LearningCloud:

A Database of Learning Objectives and Resources

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Abstract

LearningCloud is a continuously growing searchable database of learning objectives linked to learning resources for achieving them. It is currently used as a bridge between teachers' desire to individualize instruction, and the means to do so, even when the student population is diverse. It gives teachers fast, convenient access to learning objectives that fit any particular student's abilities, needs, and stage of progress, in both the academic and non-academic aspects of development.

As LearningCloud evolves, it will also become useful in non-classroom situations to independent learners of all ages. Technical articles, websites, Wikipedia entries, and books offer information/content, while LearningCloud will offer the means to learn it via an ever-expanding access facility to this information, using associated learning objectives and learning resources. This database, which currently contains close to 8,000 learning objectives, will continue to expand through contributions from educators and subject matter experts, with the quality of the contributions controlled by qualified curators. The long-term goal is for LearningCloud to provide learners everywhere, including those in college and beyond, with free, open-source learning access to the ever-growing stores of human knowledge, and with powerful tools for lifetime learning.

LearningCloud has been under development at Queens Paideia School for the past five years, with funding from the Mechner Foundation.

Key terms: individualization; personalization; educational technology; education and school reform; curriculum; learning objectives; learning resources.

Use for Individualizing Education in Schools

LearningCloud is a searchable relational database of learning objectives that specify learning outcomes to be achieved, along with links to possible learning resources for achieving those objectives. LearningCloud enables teachers to increase the individualization[1] of the education they provide. To individualize education, teachers need fast and convenient access to a large database of learning objectives in all content areas, from which they can select ones that fit each student's unique and ever-changing abilities and learning needs, and stage of progress. LearningCloud is such a database, with a theoretically unlimited number of learning objectives. Mechner, Fiallo, Fredrick, and Jenkins (2013) describe how LearningCloud is key to the practical implementation of individualized instruction via the Paideia Individualized Education technology.

Why is individualization of instruction important? There is now broad agreement that one-size-fits-all educational paradigms must be replaced by more personalized ones; and that the new learning paradigms must be designed to engage and motivate the student (e.g., Darling-Hammond, 1993; de la Fuente, 2013; Hathaway & Jaquith, 2014; Mehta, Schwartz & Hess, 2012; Ravitch, 2010; Sirotnik, 2005, p.666). The cost of failure to reach some students is paid by the entire education system in the form of discipline problems, remediation requirements, teacher morale problems, and dropouts, and in the long term, our entire society loses the potential fruits of the talents of those who could progress faster.

Individualization requires teachers "to adapt their instruction in the midst of instruction, in real time, to meet the specific needs of individual students...to be responsive to unanticipated issues that arise" (Parsons, Dodman, & Burrowbridge, 2013). The function of LearningCloud is to make this possible. It provides teachers with a practical tool for targeting every student's particular educational needs in real time, even when the student population is diverse. As more schools—public, charter, and private—seek to individualize the education they deliver, they may find LearningCloud to be a practical bridge from the *intent* to individualize to the means for doing so.

[1] The term "Individualization," as used here, includes the meanings of personalization and differentiation.

Ways LearningCloud Can Be Used

In-school scenarios

☐ A classroom teacher, observing that a student can't keep up (or could move ahead faster), searches LearningCloud for learning objectives and related resources to match his or her level of preparation and ability.

☐ A homeschooling parent (who is usually not a teacher) searches for learning objectives and applicable resources.

☐A college student writing a paper on Africa enters search terms for the history, populations, cultures, economies, and governments of various African countries.

☐ A high school math teacher's student is interested in number theory. The standard textbooks are too advanced for that student. In LearningCloud, she finds instructional resources that are right for that student's level.

☐ A college professor searches for learning objectives, learning units, and associated learning resources to provide remediation for a student whose writing skills are inadequate.

