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ECONOMIC INSTRUCTION

Cognitive science teaching strategies and literacy-targeted economics complementarities

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ABSTRACT
This article's authors describe both the advantages of a literacy-targeted introductory course and how it might be taught by employing evidence-based teaching practices developed by cognitive scientists to maximize learning. This pairing of literacy-focused content with evidence-based pedagogy is intended to enhance student learning while focusing on economic literacy rather than mastery of an encyclopedia of models. The literacy-targeted approach reduces the number of models and concepts introduced, therefore leaving more time for teaching strategies that increase comprehension and retention. The authors propose using two foundational economic models that can be utilized to illuminate a variety of economic concepts. These two models are illustrative of this approach, and others might be used. Frequent and varied use of these models deepens student understanding and lengthens retention.

KEYWORDS
Economic education; introductory economics; literacy-targeted

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A10; A22

Instructors designing an introductory course have decisions to make regarding instruction that fall into two broad categories—what to teach (content) and how to teach it (pedagogy). In this article, we propose a literacy-targeted course for content. Proponents of the literacy-targeted (LT) approach argue that it is far more valuable for students to learn and be able to apply core economic concepts well than to be exposed to a wide range of concepts and techniques they will not master and therefore will soon forget. By reducing the content in the course, instructors have time to implement in-depth teaching strategies. On the pedagogy side, we propose strategies that leverage research-based methods from cognitive science. We believe this melding provides students with the optimal combination of relevant content delivered using engaging pedagogy that ensures that learning is deep and durable. In addition, we argue that research-based methods are particularly important for an LT course. While economics majors will see the same topics over several semesters, which will likely help them retain that content, most LT students will never take another economics course, and methods from cognitive science could well help maximize long-term retention.

Literature review

The call to provide a more focused, literacy-targeted approach has a long history. A 1950 report to the American Economic Association recommended: "The number of objectives and the content of the elementary course should be reduced" (Hewitt et al. 1950, 56). In 1963, George Stigler complained that too many concepts were taught at the introductory level, and commonly used pedagogy did not teach students to think (Stigler 1963). In 1998, Robert Frank recommended a short list of core ideas with repeated application (Frank 1998).

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Hansen, Salemi, and Siegfried (2002) propose a two-course approach, a standard principles course with the usual number of concepts and models, and a one-term course that will improve economic literacy for students who are likely to take only a single one-term course in economics. Gilleskie and Salemi (2012) showed that students who completed the literacy-targeted principles course earned grades as high as those who completed a traditional course when both groups took intermediate-level courses. Benjamin, Cohen, and Hamilton (2020) had similar results using a dataset of 13,000 students over 11 years. They argue that the literacy-targeted course is a Pareto-improving alternative to standard principles. Further, Hoover and Washington (2024) suggest that the literacy-targeted approach can increase interest in economics among racial and ethnic minorities and other students underrepresented in the economics profession.

When it comes to pedagogy in economics classrooms, instructors reported that they allocate 61 percent of class time to lecture, 21 percent to leading classroom discussion, and 18 percent to implementing methods, such as experiments, group activities, peer instruction, and clickers (Goffe and Kauper 2014). Sheridan and Smith (2020) show that instructors underestimate the time they spend lecturing, suggesting the number is about 89 percent of class time. And while lecture dominates, a majority of instructors realize its shortcomings. Specifically, only 33 percent of instructors thought students learn best from lecture, while 28 percent acknowledged that students do not learn best from lecture, they viewed lecture as a cost-effective way to deliver content, and 39 percent acknowledged students do not learn best from lecture and were open to alternatives (Goffe and Kauper 2014). Covering the large number of concepts and models in the standard one-semester course imposes a burdensome time constraint on instructors.

In their description of a literacy-targeted course, Hansen, Salemi, and Siegfried (2002) suggest allocating the time that would be spent covering complex content in the standard course to improved pedagogical practices, such as a focus on puzzles, cooperative learning, and opportunities to practice. In this way, a literacy-targeted economics course covers content and gives instructors more time to pursue methods that might have better learning outcomes but may be perceived as less cost-effective than lecture. Boyle and Goffe (2018) implemented teaching practices based on the cognitive science principles described below and showed promising results as students demonstrated larger than typical gains on the *Test of Understanding in College Economics* over the course of the semester.

