Playing to Learn: Curricular Knowledge and a Theory of Need

Hanan Yaniv

Abstract

A new model for generating learner's engagement learning curricular knowledge is presented. An alternative to the conventional "intrinsic" Vs. "extrinsic" motivation dichotomy shifts the focus from "content" to "task", proposing that curricular knowledge should be constructed as necessary information to complete a desired task. It is proposed that using highly motivating tasks (such as adventure games, decision making activities and team work) within a learning environment can be applied into any curricular topic, making learning enjoyable. The model is based on a highly successful learning game designed by the author that has been in use for the past ten years.

Introduction

School was hell. Trying to retrieve some memories of the times always results in a grey background; everything is faded in a grey screen of boredom. I was just sitting there, watching the seconds hand on my watch in its endless travel to freedom – the bell. Nothing could make me learn. All the promises, the encouragements, the threats, the punishments… I wanted to learn. I wanted to make them happy, but I was just sitting there… At the end of the 10^{th} grade – they said enough and showed me the door.

I don't blame them for that constant torture; most of my friends could handle it. This paper is an attempt to help.

"In schools, for example, it appears that intrinsic motivation becomes weaker with each advancing grade". (Ryan and Deci, 2000)

In spite of this gloomy opening, this paper is loaded with hope. It presents a model for transforming any type of curricular content into an exciting, motivating learning experience. This paper presents a model that is based on a learning environment that has been maintaining an unquestionable success in motivating students to learn over the past ten years. This model, field experience and interdisciplinary quandary into motivational research challenge the relevancy of the popular dichotomous definition of "intrinsic" and "extrinsic" motivation to a classroom setting.

What is motivation and why it is important: a theoretical overview with a personal touch

Many theorists and researchers have been trying to understand what makes people learn. Reading in educational theory and philosophy, educational psychology, psychology, social studies, organisational management, instructional design and general literature, reveals two main streams of search: **internal**: that probes into the human mind, searching for scholastic or practical interest in the content; passion; excitement; curiosity… and **external** that searches for energy that makes people learn in the life around them, in people that influence their learning, in events and goals that guide them.

My claim is that this distinction between intrinsic and extrinsic motivation is too narrow and not always relevant to encompass the phenomenon of the human need to learn. Generating intrinsic motivation in children could not be expected of teachers if

they have so little control over the content (it is prescribed by curriculum). We need to offer teachers more reachable goals – as we need to account for their motivation as well. This point will be treated later, once the model has been introduced, as it applies to the teacher's motivation as well as the student's.

This paper is not the first to challenge the common concepts of "intrinsic" and "extrinsic" motivation. Reiss (2004, 2005), offers a thorough and well articulated review of motivational philosophy theory, challenging the validity of intrinsic motivation research and offers an exciting multifaceted model of intrinsic motivation based on 16 universal desires. He claims that these desires manifest themselves in different strengths to create a personality profile in each of us. Unlike Reiss, this paper is not focused on the attempt to understand why people are motivated. This paper and the model it presents are focused on the assumption that when unbound by any external impositions, people chose to engage in activities that satisfy a need within them. These activities can be identified and recruited to generate energy that comes for the sake of the activity itself.

Consider the following situation:

One day, many years ago, I brought home a computer learning game called "Where in the World is Carmen Sandiego" by The Learning Company. The game sends the player to catch Carmen (a thief) following clues that she left in many countries and cities around the world. Searching for Carmen, the player stumbles upon geographical facts, learning them, hopefully, while having fun. My boys, 12 and 7 (1991) at the time, conquered my home office and my computer; brought in atlases,

encyclopaedias, reference books, and didn't leave the room until they finished the game.

I was puzzled. The content was uninspiring, the game was quite limited (graphics and technology of about 15 years ago), what was the energy?

The first question that comes to mind is: was this "motivation"? Although I conducted no interviews, I didn't have my boys fill-out any questionnaires or personal inventories – the facts were evident: the boys stayed with the tasks for about 20 hours and didn't leave until they finished. They invested energy in searching for support materials (no Google – just books) and disregarded any alternative temptations as watching television and playing with their friends... Yes, I don't believe there will be much of a debate – it was motivation at its best.

The second question we can ask is what type of motivation was it? Was it "intrinsic"; "extrinsic" or a combination of both? Why are we concerned about the type of motivation?

