

Research Article

A Household Production Model of College Student Motivation: Teaching Strategies to Inspire Enhanced Learning

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Abstract

College teaching can be enhanced by a deeper understanding of student motivation. A highly motivated student can often outperform students with less enthusiasm and ambition. Reflection and consideration of student motivation allows teachers to develop and implement learning environments to maximize student learning outcomes. The objective of this research is to identify the major determinants of student motivation for learning in an academic environment, using an economic model of household production theory. The determinants of student motivation are identified by the construction of a mathematical model of human capital acquisition. The model provides useful implications concerning how college-level instructors could implement strategies that use student motivation to enhance student effort level and learning outcomes. Timely and useful strategies for teachers are derived from the economic model.

1 Introduction

College teaching can be enhanced by learning more about student motivation. A highly motivated student can often outperform students with less ambition or drive. Learning about student motivation allows teachers to develop and implement learning environments to maximize student learning outcomes (Lovett et al. 2023). Economists commonly learn about the world through the construction of theoretical models about human behavior, derivation of refutable hypotheses from the models, and tests of the hypotheses with real-world data and experience (Ouliaris 2011). This research develops a theoretical model to provide college teachers with a new way of looking at educational objectives and practices in institutions of higher education. The ultimate goal is to improve our ability to enhance teaching and learning. It is hoped that reflection on the outcomes from the theoretical model will provide a catalyst for pedagogical design and implementation of courses that better meet student needs and objectives (Eccles, Wigfield, and Schiefele 1998; Hattie, Hodis, and Kang 2020; Koenka 2020; Jansen et al. 2022).

The objective of this research is to identify the major determinants of student motivation for learning in an academic environment (Schunk 2000; Seifert 2004; Mega, Ronconi, and De Beni 2014; Schunk, Meece, and Pintrich 2014; Linnenbrink-Garcia and Patall 2016; Baber 2021; Feraco et al. 2023). These determinants will be identified by the construction of a mathematical model of human capital acquisition similar to Grossman (2003). The model provides useful implications concerning how college-level instructors could implement strategies that use student motivation to enhance their effort level and learning outcomes. “Teaching Takeaways”—specific pragmatic and useful strategies—are emphasized throughout. For convenience, these summary statements are also listed at the end of the article.

The research is based on a thorough review of the literature on motivation and learning. Important motivational determinants are presented and discussed, including external motivation, internal (intrinsic) motivation, enjoyment of learning for learning’s sake, and economic returns to academic achievement. The article emphasizes the complex, diverse range of student motivations. Next, a

life-cycle household production model of investment in education is constructed, capturing and incorporating the major motivations for learning. The solution to the model consists of first-order conditions, which provide the optimal level of effort and motivation for a rational, utility-maximizing student. Comparative statics provide for careful analysis and insight into what motivates students to learn the material in a college course.

Careful consideration of the major determinants of student motivation, and how each determinant affects student effort levels and performance, provides useful information about teaching strategies that use innate student characteristics to encourage more efficient learning. The model suggests that students may have a diversity of distinct motivations that operate both independently and together for enrolling in college courses and learning the material. For example, recent research has found that students care less about money and more about personal meaning in their careers (Carlson and Laff 2024).

The model developed here incorporates a wide range of motivations, including financial, pleasure of knowledge, and joy of learning activities, as explained below. Teachers could benefit from learning more about the specific motivations of their students and addressing the motivational differences in the classroom. The model helps teachers identify why students desire to learn and how they can assist students meet their learning objectives and career goals.

2 Literature Review

Motivating students to achieve in school is a topic of great practical concern to teachers ... One of the greatest challenges and opportunities of the 21st century will be for schools at all levels to focus more on assisting students to become motivated in order that they can succeed in school (Tuckman, 1999).

Tuckman responds to this challenge by presenting a model of motivation that includes three components: (1) attitude, (2) drive, and (3) strategy. Tuckman concludes that these three effects, individually and in combination, contribute to student motivation. Urhahne and Wijnia (2023) provide an integrated framework that combines the most common theoretical models of motivation, including

- (1) expectancy value theory (Tolman 1932; Lewin 1951), which hypothesizes that motivation is based on the feasibility and desirability of an action (Schnettler et al. 2020);
- (2) social cognition theory (Schunk and DiBenedetto 2021), which suggests a broad system of personal, behavioral, and environmental factors;
- (3) self-determination theory (Deci and Ryan 2000, 2013), which focuses on intrinsic motivation and on students' psychological needs;
- (4) interest theory (Dewey 1913), which views motivation as an engaging and absorption of the self;
- (5) achievement goal theory (Elliot and Hulleman 2017), which explores the differences between studying to learn (mastery) and achievement, or studying for a grade; and
- (6) attribution theory (Graham 2020), which considers an outcome to be important, unexpected, or negative.

The model created by Urhahne and Wijnia (2023) is based on the action models introduced by Heckhausen and Heckhausen (2018) and Hattie, Hodis, and Kang (2020).