Non-School Scenarios

A user, having located desired information in, say, Wikipedia, scholarly articles, or other sources that are too technical, turns to LearningCloud and enters search terms related to the topic so as to find learning objectives and learning resources that will make the knowledge accessible. Here are some sample scenarios in which this can occur:

- A doctor, in considering the potential of a new drug, wants to acquire relevant background knowledge in chemistry or neurobiology.
- An insurance company executive, hoping to advance to a higher position, believes that more knowledge of actuarial mathematics will help him get there.
- A public official seeks to understand the scientific basis for a proposed piece of legislation on which he will be voting.
- A lawyer in a patent case needs an understanding of a particular concept on which the case rests.
- A scientist, wishing to understand a colleague's article, looks for learning objectives that may provide learning portals or ladders to complex concepts.

LearningCloud as a Management System

LearningCloud can also serve as a management system for schools. With access to current data on every student's performance in all of the subject areas—learning objectives already achieved and those being worked on—teachers and the school's managers can find out what a particular student recently learned and did. Thus, if a student has difficulty in an area, the teacher can determine if the problem is limited to one particular subject or occurs across the board, and whether the problem is with the quality of the learning resource, the student's ability, or the appropriateness of the student's learning plan. Similarly, parents, and even students (all with password-protected access to different types of information), can keep abreast of that student's progress.

Learning Objectives and Learning Outcomes

The basic unit of LearningCloud is the *learning objective*, which describes a learning outcome in a way that allows different parties, including the learner, to agree on whether it has been achieved. A *learning outcome* is the actual achievement of a learning objective, and may use any mix of text, graphics (images, diagrams, graphs), and ancillary materials.

Academic learning outcomes may take the form of demonstrating a skill, explaining a concept, answering a question, solving a problem, labeling a diagram, or creating some type of work product. Non-academic learning outcomes may consist of exercising a self-management skill or applying self-query heuristics that define certain thinking skills (e.g., "Have I seen a similar problem before?" "What might a solution look like?" "Should I use algebra or just logic?") One approach to the teaching of thinking skills is described in Mechner, Fredrick, & Jenkins, 2013.

LearningCloud's learning objectives consist of a descriptive statement and criteria that define achievement of the intended learning outcome, so that not only the teacher but also the student can recognize if and when it has been achieved. The ability level that any particular learning objective or learning resource requires reflects the achievement ability level of the student for whom it is deemed appropriate.

Here are some hypothetical examples of simple learning objectives:

- ***Math example***

Learning objective: Multiplies any pair of numbers from 0 to 12.

Achievement criteria: Answers correctly within 3 seconds.

Level: Grade 3 and up.

- ***Science example***

Learning objective: Given a 2-column, 6-row table of numbers, graphs the relationship between the two named variables.

Achievement criteria: Draws and labels the x and y axes; shows a linear number scale on each axis; plots the six coordinate pairs; connects them with straight lines; and writes a title above the graph, naming the two variables.

Level: Grade 5 and up.

- ***Social studies example***

Learning objective: Given a topic (e.g., an invention or discovery; a war; a culture; a work of art; an empire), performs the needed research and writes a 300-400 word essay about it.

Achievement criteria: States when and where it took place or existed, who was involved; primary and secondary sources of evidence that it happened; how it affected peoples' lives at that time and/or today.

Level: Grade 5 and up.

- ***English language arts example***

Learning objective: Summarizes an article of 500 to 2,000 words.

Achievement criteria: In 80-120 words, states the main points or arguments, with a reference to the author's objective or style.

Level: Early grades.

- ***Self-Management example***

Learning objective: When faced with an adversarial situation, invokes applicable verbal self-queries (e.g., what outcome do I want to achieve? What is the other party trying to achieve?).

Achievement criteria: Resolves the situation in a way that avoids conflict or aggression, and states an appropriate heuristic when prompted.

Level: Grade K and up.

Learning objectives are often organized into a *learning unit*, which can be a short (or long) instructional program, a set of exercises that teach a concept, or a large, encompassing learning objective like mastery of a particular skill or type of knowledge.

