to used to plan with this information. Suppose that there is only time in the week’s schedule for two small-group sessions. (The ALEKS

class has only one hour in the lab, and ten minutes are set aside to speak with each small group; the remaining 40 minutes are for helping students in the lab.) The instructor will look over the topics with two questions in mind: which topics have the greatest numbers of students, and which are pedagogically most worth discussing.

For example, looking at the list of topics “Ready to learn,” the instructor sees “Elemental analysis.” The instructor knows from experience that students have difficulty with the concept, and that they are more successful with it if they have had a chance to review. This topic has 12 students out of 30 in the class. The instructor uses the message feature to send a note to these students, asking them to meet in the front of the room at the beginning of the lab; the students will receive this note the next time they log on to ALEKS, no later than the beginning of that lab.

6 Models of Classroom Integration

There are numerous ways in which ALEKS can be and is used in concrete educational situations.

1. **Supervised Science Lab.** Expert supervision can be provided for the students’ use of ALEKS in regularly scheduled science lab periods, whether or not these are part of a conventional class structure. Students benefit from the direct coaching and assistance of qualified instructors in the course of their work with ALEKS.
2. **Science Lab in Structured Course.** The supervised science lab may be part of a structure of class meetings, combined with conventional and lecture-style classes. The instructor in such a setting need not gear the sequence of topics covered in classes in any way with what the students are doing in ALEKS; the students’ independent work in ALEKS will increasingly benefit their performance on quizzes and tests, as well as their understanding of lectures, as the course progresses. ALEKS is not designed to “teach to the test,” although experience has shown that students’ performance on comprehensive tests improves dramatically when they have worked with ALEKS over time.

3. **Small-Group Instruction.** The recommended use of ALEKS in a classroom setting makes use of the detailed analysis of individual student knowledge provided through the Course Report page to tailor the lectures to the skills of students.
4. **Self-Paced Learning.** In this scenario students may use the college computer lab on their own, with only informal supervision. ALEKS is used in this case much as it is for distance learning, except that students have the opportunity for closer consultation with the instructor.
5. **Distance Learning.** ALEKS is used with great independence by students who may never enter the physical classroom, or may enter only on a few occasions for orientation and supervised assessments. ALEKS provides a range of features for communication between instructor and student, as well as powerful facilities for the monitoring and evaluation of student work.

Regardless of which approach is used, you can derive more benefit from ALEKS through monitoring the students' use of ALEKS and communicating with them, whether in direct contact, by email, or by messages through the ALEKS system. As discussed above, we recommend that a certain number of hours in ALEKS each week be required (See Sec. 2); this should be made clear from the start as part of the published course syllabus and rewarded appropriately through the grading scheme. Students' progress in ALEKS should be recognized and reinforced early on by informal, personal praise; conversely, students who do not seem to make adequate progress should be contacted promptly, the cause of their difficulty determined and remedied.

The following sections of this chapter provide more information on these issues affecting the classroom use and integration of ALEKS.

7 Monitoring Student Use

In the day-to-day use of ALEKS by a class, a principal concern of the instructor is to monitor that students are using the system with the required regularity and for at least the minimum required amount of time. The most convenient place to find this information is the "Learning progress since latest assessment page" (under "Reporting"). Each student's name is displayed on this page with the total number of hours that student has spent logged on to the system. Students can see this same total in their own accounts by using the button "Report."

It is also important that critical assessments throughout the course be supervised by the instructor, to ensure that valid results are received (See Sec. 2).

8 Monitoring the Progress of a Course

The instructor can also use the bar graphs to see how close each student is to mastery of the subject matter on the Learning Progress Since Latest Assessment page. It should be kept in mind that the bar graphs displayed on this page show only the students' achievement as of their last assessment (in blue) and any progress made in the Learning Mode since that assessment (in green). For a more panoramic view of the progress made by a group, select the "Overall progress in assessment" report. This displays the difference between the students' knowledge as of their first assessment and that demonstrated on their most recent assessment.

To see each of the assessments for a given student, with that student's progress subsequent to each assessment in the Learning Mode, the instructor should view the page "Progress report for a single student in this course" for the student.

9 Monitoring Individual Progress

On the page "Progress report for a single student in this course" there is a line for each assessment taken by a particular student, with bar graphs showing mastery as of that assessment and subsequent progress made in the Learning Mode. The initial assessment is shown in the bottom line, with later assessments "stacked" upward. By following progression from earlier to later assessments, the instructor can see very clearly how a student is progressing toward mastery of the subject matter.

Caution should be exercised in interpreting this information. Students vary widely both in the smoothness and in the speed with which they master material. Progress made in the Learning Mode (green bar) is not always immediately reflected in the student's level of mastery on a subsequent assessment. Some students progress more quickly in assessment than in the Learning Mode. In such cases the "new" blue line is further ahead than the green line just below it. On the other

hand, many students make faster progress in the Learning Mode than in assessment. In such cases the “new” blue line lags behind the green line below it. It is very common for a student to master the entire subject matter two or more times in the Learning Mode before that mastery is finally confirmed in an assessment. None of these situations is unusual. Part of the power of the ALEKS system is that it does not expect students to behave like machines, but makes allowance for a robust and unpredictable “human factor.”

NOTE. In cases where a student moves backward in his or her mastery, the instructor should make individual contact with the student. This student may be experiencing a personal problem, there may have been third-party help on an initial assessment, or there may be other external factors affecting the situation.