Pintrich and Schrauben (1992) report and summarize a large body of research that provides evidence that the value of an outcome to the student affects motivation. Bandura (1977) defines and explains the concept of self-efficacy as how capable individuals judge themselves to be in the successful performance of a task, concluding that self-efficacy enhances the motivation to achieve and results in higher levels of achievement. This leads to social cognition theory (Schunk and DiBenedetto 2021), which asserts that perceived self-efficacy allows individuals to engage in behaviors that lead to positive

outcomes. Careful consideration of the relationship between actions and outcomes can result in feedback that influences self-efficacy (Bandura 1989).

Incentive theories of motivation focus on the value of outcomes in explaining human motivation: individuals will undertake a task if the outcome is valuable or important to them (Rotter, Chance, and Phares 1972; Overmier and Lawry 1979). Likewise, Atkinson (1966) and Wigfield and Eccles (1992) assert that the incentive value of a task will influence task choice. College students are enormously diverse, so the range of task values is also widely varied. The findings cited from the psychology literature provide a foundation for the economic model of student motivation in this research: humans appear to be motivated by things that improve their current or future situation. There is a strong connection between motivation and economic behavior, since effort levels and level of resolve determine outcomes. Thus, the social psychology literature provides keen insights into choices about effort level, major field of study, and career choices. These lifetime choices in turn have a direct impact on student motivation and effort levels in the college classroom (Urhahne and Wijnia 2023).

Improvements in future outcomes cover an enormous diversity of possibilities, since higher education is characterized by a long-term investment in time and money: 4 to 5 years, on average, are required to earn a bachelor's degree. The reasons for attending college are therefore varied, covering a broad range of motivations, from driven, competitive students to those who are not motivated to participate in the learning process. Many students may enroll due to parental pressure and/or expectations (Astin 1978; Strada Education Foundation 2018). Instructors may face a significant challenge engaging students who are not self-motivated. Highly motivated students may be highly engaged without instructor effort. However, students who enroll in college without a known purpose will be given special attention in the analysis that follows.

Dewey (1913) suggested that students can be interested (engaged and absorbed) in activities, topics, or ideas. This "interest theory" suggests that interest-driven activities do not need to have external incentives or rewards. Instead, students can provide effort based on intrinsic motivation, or flow experience (Csikszentmihalyi 1990, 2000). Urhahne and Wijnia (2023, p. 45) summarize relevant literature in interest theory: "Individual interest in content or subject matter is a stable prediction of academic achievement."

The next section presents a mathematical model of student motivation. The model closely follows previous work in the theory of human capital and household production models (Grossman 1972, 1999, 2003; Huffman 2011). The theory of human capital is based on the idea that an individual's stock of human capital determines both earnings in the labor market and the individual's productivity in nonmarket (or household) activities. Becker (1964) and Ben-Porath (1967) use dynamic economic models to solve for the optimal level of investment in human capital at a given age.

Household production theory was pioneered by Becker (1965), Lancaster (1966), and Michael and Becker (1973) based on original work by Reid (1934) and Mincer (1963). In a household production model, consumers are hypothesized to produce commodities with inputs of market goods and services, together with their own time (Huffman 2011). These commodities enter the utility function directly, creating satisfaction or happiness. For example, reading and computers are combined with a student's time to produce "knowledge," which provides pleasure, or utility. Thus, household production theory, based on economic principles of tradeoffs and choices, explains how households combine inputs such as time, goods, and services to produce valuable outputs such as health, leisure, and well-being. There is a strong connection between social psychology and household production theory, since social psychology provides insights into how motivation and other psychological processes influence household production decisions, including effort levels in college courses (Dweck 1986).

3 Model

The household production approach to education clarifies that students are both producers and consumers of knowledge. Winston (1999, p. 33) states, “One who thinks a college is like any other business will look in all the wrong places.” The demand for education is derived in part from the demand for useful knowledge and information. Therefore, education is both demanded by and produced by students. Education enters the utility function as a source of satisfaction, and it determines earnings. The model emphasizes the diversity of motivations among college students. The link between motivation and household production is strong. Knowledge of the psychological causes and motivations behind production activities is essential to understanding how individuals allocate time and resources to a wide variety of activities, including studying and learning (Theobald 2024).

The model presented below closely follows two models of human capital: Michael’s (1973) study of the relationship between education and the demand for children and Grossman’s (1972) study of the determinants of good health. Household production models use a dynamic production framework to identify and clarify the determinants of fertility (Michael 1973) and health (Grossman 1972, 1999, 2003; Chen 2024). The term “human capital” is related to “education,” but broader: education is one component of human capital. Education is the process of acquiring knowledge and is one way to build human capital, but training, skills, experience, and other attributes are also human capital determinants.

In the dynamic representation of human capital, the “stock” of human capital refers to the level of an individual’s knowledge, skills, and experience. The stock is the accumulation of all activities that contribute to the personal assets that affect career outcomes and lifetime happiness, including both factual knowledge and “soft skills.” The “flow” of human capital represents the change in the individual’s stock of human capital. The flow is therefore the new skills acquired through education, training, and experiences that contribute to additions and subtractions to the stock of human capital. The flow of human capital plays the important role of capturing how college education and experiences can affect an individual’s career and lifetime satisfaction, as will be shown below.