Cognitive science fundamentals

It is helpful to review a bit of cognitive science before applying it to an LT course.[1] Cognitive science can help give instructors knowledge to design their courses so they have a firm foundation in what is known about how people learn. Further, experienced instructors may have observed aspects of these concepts, so the following may well explain their observations. One overarching concept from cognitive science that is used by STEM educators is constructivism. Hartle, Baviskar, and Smith (2012, 31) define it as

> a theory that describes learning as taking new ideas or experiences and fitting them into a complex system that includes the learner's entire prior learning. In other words, students arrive with pre-existing 'constructs,' and in order to learn, must modify these existing structures by removing, replacing, adding, or shifting information in them.

Thus, instructors need to be aware that students likely bring ideas and concepts to even an LT course, and these constructs might be resistant to change as they have served the students well to date. Staples et al. (2020) illustrate this point with student reasoning on simple supply and demand problems—even after instruction, they seem to retain incorrect notions of how this simple model works. Below, we discuss how an LT instructor might address constructs that are resistant to change with "elicit, confront, resolve" exercises.

"Schemas" are another concept from cognitive science that economics instructors will likely find useful. Cognitive scientists argue that we store information in "schemas," or networks of ideas, concepts, and procedures. Each of these is a node, and our minds connect these nodes to each other to greater or lesser degrees. This framework helps explain why we generally have an easy time remembering something that is connected to something we already know (e.g., the paper you read yesterday that is a variation on a paper you wrote last year) while isolated facts are difficult to remember (e.g., phone numbers in the days before contact lists in our cell phones). One excellent discussion of schemas as applied to college instruction is by Ambrose et al. (2010, ch. 2).

Not surprisingly, experts and novices have very different schemas—experts have a rich set of connections between ideas, concepts, and procedures, and they see the "deep structure" of a subject, while novices have weak or no connections between schema elements. For instance, a novice might not connect similar topics, like own-price elasticity and income elasticity, or they might not understand some of the similarities of supply and demand curves. Instead, they may see each topic as isolated from other topics. Schemas help explain why scaffolding aids instruction—the instructor slowly introduces topics or procedures that build upon the previously understood topics so as to build students' schemas.

Students' schemas suggest why an economics survey course (covering both macroeconomics and microeconomics in one term), which by necessity quickly covers many unrelated topics and models, might lead to poor long-term retention by students. Almost by design, a survey course does not allow students to make many connections between topics and models, and thus their schemas are anemic and quickly decay. If a course uses instead a few models to illustrate a variety of economic concepts, their long-term retention of both the models and topics is likely enhanced as their schemas have been enriched by repeated use of the handful of models. Each use of the model on a different topic deepens their schemas of that model. Here, we propose to use two very well-known models, the circular flow and the production possibilities frontier, to illustrate a number of concepts, from recessions to monetary and fiscal policy to economic growth. Further details are provided below. Students' schemas might not be obvious to instructors due to the "Curse of Knowledge." This cognitive bias can afflict experts—it describes how they often have a difficult time understanding how novices think about a topic. One implication is described by Wieman (2007, 8):

> Students can think about a topic in ways quite unimagined by the instructor, and so a lesson that is very carefully thought out and is beautifully clear and logical to experts may be interpreted totally differently (and incorrectly) by the student.

Many instructors likely have experienced the Curse of Knowledge when a student's question surprises them with its naivete, a shockingly wrong conception of a topic, or invokes a framework that the instructor never considered.

Humans' limited "working memory," which is how many different "chunks" of information we can manipulate when thinking, might be surprising to some instructors. This limitation was nicely illustrated by Steve Chew in his plenary address at the Conference on Teaching and Research in Economic Education (CTREE) in 2019 when he asked, "What are the days of the week?" Then, with a pause, he added, "Oh, in alphabetical order by the first letter of the day." Despite one's familiarity with these very common words, most find this to be a challenging task due to our limited working memory. Miller (1956) found that human working memory is limited to roughly seven chunks of information, and later research found it might be three or four chunks for novel information. Further, for a given subject, experts can manipulate larger "chunks" than novices. For example, an economics instructor might be able to mentally visualize all of a circular flow diagram at once while a student cannot. Limited working memory is another reason for scaffolding—this teaching method avoids swamping students' working memory. For more on the impact of working memory in teaching, see Hultberg and Calonge (2017) and Chew and Cerbin (2021).