10 Ordering Assessments

Following the initial assessment (which should be taken under the instructor’s supervision), the ALEKS system will automatically schedule any other assessments needed for correctly informing and guiding a student’s progress. The instructor, however, can order an individual or group assessment at any time. It is a good practice for the instructor to schedule supervised assessments at regular intervals (midterm and end of the course), as “snapshots” of overall course achievement. Assessments may be ordered more frequently if the instructor feels that there has been third-party help on some automatic assessments, producing invalid results.

11 Independent Study and Distance Learning

The ALEKS system is well suited to use in an independent study or distance learning context. ALEKS is self-contained and adaptable to any syllabus or course materials. Students using ALEKS under these circumstances know exactly what the course goals are, where they stand in relation to those goals, and where to find the instructional and practice tools to achieve them.

For the instructor administering an independent study or distance learning program, ALEKS solves nearly every problem of management, oversight, evaluation, and communication. All of the informa-

tion needed to keep track of far-flung independent learners is at the instructor's fingertips, through the features of the Instructor Module. The internal message system of ALEKS puts the instructor in constant touch with students without dependence on telephone or email communication.

12 The ALEKS Knowledge Structure

Each ALEKS subject, such as Prep for General Chemistry, has a knowledge structure associated with it. The knowledge structure for Prep for General Chemistry, for example, is covered by about 170 ALEKS items (or problem types). A knowledge state is a subset of items which may correspond to the knowledge of an actual student (i.e., there may be a student who has mastered exactly those items, and no others). A knowledge structure is the family of all the knowledge states that we may encounter for a given subject.

An ALEKS structure affects virtually every aspect of ALEKS's functioning. In the ALEKS assessment mode it enables ALEKS to make inferences from student answers, keeping the ALEKS assessments brief, but uncannily accurate.

The structure is also crucial in the ALEKS Learning Mode. Using the structure of Prep for General Chemistry, for example, the system knows precisely which items are in the inner fringe and outer fringe of each of the knowledge states in ALEKS for Prep for General Chemistry. The items in the outer fringe of a student's knowledge state are those items that the student is the most ready to learn next. (From a technical standpoint an item is in the outer fringe of a state if adding that item to the state results in a feasible knowledge state.) These items are presented to the student in MyPie when the student moves the mouse pointer over the ALEKS pie chart. Similarly, an item in the inner fringe of a student's state is an item either recently learned or one whose mastery by the student might be shaky. (Technically, an item is in the inner fringe of a state if removing that item from the state results in another feasible knowledge state.) They are presented to the student when the student is having difficulty in the ALEKS Learning Mode and during ALEKS review.

An additional benefit of the proliferation of connections among items in ALEKS is its extreme flexibility from the students' viewpoint: for any particular topic, there is a vast number of possible approaches, or

learning paths, which may lead students to mastery of that topic. This flexibility does not imply, however, that *any* order is possible. Each learning path leading to a particular topic must contain, at a minimum, the items which are “below” such topic in the ALEKS structure. That is, we may say that the more “advanced,” or “highest,” topics in an ALEKS structure are those for which the ALEKS system will require the student to learn the largest number of other items before those items will be presented to the student.

13 Intermediate Objectives

ALEKS provides a facility for creating multiple sets of syllabi within a single course (See Sec. ??). The Intermediate Objectives feature makes it possible to prioritize particular sets of items for particular periods of time, by constraining the choices available to the students. When Intermediate Objectives have been set, students will be guided to these items by the shortest possible path.

14 Learning Rates in ALEKS

ALEKS allows instructors to flexibly evaluate and interpret student learning. There are four criteria, which can be used in any combination: percentage of course goals mastered, total hours spent in ALEKS, average items gained per hour of use, and average number of items gained per week of use. Each can be set to “Private,” so that only the instructor sees the evaluations, to “Public,” so that the instructor sees the evaluations for all students, and each student sees their own, or to “Disabled,” so that no one sees them.

For detailed instructions on the use of the learning rates feature, see Section ??.

Caution must be exercised in determining which, if any, of these criteria should be set to “Public,” so that they are seen by the students. For example, if the evaluation for percentage of course goals mastered is set to A for 90 percent, B for 80 percent, C for 70 percent, D for 60 percent, and Failure below that, the students will see these letters in their accounts as long as their percentage mastery is in the ranges given (i.e., D when it is between 60 and 69 percent). This will only make sense when the students are close to finishing the course, and

may cause confusion if the grades are made “Public” before then.

The same proviso applies to the other kinds of evaluations available through ALEKS. The value of using these evaluations in the “Public” mode may be greatly enhanced if the instructor decides to set a new scale every week, or at other appropriate intervals. This might mean, for example, that A is set to 20 percent for the first week, to 25 percent for the second week, and so forth, with the other evaluations set accordingly. Such a procedure requires more work by the instructor, but it certainly gives the students a more meaningful frame of reference for their progress.

Some of the kinds of evaluations in ALEKS may be more useful for the instructor alone than for the students. Such evaluations should be set to “Private.” The evaluation based on average items gained per week, for example, might be set to some minimum value like 3 (in a Chemistry class requiring 3 hours of work in ALEKS per week). Now, the instructor would not want to send the message to the students that 3 items gained per week is “Enough,” since many students in the course may be capable of much more. Conversely, a student whose progress falls below this rate might not be helped by the stern notation in their account that their progress is “Not enough”; the reasons for slow progress may be varied. At the same time, a student making slower progress than this should be brought to the instructor’s attention for intervention of some kind. If the evaluation is set to “Private,” the instructor will see the flag “Not enough” appearing next to the names of students whose progress is slower than this, on the Course Progress page, alerting them to the need for special attention.