A representative student maximizes utility (U), assumed to be a function of n household commodities at time t (Z_{it} , $t = t_0, \dots, \tau$, $i = 1, \dots, n$) produced and consumed at home. The flow of human capital (the change in the stock of human capital, e_t) and investment in human capital (I_t), are shown in Equation (1):

$$U = u(Z_{1t}, \dots, Z_{nt}, e_t, I_t). \quad (1)$$

For notational simplicity, we will focus on a single good, Z_1 , defined to be, “educated life,” produced and consumed by the household. The flow of human capital (e_t) is equal to the stock of human capital, E_t , times the rate of flow ϕ_t , (Equation 2). The term e_t is therefore the total consumption of “educational services” available to the student at time t .

$$e_t = \phi_t E_t. \quad (2)$$

The household commodity, Z_{1t} , is produced with household production inputs, x_{1t} , and time inputs, T_{1t} , conditional on the flow of human capital, e_t , as specified in the production function in Equation (3):

$$Z_{1t} = f_1(x_{1t}, T_{1t}; e_t). \quad (3)$$

The rate of change in the stock of human capital is (by definition) determined by gross investments in human capital (which includes education, I_t) and the depreciation rate of human capital (δ). The rate of depreciation is assumed to remain constant over the lifetime of the student (Equation 4):

$$E_{t+1} - E_t = I_t - \delta E_t \quad (4)$$

Investment in human capital (I_t) is considered to be a household commodity, so is determined by both household inputs (x_{1t}) and time inputs (T_{1t}), as shown in Equation (5), where the variable M_t is the exogenous level of motivation, described in Equation (6):

$$I_t = f_I(x_{1t}, T_{1t}; M_t); \quad (5)$$

$$M_t = f_M(X_{Mt}, T_{Mt}; R_t, A_t). \quad (6)$$

The variable R_t is the level of challenge, or expectations, put forth by the instructor, and the variable A_t is the student's innate ability. The relationship between the level of challenge and student ability is explored in Barkley and Coffey (2018). The student's objective is to maximize lifetime utility, given (1) the time constraint (Equation 7) and (2) the lifetime budget constraint (Equation 8), with retirement occurring at time period $t = \tau$.

$$T_{1t} + T_{It} + T_{Mt} + T_{Wt} = T; \quad (7)$$

$$\sum_{t=t_0}^{\tau} \frac{[p_{1t}x_{1t} + p_{It}x_{It} + p_{Mt}x_{Mt}]}{(1+r)^t} = \sum_{t=t_0}^{\tau} \frac{[w(E_t)T_{Wt}]}{(1+r)^t}. \quad (8)$$

The earnings level, w , is a function of the stock of human capital, and the wage function is assumed to be a constant fraction of the level of human capital: $w(E_t) = \alpha E_t$. Note that the wage rate (w) is the opportunity cost of the student's time, so the "shadow price" of time is given by the wage rate: $p_T = w(E_t)$. The student's "full income" constraint can be found by combining Equations (7) and (8), where the student's full income is the opportunity cost of time over the entire period, t_0 to τ (note that $T_{Wt} = T - T_{1t} - T_{It} - T_{Mt}$):

$$\sum_{t=t_0}^{\tau} \frac{[p_{1t}x_{1t} + p_{It}x_{It} + p_{Mt}x_{Mt} + p_{Tt}(T_{1t} + T_{It} + T_{Mt})]}{(1+r)^t} = \sum_{t=t_0}^{\tau} \frac{[w(E_t)T]}{(1+r)^t}. \quad (9)$$

3.1 Major Motivations for Learning: First-Order Conditions

The Lagrangian to be maximized by the student is found in Equation (10):

$$\text{Max } \mathcal{L} = U(Z_{1t}, e_t, I_t) - \lambda \left\{ \sum_{t=t_0}^{\tau} \frac{[p_{1t}x_{1t} + p_{It}x_{It} + p_{Mt}x_{Mt} + p_{Tt}(T_{1t} + T_{It} + T_{Mt})]}{(1+r)^t} - \sum_{t=t_0}^{\tau} \frac{[w(E_t)T]}{(1+r)^t} \right\}. \quad (10)$$

And the first-order conditions for educational market inputs (x_{1t}) and time inputs (T_{1t}) are found in Equations (11a) and (11b):

$$\frac{\partial \mathcal{L}}{\partial x_{1t}} = \left(\frac{\partial U}{\partial Z_{1t}} \right) \left(\frac{\partial Z_{1t}}{\partial x_{1t}} \right) - \lambda \left(\frac{p_{1t}}{(1+r)^t} \right) = 0 \quad \forall t; \quad (11a)$$

$$\frac{\partial \mathcal{L}}{\partial T_{1t}} = \left(\frac{\partial U}{\partial Z_{1t}} \right) \left(\frac{\partial Z_{1t}}{\partial T_{1t}} \right) - \lambda \left(\frac{p_{Tt}}{(1+r)^t} \right) = 0 \quad \forall t; \quad (11b)$$

which can be combined to achieve the equilibrium condition in Equation (12):

$$\frac{MU_Z f_{1x}}{p_{1t}} = \frac{MU_Z f_{1T}}{p_{Tt}} \quad \forall t. \quad (12)$$