Cognitive science and preparation for class

Many of the above cognitive science concepts are important reasons why introducing students to course topics before class will aid learning. The methods described below are particularly important in an LT class as instructors have one chance to help students learn key economic concepts. Constructivism and the Curse of Knowledge suggest that it is helpful for instructors to understand the ideas and concepts that students bring to class and which concepts and ideas they find difficult (or, what are the "holes" in their developing schemas), and pre-class activities can fill their void. Further, if students learn a bit before class, it is less likely that their working memory will be swamped in class when they are exposed to numerous concepts.

What kind of pre-class work might instructors assign? One possibility is a low-stakes quiz after students read an assignment or watch a video. One specific type is a "Readiness Assurance Test" (RAT) in Team-Based Learning (TBL), where students take a reading quiz individually, and after turning in their results, they take it again as part of their permanent team (these are sometimes called a "two-stage exam"' see Simkins, Maier, and Ruder 2021). Author William Goffe has used this technique in some courses and was continually surprised at what his students found difficult. Other possibilities are "JiTTs" (Just-in-Time Teaching assignments; see Guertin et al. (n.d.) and Simkins and Maier (2010), where students answer short-answer questions on a reading in their course management system. A question often used with JiTTs is one along the lines of "What did you find puzzling, confusing, or surprising in this reading?" Given the Curse of Knowledge, instructors will likely be surprised by what students find difficult. For example, author William Goffe was surprised to find that his macro principles students found real GDP, as well as aggregate supply and demand, particularly challenging. As a result, more of the class time was devoted to these topics. Another possibility is social reading software, like Hypothesis or Perusall. Students jointly read an assignment and together ask and answer questions on the text. Perusall can generate a "confusion report" for instructors to catalog students' prior conceptions and difficulties.

Cognitive science and conducting class

It is important for the instructor to set the stage for course topics. This point is emphasized by Bain (2004), who found that leading instructors oriented their courses around answering enticing questions, with the implication that course topics are valuable and worth spending time learning. Chew and Cerbin (2021) make a related point about student mindset—in part, if students find their work in a course to be valuable, they are more likely to be interested in the course. To address these points, author William Goffe bases his macro principles course around two major questions: why economies grow in the long run and a topical question about the current state of the economy (past ones include what will the recovery from the COVID Recession look like, and why did inflation increase so much during the recovery from the COVID Recession). An LT course could easily take a similar approach.

Deslauriers, Schelew, and Wieman (2011) argue for a specific type of active learning in class—"deliberate practice." This concept comes from the work of Anders Ericsson, a cognitive scientist who studied how experts become experts. In Ericsson and Pool (2016), deliberate practice is defined as activities that are just beyond current abilities, require one's full attention, timely and accurate feedback is given, and schemas are developed and enhanced. Ericsson and his colleagues argue that experts become experts when they undertake such activities, and Deslauriers, Schelew, and Wieman (2011) apply it to teaching a second-semester physics course. For one week, one section was taught using deliberate practice, and another was taught using a standard approach. The following week, students were tested on their knowledge from the previous week; students from the class taught with deliberate practice learned much more—the effect size was 2.5 standard deviations.

One of the benefits of deliberate practice is schema development. This includes making connections to related concepts and addressing incorrect prior knowledge. For example, a worksheet on elasticities might not have students just compute them but ask how income and own-price elasticities are both similar and different so that they think more deeply about the topic and make connections to enrich their schemas. For a supply and demand activity, students might not only describe shifts in curves but also be asked questions that get to the heart of common student misunderstandings, as described by Staples et al. (2020), where they find that students often reason from only the supply side. Thus, learning is certainly active, but activities are specifically designed to maximize schema formation. Also, note how deliberate practice requires one's full attention; in the examples above, students had to go beyond what is often asked in entry-level courses and think more deeply about the topics at hand.