Every learning objective or unit in LearningCloud has attached tags that help teachers find the learning objective that will serve their immediate need:

- Search terms for finding the learning objective or unit.
- The general level (K-12 or beyond) for which it is appropriate.
- A linked list of applicable learning resources.
- Prerequisite skill or knowledge, when applicable.
- Links to other learning objectives or units that may be related.
- Information about its origin (authorship) and editorial history.
- Utilization feedback—reviews or data regarding usage of the learning objective.

Learning Resources

To achieve a learning objective, students use associated *learning resources*—a book, online program, video, or anything that helps them achieve the objective independently. LearningCloud users can view lists of possible learning resources for a particular learning objective by clicking on its *Applicable Learning Resources* link. Learning resources may be available at the school or online, or may need to be procured.

A listed learning resource may have been entered into the database by teachers or by its developer/publisher, always with approval from one of LearningCloud's curators. Marketers of learning resources will have an incentive to provide useful information as to how their product can help achieve a targeted learning objective or unit. For each resource shown, there may be teachers' comments, suggestions, and/or reviews regarding its quality and usefulness for a particular purpose. LearningCloud thus has the potential to turn into a giant clearinghouse for users and creators of learning resources.

Learners will differ in how accessible and achievable they find any particular learning objective. The contributor of the learning objective, anticipating this diversity, may try to widen the range of learners for whom the learning objective will be accessible by including little "learning ladders,"—instructional material that builds the required skills or knowledge that takes learners from where they are to where they need to be to achieve

the learning objective. The instructional material may consist of one or two explanatory sentences, a didactic paragraph, or a programmed instruction sequence consisting of a progression of steps that require active responding by the learner. The instructional material may take anywhere from minutes to hours to complete, and motivated learners will have the option of availing themselves of it or not. When contributors choose to provide such ladder material they are, in effect embedding learning resources within and part of their contributions, rather than merely referencing or suggesting outside learning resources, or leaving it for others to provide links to learning resources.

Contributors will obviously differ widely in their ability or disposition to create such ladders or access portals to the learning objectives they contribute. LearningCloud will include guides on how to do it—articles and instructional resources on how to create effective instructional material. Contributors who are educators or teachers may be more ab le and disposed to attach learning materials to their contributions than, say, authors of technical publications who may be content to use learning objectives as simple learning portals rather than complete learning resources.