Our focus is on the determinants of a student’s investment in education, which can be found by taking the first derivative of Equation (10) with respect to the investment time (T_I) at time $k = 0$:

$$\begin{aligned} \frac{\partial \mathcal{L}}{\partial T_{Ik}} &= \sum_{t=k+1}^K \left\{ \left[\left(\frac{\partial U}{\partial Z_1} \right) \left(\frac{\partial Z_1}{\partial e_k} \right) \left(\frac{\partial e_k}{\partial E_{k+1}} \right) \right]_t \left(\frac{\partial E_{k+1}}{\partial I_k} \right) \left(\frac{\partial I_k}{\partial T_{Ik}} \right) \right\} \\ &+ \sum_{t=k+1}^K \left\{ \left[\left(\frac{\partial U}{\partial e_k} \right) \left(\frac{\partial e_k}{\partial E_{k+1}} \right) \right]_t \left(\frac{\partial E_{k+1}}{\partial I_k} \right) \left(\frac{\partial I_k}{\partial T_{Ik}} \right) \right\} + \left(\frac{\partial U}{\partial I_k} \right) \left(\frac{\partial I_k}{\partial T_{Ik}} \right) \\ &- \lambda \left\{ P_{Tk} - \sum_{t=k+1}^K \left[\frac{\alpha \left(\frac{\partial E_t}{\partial I_k} \right) \left(\frac{\partial I_k}{\partial T_{Ik}} \right) T}{(1+r)^t} \right] \right\} = 0. \end{aligned} \tag{13}$$

This equation can be reorganized to achieve the optimal condition for student investment in education (Equation 14), where the term ϕ is defined as $(\partial e_k / \partial E_{k+1})(\partial E_{k+1} / \partial I_k)$:

$$\begin{aligned} P_{Tk} &= \sum_{t=k+1}^K \left[\frac{\alpha \left(\frac{\partial E_t}{\partial I_k} \right) \left(\frac{\partial I_k}{\partial T_{Ik}} \right) T}{(1+r)^t} \right] \\ + \frac{1}{\lambda} \left\{ \sum_{t=k+1}^K \left[(MU_{1f_1} \phi)_t \left(\frac{\partial I_k}{\partial T_{Ik}} \right) \right] + \sum_{t=k+1}^K \left[(MU_e \phi)_t \left(\frac{\partial I_k}{\partial T_{Ik}} \right) \right] \right\} \\ &+ \frac{1}{\lambda} \left[MU_{Ik} \left(\frac{\partial I_k}{\partial T_{Ik}} \right) \right]. \end{aligned} \tag{14}$$

Equation (14) highlights four major motivations for investing time in education. These four motivating factors are summarized in Figure 1 and explained in the next section. The term P_{Tk} on the left-hand side of Equation (14) is the opportunity cost of making a one-unit (1 hour) investment in education at time $t = k$. The benefits of undertaking this investment appear on the right-hand side. The first term is the rate of change (derivative) in the wage rate (w), given a 1-hour investment in education (T_{Ik}). The wage rate, $w(E) = \alpha E_t$, is the foundation of the monetary motivation for investments in education. The next two terms capture nonmonetary motivations: enhanced utility (pleasure) associated with investments in education. The term MU_{1f_1} , captures the marginal utility, or additional pleasure, resulting from an additional hour of investment in education, and MU_e , represents the extra utility resulting from one more hour of investment in human capital. Last, the intrinsic reward of an investment in human capital (MU_I). Each of these important determinants of student motivation, including both financial and nonmonetary drivers, will be explored in the next section.

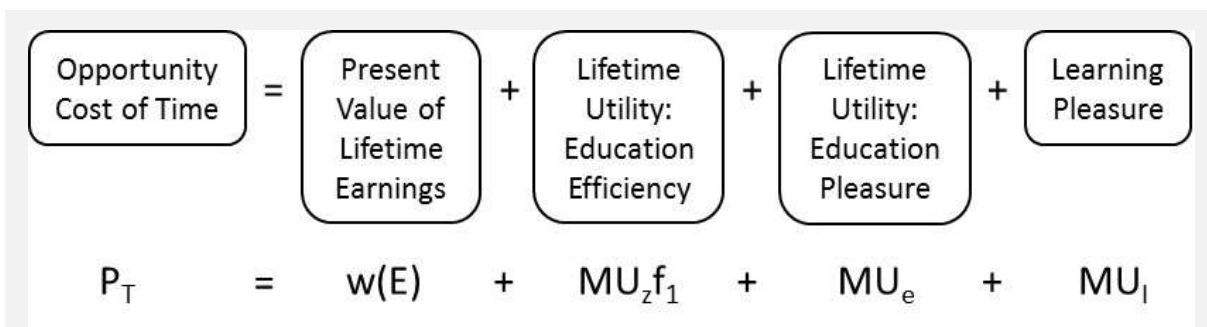


Figure 1. Summary of model first-order conditions from Equation (14)

4 Model Results: Implications for Enhanced Learning by Motivating Students

The mathematical results summarized in Equation (14) can now be interpreted for higher levels of teaching effectiveness.