Another way to think about deliberate practice is through the aphorism, "memory is the residue of thought" (Willingham 2021, 58). That is, people remember what they think about, and one way to get students to do this is to ask challenging questions that have them think deeply about the topic at hand.

Ideally, these questions are centered on topics and concepts that students find particularly confusing, such as changes in demand vs. changes in quantity demanded or the difference between inflation and the price level. Instructors can develop these questions from misconceptions discovered from pre-class activities (reading quizzes, TBL's RATs, JiTTs, or Perusall/Hypothesis assignments) and by recording common difficulties from exams in previous semesters. Part of asking questions is, of course, answering them. It appears that learning is enhanced if several different explanations are used (when possible); see Smith et al. (2011) and Schwartz, Tsang, and Blair (2016, ch. A).

If the instructor suspects that student preconceptions are firmly held, such as inflation is always harmful, or U.S. living standards have not improved in the last century, he or she might take an approach used in physics: "elicit, confront, resolve" (Wosilait et al. 1998). That is, first elicit student views on the topic at hand, confront these views (in a safe way) with other evidence, and then resolve this conflict with a better description of the topic. Author William Goffe uses "elicit, confront, resolve" when teaching economic growth across countries in principles of macroeconomics. First, students are surveyed with clickers on how a given country grows—most feel that growth is generally zero-sum across countries. Next, they are shown data from Gapminder.com on the substantial growth in real per capita income from around the globe since 1800. Students are then invited to discuss with their peers if the substantial growth in real per capita GDP across countries is consistent with zero-sum growth. Most vote that it is not. Finally, the instructor briefly describes economists' understanding of economic growth. Note how the "elicit, confront, resolve" very much follows a constructivist approach to learning—students can come to class with preconceptions that can be difficult to truly displace.

There are several established ways to teach a class centered around asking questions. One is "Team-Based Learning" (Simkins, Maier, and Ruder 2021, n.d.), where students are formed into permanent teams that last the semester. "TBL" has pre-class activities built in, and the class itself is oriented on questions that students answer individually and in their teams. A less structured approach, which is easier to implement for larger classes, involves clicker-based "ConcepTests," which are the type of challenging questions described above (see Wieman et al. 2017). Note that if this in-class approach is paired with some type of pre-class activity, as described above, learning will be maximized.

The reader might notice that a class organized on the above principles is "flipped" with work before class and questions in class, but the above goes beyond how many people think of a flipped class with a focus on specific pre-class and in-class activities. In addition, learning is active with students participating in varied activities, but these activities are derived from principles from cognitive science.[2]

Cognitive science and course structure

Other findings from cognitive science can certainly be used to increase learning and its retention. These include "retrieval practice" (Roediger and Butler 2011), which is the idea that when one tries to retrieve an idea or procedure from long-term memory, that memory is enhanced. By recalling information, you tell your brain that that information is useful. An instructor might implement retrieval practice in several ways. One is to incorporate it into questions asked in class (as described above). Or an instructor might start class with low or no-stakes quizzes. Another finding is "spacing," the idea that if one studies material spaced over time, it is likely to be remembered for longer periods in the future. This phenomenon has been studied for nearly 150 years, and Lyle et al. (2020) find that spacing enhances the retention of mathematics knowledge from a college class months after it ends. Spacing implies that if course topics appear repeatedly across the semester, learning will be maximized; this is perhaps most easily done by revisiting topics in homework, quizzes, and exams, but it can also be implemented in in-class questions when one topic relies upon a previous one.

Cognitive science even has something to say about how to group homework problems. It might seem best to "block" problem types, where similar problems are solved one after the other. It turns out that learning is enhanced if problems are "interleaved." That is, problems of different types follow each other. While there is a robust interleaving literature, a particularly wide-ranging paper is Rohrer et al. (2020). The intuition behind interleaving is that when problem types are jumbled together, students have to determine the best solution method for each problem, and thus, they are more likely to solve problems correctly at a later date.