Learning Outcomes versus Learning Activities

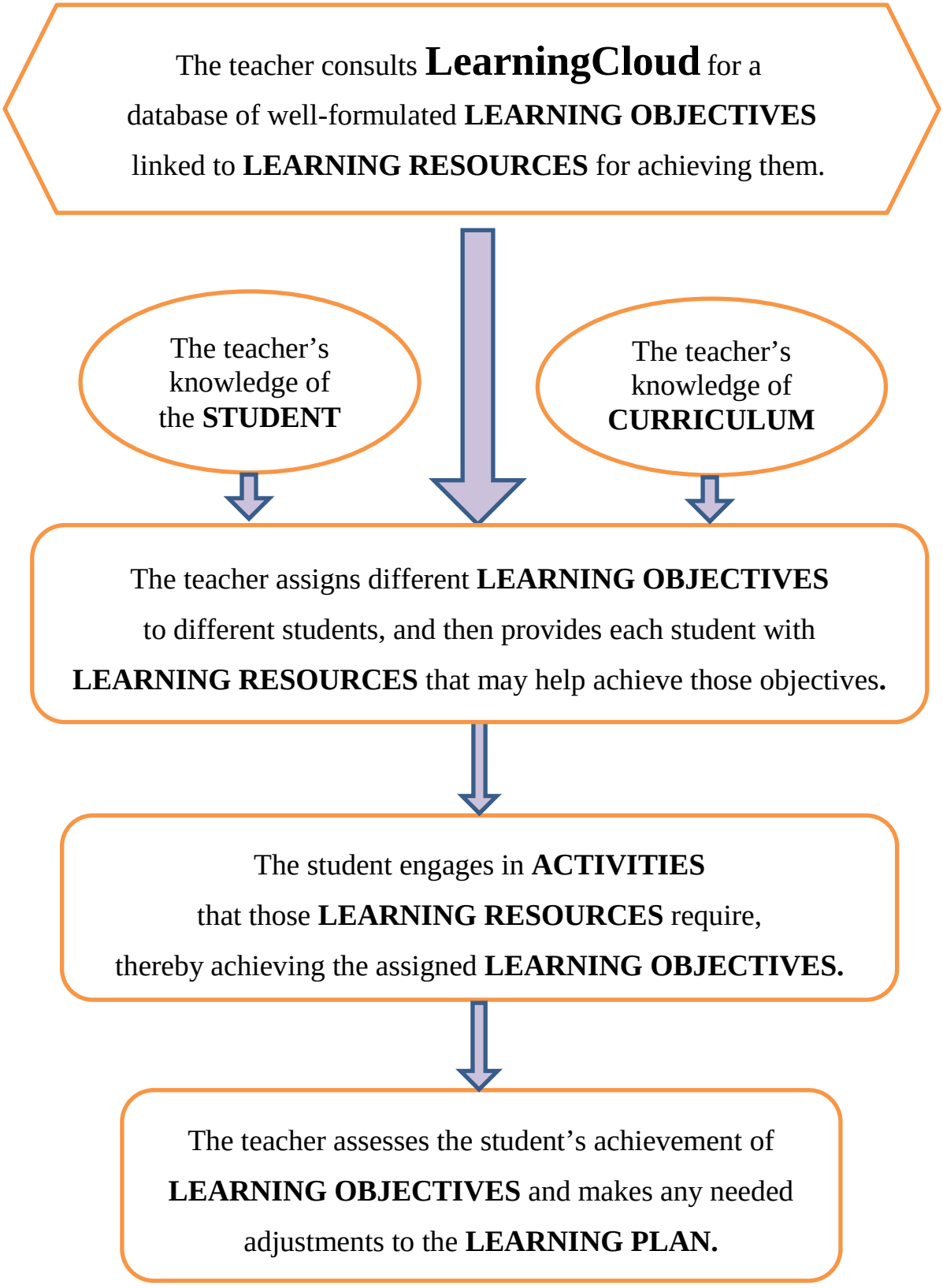
Most traditional learning paradigms involve students engaging in activities: using a workbook, listening to a lecture, taking notes, practicing a skill, studying a textbook, watching a video, going on a field trip, writing a report, or doing a project. The implicit assumption and hope is that such activities result in some learning, but even when they do, the learning outcomes may not be the intended ones. The activity is typically the means *and* the end, with insufficient focus on *what* is being learned.

LearningCloud provides teachers with learning objectives they can attach to their students' learning activities (e.g., Paris, Lipson, & Wixson, 1983). When they do this, they specify the desired learning outcomes, reflecting the broader principle that without clear objectives, the mere performance of an activity rarely achieves desired outcomes. Learning outcomes achieved define the education the student has received, whereas the activities that were performed do not.

Learning is relevant to a particular curriculum to the extent that it is focused on learning objectives. Such a focus also provides the teacher with vital feedback on what students are *actually learning* rather than just on what they are *doing*; and the motivational engagement of students increases when they have clear learning goals.

The relationships among learning objectives, learning resources, learning activities, and learning outcomes are shown in the following flowchart:

Flowchart of the Learning Paradigm Made Possible by LearningCloud



These are some common learning situations in which these relationships are evident:

- A laboratory can serve as a learning resource for learning activities, like experiments or demonstrations. For these activities, LearningCloud can suggest learning objectives that describe desired learning outcomes.
- Lectures or video presentations are learning resources. The associated learning activities of listening or note-taking can focus on learning objectives that may result in desired learning outcomes.
- Museums and zoos are learning resources, and visits to them are learning activities. LearningCloud can help focus the visits on specific learning objectives that specify desired learning outcomes.