4.1 Opportunity Cost of Student Time: p_T

Dost thou love life? Then do not squander time, for that is the stuff life is made of.
~ Benjamin Franklin (1746)

The term on the left-hand side of Equation (14) captures the marginal cost of an investment in human capital: the opportunity cost of the student's time (p_T). This simple term, representing the value of the student's next best alternative use of time, emphasizes the importance of a college instructor's respect for student time. Every course activity must be perceived to be at least as valuable as the next best alternative, or students will not participate in the activity. This holds true for classroom lectures, homework assignments, assigned readings, or studying for an exam. The social psychology literature can help explain the important role of student time: expectancy value theory, explored by Atkinson (1957), suggests that the opportunity cost of time invested in education arises since the time spent is no longer available for other activities (Urhahne and Wijnia 2023, p. 45). Thus, educational pursuits can conflict with other valued activities (Locke, Latham, and Erez 1988; Eccles and Wigfield 2020). The implication for instructors is clear: do not waste students' valuable time. Grund and Fries (2012) use the psychological principles of education to understand tradeoffs between studying and leisure. This fundamental tradeoff is the much-researched economic idea of the labor/leisure tradeoff.

TEACHING TAKEAWAY ONE. Provide learning opportunities and environments that use all class and course time effectively and efficiently. Keep students busy and moving forward.

It is important to emphasize that it is the *student* who determines what is meaningful in both (1) this model and (2) real life. The utility function belongs to the student. The social psychology literature emphasizes this point: student engagement is motivated by interest theory (Dewey 1913); curiosity; the optimal amount of arousal (Donnellan et al. 2022); and "flow" (Csikszentmihalyi 1990, 2000; Barkley and Coffey 2018). The arguments in the student's utility function and the shape of the utility function may differ—in some cases enormously—from the instructor's utility function. Careful attention to student reactions can enhance the learning environment in ways that make the benefits of the educational experience outweigh the significant opportunity cost of a student's time.

Teachers could ask students to share information about themselves on the first day of class, including backgrounds, interests, and future career plans. This information could be used to customize course examples and lectures throughout the term, based on the information that is shared. Often, the more an instructor knows about the students, the more effective the instructor can be at making the course material timely, relevant, and important to enrolled students. This idea is the driving force behind educational psychology: Dewey (1913) explains that individual, personal interests are the main drivers of student effort level.

TEACHING TAKEAWAY TWO. Provide a strong connection between each topic and students' lives.

4.2 Money: $w(E)$

“Wealth is the ability to fully experience life.”

~ Popularly attributed to Henry David Thoreau (n.d.)

The first term on the right-hand side of Equation (14) captures the purely pecuniary benefits of investments in education: an increased earnings stream from the time period when the investment is made ($t = k$) throughout the future working life of the student, until retirement ($t = \tau$). Since time invested in education during the period $t = k$ is the time input used to increase investments in human capital (I_t , Equation 5), and such investments increase the stock of human capital (E_t , Equation 4); the result is higher earnings. Increases in annual earnings are captured in a simple fashion here, where it is assumed that annual earnings (w_t) are proportional to the stock of knowledge: $w_t(E_t) = \alpha E_t$. This simplification could easily be expanded to include actual earning functions, such as those estimated by Mincer (1974) and Rosen (1992). Research in educational psychology by Urhahne and Wijnia (2023) emphasizes that goals, including financial goals, are the foundation of motivation, a view consistent with motivational research, including Elliot and Fryer (2008), Schunk et al. (2014), and Elliot and Hulleman (2017).

Financial goals have always been a major motivating force for seeking a college education (Astin 1978; Strada Education Foundation 2018). As higher education has expanded to include new populations and groups, this goal has been enhanced. For many college students, the opportunity to increase future earnings is a major motivational factor in seeking higher levels of education (Strada Education Foundation 2018). This motivation is worthy of careful consideration by academics, who have in many cases personally sacrificed higher lifetime earnings through occupational choice. Many students are motivated by money and future earning potential, and this typically differs from the instructor’s motivations and lifestyle choices (Astin 1978; Strada Education Foundation 2018). It is important to point out that student interest in financial goals has declined in recent years, together with an increase in desire for meaningful work (Carlson and Laff 2024).

Instructors who devote time and energy to finding out what employers are seeking when hiring, paying, and promoting students may be making a solid investment in helping students to achieve their career goals and lifetime earning capacity. This is equivalent to enhancing the level of the variable α : increasing the ability of learners to convert what they have learned (E_t) into earnings (w_t). Research shows that students in all majors can do well financially (Nussbaum 2016).

TEACHING TAKEAWAY THREE. Link all course topics with careers to enhance motivation. Former students as guest speakers can provide a powerful source of real-world connections for current students.

The next several sections describe relationships between knowledge, learning, fun, and productivity. While the concepts are all closely related, each section is distinct and different from the other ideas.

4.3 Better Living Through Education: f_1

“An unexamined life is not worth living.”