The realization that even my 'not-so-eager-to-learn' children can sit and work for so many hours with encyclopaedias and atlases while reflecting on my own incompetence in school, was an important milestone in my professional development. I understood that if we want children to learn – we need to observe what they do when they are alone, not being told what to do or what is expected of them. In other words, we need to look at the ways they play.

Although many claims are made in the literature about the desirable nature of intrinsic motivation and its long-term effect on learning, the first step I urge you to take is a look within yourself. Think of situations in which you were engaged in a learning activity with no external demands. The most commonly used example in the literature is a hobby. Think of the learning energy you invested in a hobby that no external pressure had led you to choose. Think of how rewarding the activity has been. Think of what you learned and how retrievable this knowledge is. The second step is to compare this knowledge with knowledge you acquired in school and you will understand why we must seek intrinsic motivation in any type of a learning situation.

Dev (1997) summarizes his extensive work on the definition of intrinsic motivation. He identifies three forms: (a) curiosity, (b) for the sake of the task itself; and (c) the desire to contribute. Dev's definition is a result of integrating writings of Deci, Gottfried, Woolfolk, Bates, Vallerand, Pelletier, & Ryan, and Mills, so I feel it can be accepted as a sound foundation for understanding the phenomenon.

These three forms of intrinsic motivation suggest that it might not be the same type of energy and the inclusive term "intrinsic" might not be explaining the main source of energy that makes people do things with no external directive.

Amazed by my children's experience with "Where in the World is Carmen Sandiego, and harnessed with the enthusiastic belief that learning energy can be found in the task and not necessarily in the content, I began to explore games as a possible source of internal energies toward learning.

The Motivating Power of Learning Games

A group of researchers at the Navy Personnel Research and Development Center (Randel, Morris, Wetzel and Whitehill, 1992) conducted a literature review of 67 studies that were dealing with empirical comparisons between instructional games and conventional classroom instruction. Reporting the findings, Randel et al grouped articles by subject matter (Social Studies, Math, Language Arts, Physics, Biology and Logic) and by two more classifications: Retention over time and Interest. Of the 67 studies, 27 favor games, 3 favor conventional instruction and 37 show no difference. Looking at retention over time, game show significant difference of conventional instruction and 12 out of 14 studies report more interest in the games' activities. These last findings reinforced my conviction and energized my own quest for a model of adaptation of game based energies into any learning environment.

The Sweater Game (the birth of instructional model)

The design of a new learning environment for a new educational center build by the Manufacturers Association of Israel was my first implementation of an adventure game. The learning environment that was required had to engage grade 8th thorough 12th students for an hour and a half in 4-member teams. Each team had only one computer (budgetary imposition). The content was the "industrial cycle" – from the idea through marketing survey, design and planning, research and development, manufacturing to selling the product.

The game had 4 major components:

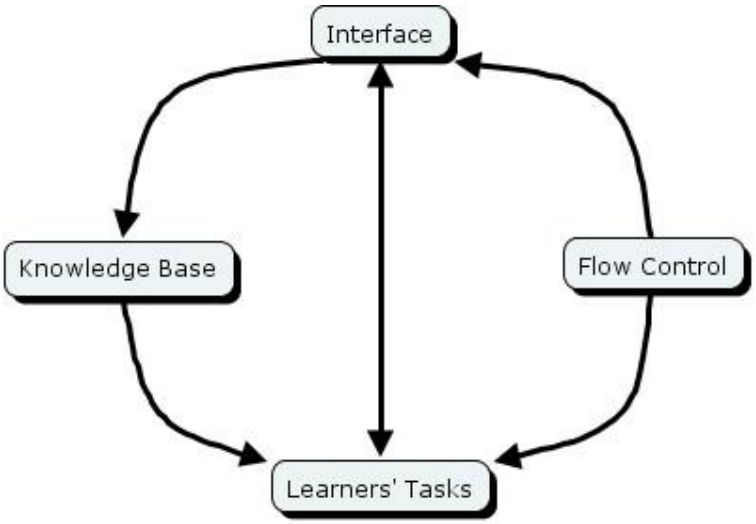


Figure 1 - The Sweater Game Components

The Interface: The "story" behind the game is of a sweater factory. On login, each of the four team members assumes a management role in the factory: Marketing; Sales, Production and Research and Development (R&D). As a common commercial adventure game, the graphics represent the locations in which the scenario is set: offices, lab, and production halls. The students have to discover by clicking on various objects on the screen what they should do next.