History and Past Uses of LearningCloud

LearningCloud originated as one of the key tools of the Paideia Individualized Education (PIE) technology first implemented at the Armonk Paideia School in 1968 (Mechner, Fiallo, Fredrick, & Jenkins, 2013). It is the conceptual descendant of the STACKS system described in Mechner (1966) and implemented by the Brazilian government's "Institute of Technological Research" in 1974-76.

A rudimentary version of LearningCloud is currently used by teachers at Queens Paideia School to create and maintain customized learning plans for the students. Learning plans consist of learning objectives for the major academic content areas as well as for the arts, social skills, self-management skills, thinking skills, and learning skills. Teachers (called "learning managers") select each student's learning objectives and associated learning resources to fit his or her unique learning style, stage of progress, abilities, and interests. As a result, every student always works at the level that is appropriate for him or her, in every subject area, and at his or her own best pace. If a student has trouble with a learning objective, the learning manager identifies the missing skills or knowledge and provides the student with appropriate pre-requisite learning objectives. Failure is thereby ruled out. LearningCloud enables the learning managers to update students' learning plans and adjust them to a student's progress by adding and deleting learning objectives.

Although Queens Paideia School has a low student-teacher ratio, LearningCloud can also be used to achieve increased individualization in much larger classrooms. Teachers

usually know who is falling behind and who can move ahead faster, but lack the time and means to act on that knowledge. They need a practical way to find learning objectives and applicable learning resources that fit a particular student's requirements (Brighton, Hertberg, Callahan, Moon, Brimijoin, Conover, & Reynolds, 2003). LearningCloud fill this need by permitting teachers to select the desired learning objectives from a large, searchable database, in the core academic subjects as well as for social-emotional and self-management skills.

LARGER IMPLICATIONS OF LEARNINGCLOUD

Implications for School Reform

Most educators agree that school reform and renewal depends on the individualization of instruction, which in turn depends on a reconfiguration of schools, classrooms, and the roles of teachers (Mehta et al., 2012; Ravitch, 2010); that one-size-fits-all approaches must be replaced by customized learning plans; that modern technologies must be brought to bear; and that learning paradigms must be designed to engage and motivate the student (de la Fuente, 2013). By making such a school feasible, as demonstrated by Queens Paideia School and the PIE technology on which it is based (Mechner, Fiallo, Fredrick, & Jenkins, 2013), LearningCloud has the potential to contribute to school reform.

The Issue of Accountability

Holding students, teachers, or schools accountable for educational outcomes would define outcomes over which they have control. Standardized test scores, though conveniently quantitative and specifiable, are rarely traceable to specific agents or events that may have been responsible for them (Sirotnik, 2005, pp. 668, 670). But the parties responsible for the achievement of learning objectives and their outcomes are always clearly identified. Learning objectives, unlike periodic and broad-brush tests, are achieved multiple times per day, and performance results are always traceable to specific agents and events. Because the achievement of learning objectives defines what students have actually learned and thus the education they actually received, learning objectives offer a valid target for accountability.

When used in conjunction with the PIE technology (Mechner, Fiallo, Fredrick, & Jenkins,

2013), the learning objectives a student has achieved are nearly always identified. If a student has trouble with a learning objective, it's the wrong learning objective for that student in that subject at that time, and is replaced or supplemented. Because failure is thus ruled out, this learning paradigm makes accountability rewarding rather than threatening.

When every student is achieving the curriculum's learning objectives in the ordinary course of the education being provided, at the fastest pace feasible for that student, the urgency of standardized testing is diminished.

Another issue is that the set of learning outcomes that periodic, broad-brush tests can sample is necessarily small in relation to the learning outcomes that were to have been achieved. That is one of the main reasons why standardized test results are often invalid (e.g., Stake, 1991). In contrast, the record of outcomes generated by a student's achievement of learning objectives is a detailed, complete, continuous, and valid definition of what the student has actually learned, and thus of the education received.