~ Socrates (quoted in Brickhouse and Smith 1994)

It has been asserted throughout the centuries that life is best lived with greater levels of information and analytical ability (Nussbaum 2016). This claim is captured in the model’s first order conditions in Equation (14), in the second term on the left-hand side: $(MU_1 f_1 \phi)_t$, summed from the time of the investment in human capital ($t = k$) to the date of retirement ($t = \tau$). This term represents the

enhancement in a student's satisfaction level over his or her lifetime: utility is a function of Z_1 , or "educated life" (Equation 1), which depends on the flow of educational services (e_t) available for decision-making, analysis, and interpretation of life events. Within the field of educational psychology, "knowledge for knowledge sake" is called the "mastery goal" of understanding the content and doing well in the course (Ames and Archer 1988).

The mathematical model captures the idea that knowledge, information, and critical thinking skills allow an individual to be more productive in their life by engaging in activities and interpreting current events in a way that increases overall efficiency. As psychologist Herbert Gerjuoy writes in Alvin Toffler's *Future Shock* (1970, p. 414), "Tomorrow's illiterate will not be the man who can't read; he will be the man who has not learned how to learn

TEACHING TAKEAWAY FOUR. Sharing personal anecdotes of how knowledge from classroom lessons leads to life and career productivity can inspire and motivate students to "learn for learning's sake."

4.4 The Joy of Knowledge: MU_e

"Science is organized knowledge. Wisdom is organized life."
~ Popularly attributed to Immanuel Kant (n.d.)

Not only does education make life more efficient (f_1), but educated life can also be pleasurable (MU_e). Many individuals generate satisfaction from knowledge and the application of the stock of knowledge. The flow of knowledge (e_t) is the use of the stock of knowledge (E_t) each period. Students can gain key insights into the course material and life from instructors who share ideas about how the knowledge gained in class can be used to spark conversations, discussions, and projects. Sharing knowledge with others can enhance the enjoyment of life, as can learning from others. Working through complex ideas and arguments often improves one's happiness.

Teachers can share ideas on how to have this kind of conversation with other students and nonstudents. The intrinsic value of education is important: better educated citizens who can think critically and analyze data may be better citizens (Nussbaum 2016). Instructors can model the idea that education can make students more well-rounded and leads to more fulfilling lives. The ability to reason and comprehend can provide a more satisfying life (Nussbaum 2016).

TEACHING TAKEAWAY FIVE. Emphasize how knowledge provides an enjoyable life.

4.5 Learning Can Be Fun: MU_1

"The essence of teaching is to make learning contagious, to have one idea spark another."
~ Marva Collins (1990, p. 147)

Many students are motivated by the enjoyment of the learning process. The degree to which this occurs varies widely, since students have diverse personalities, abilities, and interests. Some students enjoy group assignments and activities, and others detest them. Some enjoy classroom discussion, and others want "just the facts." Notice that there is a major difference between this marginal benefit and the preceding three terms: the pleasure associated with learning (MU_l) is instantaneous, occurring once at the time of learning ($t = k$). The previous three marginal benefits discussed above (w , f_1 , and MU_e) are all summed from the time of investment in knowledge ($t = k$) to retirement ($t = \tau$), the gains of knowledge over the course of a lifetime. The entire increase in satisfaction in MU_1 , however, comes from the

instantaneous joy of learning itself at time t , rather than expected future streams of utility. Many instructors know the joy of learning and desire to share it with others.

Many individuals involved in higher education believe that today's students differ from previous students in their inability to think long term and/or delay gratification (Bok 2006; Levine 2005). To the extent that many college students may have high discount rates (r), perhaps the most important determinants of the investment in learning are the two terms that occur in the present time period: the opportunity cost of time (p_T) and the marginal utility of learning (MU_1). This focuses our attention on the need to prepare and deliver information and course material that is timely, important, and interesting for students.

TEACHING TAKEAWAY SIX. Develop and assess all lectures, assignments, and coursework that are meaningful and interesting to students to emphasize student-centered education.

5 The Implications of Economic Theory for Motivating Students

“You’ve got to think about big things while you’re doing small things, so that all the small things go in the right direction.” ~ Alvin Toffler in Nina Martire (2018)

The household production model of learning and education provides important implications for teaching and learning in college courses and curricula. In what follows, six theoretical implications for teaching are presented and discussed.

5.1 Maximizing Motivation (M_t), Matching Rigor (R_t), and Ability (A_t)

“A good teacher must be able to put himself in the place of those who find learning hard.”
~ Eliphaz Levi (1898)

The economic model outlined above emphasizes the importance of motivation (M_t) in the production of knowledge. Motivation can be seen as an outcome of the interaction of the level of challenge, or rigor, determined by the instructor, and the ability level of the student. Following Csikszentmihalyi (1990, 2000), Barkley and Coffey (2018) posited that the optimal level of motivation occurs when the level of rigor is in line with a student's growing ability level. As time passes, experience and learning result in higher levels of student competency, which allows the instructor to increase their expectations. To maximize learning, teachers can continuously adjust the level of challenge to keep students motivated, interested, and engaged in learning (Barkley and Coffey 2018). In the household production model of education, the benefits to enhancing motivation can be truly enormous, since they are summed over the productive lifetime of the student. Early motivation brings higher lifetime earnings and utility, relative to motivation that occurs later.