In addition, retrieval practice, spacing, and interleaving can be applied practically in the classroom using exit tickets. For each instance, at the end of the class period, use a projector, LMS, or Web-based tool to deliver a short writing prompt that asks students to use key information from the lesson. Ask students to write a short response in 3–5 minutes before they exit the classroom. The activity asks students to retrieve important information and synthesize it with other knowledge, which contributes to schema building. To include spacing, pull a few interesting exit ticket responses to start the next class session and briefly discuss responses and key ideas. To implement interleaving, deposit exit tickets in a fishbowl at the end of each class period and during the semester, draw randomly from the collection to ensure old content is being retrieved throughout the semester.

Finally, as described in Chew and Cerbin (2021), it likely helps if instructors encourage effective study methods. The literature on the best study methods was exhaustively studied by Dunlosky et al. (2013), while Weinstein, Madan, and Sumeracki (2018) provide a more readable summary. Both of these papers have “spin-offs” for students (and instructors in a rush): Dunlosky (2013) and The Learning Scientists (n.d.).

Content—Using simple economic models repeatedly and deeply

As mentioned above, students are likely to retain information longer if a course uses a limited number of models because their schemas are enriched and enhanced each time the model is used to illustrate a new topic. We suggest using two very well-known models, the circular flow and the production possibilities frontier, as they can be used to illustrate most of the topics one might wish to address in an LT course. Tables 1 and 2 provide the details; we suspect that some instructors might be surprised at the variety of topics that these simple models can address. It is important to note that these are not the only models that instructors can use in their courses; for example, the supply and demand model will likely be used extensively. In addition, recall how teaching strategies, such as retrieval practice, spacing, and interleaving can enhance schemas. Finally, adding real-world examples provides valuable context for learning and likely enhances schemas as well.

Table 1. Circular flow.

Concept	Circular flow teaching connection
Factors of production	Factors of production are resources that households own and businesses buy in the resources market.
Supply and demand	Households act as the demanders of goods and services in the product market, and businesses are the suppliers in the product market. Both sides of the circular flow are necessary for the market to work, just as both the supply and demand curves are necessary to generate an equilibrium price and quantity.
Labor market	In the circular flow resource market, businesses are the demanders of labor, and households are the suppliers of labor. Again, stress that both sides of the circular flow are necessary for the market to work.
Institutions	Government establishment of the rules of the game determines how the actors interact, which can change the flows.
Economic shocks	Input and output markets are dependent on each other—a disruption in one side impacts the other; a shock can be driven by changes to any of the flows.
Economic intervention	The flows can be influenced by fiscal or monetary policy using policy tools to create household demand for goods and services or business demand for resources.
Unemployment	In the circular flow, businesses demand labor, and households supply labor. An interruption on either side will impact the flow of labor and impact unemployment.
Inflation	Inflation results from too much spending chasing too few goods—households are demanding goods and services at a rate that exceeds the ability of business to produce.
Measuring GDP	GDP can be measured using either the income or expenditure approach because they are two sides of the same transaction. The circular flow makes it more obvious that aggregate spending is equal to aggregate income.
Economic growth	Business investment in capital increases its ability to produce goods and services. This increase in output also creates demand for inputs. In this case, the model grows, and flows are larger.

Table 2. Production possibilities frontier (PPF).

Concept	PPF teaching connection
Factors of production	The PPF represents what an economy can produce, given its available resources. The position of the frontier is determined by the quantity of land, labor, and capital.
Scarcity	The PPF represents what the economy can produce (on or within the frontier) and what it cannot produce (outside the frontier).
Opportunity cost	Picking two points on the frontier and moving from one to the other displays the concept of opportunity cost—producing more of one good means giving up the opportunity to produce another good.
Tradeoffs	Production all along the frontier shows the tradeoffs of choosing different production levels or allocating resources differently.
Business cycle	*Recessions* can be discussed as a production level inside the frontier, representing an economy that is not fully employed, not at potential output. *Expansions* can be modeled by moving from a point inside the frontier toward the frontier (full employment) and shifting the frontier outward once potential GDP is reached.
Potential output	Producing on the frontier is producing at potential, producing inside the frontier is below potential (negative output gap), and producing outside the frontier is above potential (positive output gap).
Long-run aggregate supply	The vertical LRAS curve represents the same idea as the frontier, a production level where all resources are being utilized.
Economic growth	Economic growth is modeled as the outward shift of the frontier due to an increase in resources or technological advances (distinct from an economic expansion).
Fiscal and monetary policy	Economic policy tools can move the production point toward the frontier, representing full employment of resources.
Inflation/Phillips curve	Consistent with the Phillips curve, moving from a point inside the frontier toward the frontier (full employment) suggests resources are becoming more scarce, which creates inflationary pressure.
Gains from trade	Plot a country's pre-trade consumption on the PPF (where the country consumes only what it produces) and post-trade consumption (where comparative advantage increases consumption possibilities). The difference can be shaded on the graph to visually identify the gains from trade.