For all of these reasons, achievement records based on learning objectives and outcomes are an appropriate target for accountability. This conclusion is not completely new (e.g., Rose & Gallup, 2001).

Implications for the Common Core Standards

Teachers can use LearningCloud to help students learn what they need to meet and exceed the Common Core Standards.

The wording of Common Core Standards often requires interpretation. When they contain words like "Understands…" and "Knows…," LearningCloud provides the means for translating those into sets of learning objectives that specify the actual performance or behavior that can be considered *evidence* of "understanding" or "knowing," along with the achievement criteria for those objectives. LearningCloud thus provides *operational definitions* for the Common Core Standards: clearly specified learning objectives that serve as both instructional and assessment tools, and thereby as the specification of mastery. Learning activities by themselves cannot provide such definitions or specifications. LearningCloud thus has the potential to become one of the sought-after missing links between the Common Core Standards and their achievement.

Implications for the Curriculum Concept

LearningCloud tends to decompartmentalize knowledge by ignoring its traditional divisions into the “subject areas” of math, science, English, and social studies. Robinson (2009) r explained the benefits of dispensing with subject hierarchies, and LearningCloud accomplishes this fully by the use of key words as search terms, thereby promoting cross-overs among these areas. “Education does a grave disservice to students by enforcing artificial curricular boundaries” (Hathaway & Jaquith, 2013). This feature of Learning Cloud promotes trans-disciplinary thinking and the identification of connections among topics, encouraging the emergence of new conceptualizations.

Thus LearningCloud formulates curriculum not by topics but in terms of the learning objectives to be achieved. Because of how LearningCloud’s content is generated—by diverse subject matter experts and the authors of new knowledge—the breadth of its curriculum approaches and philosophies will continue to expand (the Common Core Standards being but one such approach). Educators will be able to select the learning objectives that fit their particular orientation. These are some of the curriculum approaches used at Queens Paideia School:

- The learning objectives in the life sciences, physical sciences, and technology cover not only content knowledge, but also scientific inquiry skills, analytical skills, and heuristics that are useful in problem-solving and for applications of the scientific method.
- Learning objectives for social studies emphasize inquiry heuristics that reveal connections among important inventions and discoveries, the impact of major historical figures, political events, wars, migrations, geography, the world’s diverse cultures, and their institutions.
- Critical thinking skills, inquiry skills, analytical skills, and creativity are targeted directly as specified learning objectives, rather than as general goals (Mechner, Fredrick & Jenkins, 2013).

Expansion and Upkeep of LearningCloud

LearningCloud is designed to grow indefinitely. Its content will continue to expand as a result of contributions from educators and subject matter experts, with qualified curators reviewing and approving all contributions. Teachers, by virtue of their direct contact with the actual learning needs of students and with their own efforts to individualize

instruction, will continue to offer vital utilization feedback and guidance regarding needs for additional functionalities and content.

The continuing expansion of LearningCloud's database also depends on the development of software for managing the relationships among the various types of users, contributors, curators, and administrators. This includes the process that will enable academic and private developers of innovative educational resources—learning programs, online lectures and videos, films, workbooks, textbooks, equipment, and games—to link their products to the targeted learning objectives.

Long-Term Goals

LearningCloud will function as a free open-source facility for use by schools, teachers, and independent learners everywhere. It has the potential to become a key tool for individualizing education—a necessary condition for the reconfiguration of schools and classrooms, and thereby for school reform and renewal.

LearningCloud's long-term significance extends beyond school settings. As its database continues to expand and it becomes a universally accessible open source, it will benefit any educational endeavor, whether individual or institutional, elementary or advanced. It will be useful to independent learners at the college and adult education levels, and will provide individuals inclined to lifetime learning with a facility that assists in doing so.

It will also enable the authors of articles, books, or Wikipedia entries to make their work accessible to would-be learners. The vision is for LearningCloud eventually to serve as a general educational interface between the world's repositories of knowledge and the minds of learners.

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