TEACHING TAKEAWAY SEVEN. Provide a diversity of challenges to students. Include both rigorous, difficult tasks and simpler tasks. Evaluate how each individual student is responding to the level of challenge and target teaching to each individual.

5.2 Making Education Useful: ϕ

“Education is not to teach men facts, theories, or laws; it is not to reform them, or amuse them, or to make them expert technicians in any field; it is to teach them to think, to think straight if possible; but to think always for themselves..” ~ Robert M. Hutchins (1935)

A second method for motivating students is to make the knowledge learned more useful, or increasing the degree to which knowledge can be converted into useable flow of human capital, as described in Equation (2): $e_t = \phi E_t$. In many cases, instructors can learn about concrete, real-world examples of how economic principles (or any course material) can be usefully used by a business firm or former student to make better business and/or personal decisions. These examples can do a great deal to demonstrate to current students how the stock of knowledge can enhance their lives. Instructors who invest in learning examples that demonstrate the use of knowledge in improving the human condition are likely not only to model to students the usefulness and value of economic principles but also to inspire them to use economics to improve their own lives.

One way to connect course material with career usefulness is to gather information and experiences directly from previous students. This could be done by email, video conversations in class, or guest speakers who emphasize how the course material enhances their work.

TEACHING TAKEAWAY EIGHT. Share real-life examples of how the course material will be used after graduation.

5.3 The Determinants of Earnings: α

“A good teacher can inspire hope, ignite the imagination, and instill a love of learning.”
~ Popularly attributed to Brad Henry (n.d.)

The labor market for college graduates is dynamic, and the skills that employers are looking for change as the market economy advances. Teachers who devote time and energy to learning about the types of knowledge and skills that maximize starting salaries and career success are likely to enhance students’ lifetime utility. Similarly, teachers can champion the economic value of critical thinking skills and higher-order learning, assets that employers can overlook or undervalue in the short run.

TEACHING TAKEAWAY NINE. Model active learning and lifelong learning. Explain how course skills will be useful in learning throughout students’ careers and lives.

5.4 Complementary Motivations: $\partial^2 U / \partial Z \partial I > 0$

“The mediocre teacher tells. The good teacher explains. The superior teacher demonstrates. The great teacher inspires.” ~ Popularly attributed to William Arthur Ward (n.d.)

Perhaps the most pragmatic implication of the household production model of education is for instructors to emphasize and reinforce the variety of benefits forthcoming from investments in human capital. Student learning can be enhanced by instructors who develop and deliver class material that meets each of the four marginal benefits of learning: (1) increased lifetime *earnings*, (2) increased lifetime *productive efficiency* through greater problem solving and analytical ability, (3) increased *lifetime utility* through knowledge about the world and the human condition, and (4) the great *pleasure* of the process of learning something new: “learning is fun.” These four educational benefits are simply the four terms that appear on the right-hand side of Equation (14) and in Figure 1. A teacher could usefully prepare for each lecture, assignment, and class activity by checking that each of these four benefits is present, clear, and obvious to students. Course material that captures each of the four benefits is likely to reach a larger number of students, particularly in classes with diverse student backgrounds, aspirations, and abilities.

TEACHING TAKEAWAY TEN. *Integrate learning objectives for (1) earnings, (2) efficiency, (3) deep knowledge, and (4) fun into every aspect of the course: lectures, discussions, assignment, and exams.*

5.5 The Law of Diminishing Marginal Utility: $\partial^2 U / \partial I^2 < 0$

“It is, in fact, nothing short of a miracle that the modern methods of instruction have not yet entirely strangled the holy curiosity of inquiry.” ~ Albert Einstein (1949)

It was claimed above that it is often considered good practice to “make the lecture relevant,” or “use real-world examples” to show the usefulness and applicability of the economic principles to be learned. However, any classroom strategy or activity can lead to diminishing returns. Teachers must be sensitive and perceptive to student burnout. Care should be taken to motivate students, but at the optimal level, before diminishing utility sets in.

The best way to avoid boredom is for instructors to use a *variety* of approaches to motivate students instead of only a *single* approach. Strategies that work during one lecture may not retain the same level of inspiration when used repeatedly. Thus, variation in approaches, styles, and strategies can lead to more sustainable results relative to a unidimensional strategy. Instructors are encouraged to try something new, even when the current approach is working well. Constant change, diversity, and variation can all play important roles in making the class more fun, interesting, and effective for both students and teachers.

When students are tired, such as after a late night or after taking an exam in the previous course, teachers can be more effective by (1) acknowledging the students’ state of fatigue and (2) sharing how the course, lecture, or activity will reinvigorate them. A simple validation of student mood provides a connection between the instructor and students, which can yield a positive attitude toward the course and the instructor. Once the students have been affirmed, a positive, energetic lecture can bring students back to a higher level of effectiveness and motivation. This approach combines Dewey’s (1913) emphasis on student interest with attribution theory’s emphasis on outcomes (Graham 2020). Class activities such as sharing ideas with other students and short breaks to look up information on the internet can lead to positive outcomes when burnout has set in. Economic principles demonstrate that consumers consume a large variety of products, rather than a single good. Why? The pervasiveness of the Law of Diminishing Marginal Utility. Variety is indeed the spice of life.