Circular flow

Introduce the circular flow diagram first with a pre-class exercise (the reading quizzes, TBL's RATs, JiTTs, or Perusall/Hypothesis assignments mentioned above) so that students come to class prepared, and so the instructor can identify common student errors and misconceptions. The following class or classes are then devoted to challenging in-class active learning exercises (described above) based on the difficulties discovered in pre-class activities to help students deeply learn the topics. Then, at key points in the course (interleaving), remind students of the circular flow, ask them to recall key concepts and learning objectives (retrieval), and apply the core concepts to the new application. These can be done in class, in homework, or in both. In this way, the circular flow can serve as a type of concept map, with different aspects of the diagram highlighted as instructors work through the course material throughout a semester (see table 1). Bringing the model in at various times connects concepts for students and provides an opportunity for instructors to incorporate retrieval practice and interleaving as they introduce the model into new contexts, contributing to building rich schemas and nuanced understanding.

Production possibilities frontier

The production possibilities frontier (PPF) is another simple model that can be used to connect ideas across the curriculum for students. Introduce the production possibilities frontier using the approach outlined above with the circular flow (see table 2). Then, at key points in the course (interleaving), remind students of the circular flow, ask them to recall key concepts and learning objectives (retrieval), and apply the core concepts to the new application. The PPF is a useful tool for laying down the course foundations and then connecting ideas that might seem distinct and isolated. Again, bringing the model into various parts of the course connects ideas for students, provides scaffolding, and assists students as they construct knowledge across the discipline.

Of course, stopping to insert previously taught models into new content spaces requires more time, which is where the LT approach to content is beneficial. Teaching fewer models but connecting them to build rich schemas will provide students with a deeper understanding and durable learning that will serve them better in the long run.

Conclusion

In this article, we describe both the advantage of a literacy-targeted introductory course and how it might most profitably be taught by employing "evidence-based" teaching practices developed by cognitive scientists, which have a wealth of evidence backing them up. Concepts include limited "working memory" (we can only juggle several items in our mind at a time), "schemas" (how we store information as networks of ideas, concepts, and procedures), and "deliberate practice" (a specific form of active learning that enhances understanding). With these in mind, suggestions were given for in-class active learning exercises that enhance deep understanding and long-term retention. Other concepts include "spacing" (repeatedly visiting a topic throughout the semester) and "interleaving" (mixing up problem types), and they too, enhance deep understanding and long-term retention. Other suggestions include pre-class work so that the instructor can get a better sense of the ideas that students bring to the classroom (which the instructor might not imagine due to the "Curse of Knowledge"). This also lessens the demands on students' working memories when in the classroom.

This pairing of literacy-focused content with research-based pedagogy is intended to enhance student learning while focusing on economic literacy rather than mastery of an encyclopedia of models. The literacy-targeted course is Pareto-improving—it provides support for the "*one-and-done*" student who does not intend to major in economics and does no harm to those pursuing a major. The literacy-targeted approach reduces the number of models and concepts introduced and therefore leaves time for teaching strategies that increase comprehension and retention. We propose using two foundational economic models as course guides and cognitive maps on which later concepts can be built. The course can be centered around basic models that are repeatedly used to illustrate core concepts.

Notes

1. These concepts are also discussed in Boyle and Goffe (2018), although the context differs.
2. This point was made in Boyle and Goffe (2018).

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Disclaimer

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