TEACHING TAKEAWAY ELEVEN. *Be mindful of burnout, diminishing energy, and pushing students too hard. Integrate breaks, activities, and exercises that allow students to reenergize and refresh.*

5.6 Technological Change: $f_{1t+1} > f_{1t}$

“Imagination is more important than knowledge. For while knowledge defines all we currently know and understand, imagination points to all we might yet discover and create.” ~ Popularly attributed to Albert Einstein, n.d.)

Clear demonstrations of the usefulness of course material often result in true astonishment, a sense of accomplishment, and a desire to learn more. When teachers emphasize the progress that students have made, and the value of the knowledge that they have learned, student motivation is likely to increase significantly.

TEACHING TAKEAWAY TWELVE. *Measure student accomplishment to demonstrate how much student learning has occurred and share these milestones frequently throughout the course.*

6 Conclusions

The major determinants of student motivation for learning in an academic environment were identified by the construction of a mathematical model of human capital acquisition. The motivations are diverse, mirroring the broad interests, personalities, backgrounds, and aspirations of college students. The model provides useful implications concerning how college-level instructors could implement strategies that use student motivation to enhance their effort level and learning outcomes. The Scholarship of Teaching and Learning (SoTL) provides a systematic approach to studying teaching and learning practices. When viewed from this perspective, the twelve teaching takeaways derived from the household production model can be usefully considered as research paths or hypotheses that could be examined in future work. Further investigation of these concepts is crucial given changes in enrolled students over time.

Four major determinants of student motivation were identified by the model of household production (Figure 1). The opportunity cost of student time (pr) is the marginal cost of investments in education, which highlights the importance of a college instructor's respect for student time, and emphasizes that it is the student who determines what is meaningful in the classroom, since the utility function belongs to the student. The first motivational determinant is money, or lifetime earnings capacity. An investment in education today will have a long string of returns over the course of the student's working life. Instructors who devote time and energy to finding out what employers are seeking when hiring, paying, and promoting students may be making a solid investment in helping students to achieve their career goals and lifetime earning capacity.

The second motivating influence on students is the impact that education has on the production of "educated life," a good that enters the utility function directly. "Educated life" is the flow of useful educational services (e_t) available for decision-making, analysis, and interpretation of life events. Knowledge, information, and critical thinking skills allow an individual to be more productive in their life, by engaging in activities and reading to events in a way that increases overall efficiency. The third motivation is the pleasure of knowledge: knowing things increases satisfaction. The pure joy of learning provides the fourth and final motivation for students in higher education. This focuses our attention on the need to prepare and deliver information and course material that is timely, important, and interesting for students.

The model results provide six strategies for teachers:

- (1) Maximize motivation, and thus learning outcomes, by carefully and continuously matching the degree of rigor with student ability.
- (2) Make education as useful as possible by modeling how knowledge can be used in everyday business and personal decisions.
- (3) Devote time and energy to learning about the type of knowledge and skills that maximize starting salaries and career success, which are likely to enhance the lifetime utility of students.
- (4) Emphasize and reinforce the variety of benefits forthcoming from investments in human capital, providing students with incentives to study hard and learn the material.
- (5) Be wary of the law of diminishing marginal utility by providing a dynamic and interesting learning environment, and
- (6) Clearly demonstrate the usefulness of course material, which will often result in true astonishment, a sense of accomplishment, and a desire to learn more.

When teachers emphasize the progress that students have made, and the value of the knowledge that they have learned, student motivation is likely to increase significantly.

7 Teaching Takeaways Summary

- (1) Provide learning opportunities and environments that use all class and course time effectively and efficiently. Keep students busy and moving forward.
- (2) Provide a strong connection between each topic and students' lives.
- (3) Link all course topics with careers to enhance motivation. Former students as guest speakers can provide a powerful source of real-world connections for current students.
- (4) Sharing personal anecdotes of how knowledge from classroom lessons leads to life and career productivity can inspire and motivate students to "learn for learning's sake."
- (5) Emphasize how knowledge provides an enjoyable life.
- (6) Develop and assess all lectures, assignments, and coursework that are meaningful and interesting to students to emphasize student-centered education.
- (7) Provide a diversity of challenges to students. Include both rigorous, difficult tasks and simpler tasks. Evaluate how each individual student is responding to the level of challenge and target teaching to each individual.
- (8) Share real-life examples of how the course material will be used after graduation.
- (9) Model active learning and lifelong learning. Explain how course skills will be useful throughout the students' careers and lives.
- (10) Integrate learning objectives for (a) earnings, (b) efficiency, (c) deep knowledge, and (d) fun into every aspect of the course: lectures, discussions, assignment, and exams.
- (11) Be mindful of burnout, diminishing energy, and pushing students too hard. Integrate breaks, activities, and exercises that allow students to reenergize and refresh.
- (12) Measure student accomplishment to demonstrate how much student learning has occurred and share these milestones frequently throughout the course.

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