The Tasks: All tasks confront the team with a decision making task. To make a decision, each team member has to input into a Decision Support System his own vote and the computer calculates the teams' average. To make their decisions "educated", the team members need to consult the knowledge base. Each team member needs to

represent his role's interest in the decision process. The more "educated" the team's decisions, the more "money" they make selling sweaters at the final phase of the game.

The Knowledge Base: Contains all the content in a hypertext form. There are three possible access points: A direct access icon on the main panel that takes the player into the index, a "compass" that shows the player's position in the game and links into a relevant position in the knowledge base and the "consultant" who explains the task and proposes knowledge resources that can help. The "consultant" charges "money" for his advice.

The Flow Control Engine: Transparent to the players, the flow control limits the access to areas of the game that are not yet permitted, counts the players' "money" and charges them for expenses.

The Sweater game has been played in 6 educational centers throughout Israel over the past ten years. Ten thousand children and over 700 teachers assumed a role in the Sweater factory and played the game until its ending; they were excited, compared results and asked to come back or buy it (it was not for sale).

As no formal academic research has been conducted, the data provided here is based on the centers' logs and the counselors' observations as reported by the head of the project Dr. Shmuel Weiss.

Encouraged by the Sweater Game success, I have been using the instructional model behind it to design educational systems and training systems for many companies, military and government institutions in Israel, South Africa, US, Portugal, ever since. Amongst these projects you could find "burner maintenance" – An interactive videodisk project for the Israeli Electric Company, "F-15 fuel system" for the Israeli Air-Force, "Lost Passport" for the Israeli Ministry of Foreign Affairs, "Active Biology" – grade 6 biology of the heart program for IES in South Africa…

The model is simple: Engage a learner in a task with high energies, link the task with a need for prescribed knowledge to complete it and you get internal energies harnessed into learning.

A true to life example of how the model is applied can be observed at my "Computer Based Learning" graduate level course. This year long course and its lab is conducted along the model in several layers described in the following table:

	The Course	The Game	An Example (Scene)
Goal	Create an adventure game while learning instructional design, technologies, theories, models	Create Teachers' PD adventure game to engage teachers in exploring loaded educational issues and making a stand	Inquire "Bullying"
Tasks	• Collect Scenarios • Identify Themes • Define Decision Points • Build Knowledge Base	• Video Triggers (Boston Public) • Role Assignment • Team Decision • Narrative	• Watch a clip of a child bullied by a bigger one but too afraid to tell. • Choose a role: principle, student, parent, teacher • Participate in a team decision, support your views with knowledge and facts
Knowledge	• Theories • Philosophies • Models • tools	• Case Histories • Policies • Surveys • Interviews • Articles	• Case studies • Rules and policies • Survey data • Research findings • Personal experience and beliefs
Flow	Course Outline, instructor, students	Narrative and decision points	Each decision point will lead to another

Table 1: L-Tag as a model for Computers in Learning Graduate Level Course

As can be seen in the table, I have been using the model in a course that is using the model to construct a real learning environment. The game, produced by the students, serves as a task to engage them in learning the course topics, highlighting the link between curriculum and the model.

The energy level produced in the course is monitored and recorded by the students every day with a tool I created called ELM (Eye-Light Monitor), and is reported to me on a weekly basis. The ELM is not presented in this article as it has not been validated academically, yet – but the data collected show a constant maximal level of interest.

The Need

Having to face curriculum requirements, it is obvious that teachers have very little control over the student's curiosity. Imposed from governments, curricular content is not designed by students' interests and authentic needs. It is expected from the teachers to find a way to trigger the child's interest in the content, as interest is a required ingredient in intrinsic motivation and intrinsic motivation is required for meaningful learning (as stated so often in motivational research). Is this a fair expectation? Can teaches do that?! Our only hope to harness intrinsic motivation into a curriculum-based classroom-learning situation is the task itself. How do we create tasks that are compelling enough and still related enough to the curricular content?

The main potential contribution of this paper is the following claim:

If we can:

(1) Design and assign tasks that rely on human natural choice of engagement (like playing a game), (2) that are important for learners to perform (towards a desired goal like making the highest possible score of the game), (3) linking the curricular knowledge as a requirement for best performance (like making an educated decision within the game), will result in high level of engagement and more meaningful learning.

Consider a math class in which children are playing “supermarket” and need to estimate if they have enough money to pay for everything the want to buy.

The game, the task is the supermarket – an authentic, life like “adult” world that children like to imitate. The curricular content is “addition”, “subtraction” and even percentages that poses problems for many children as everything connected to “math”. The link is the need for knowledge to perform a desired task.

Getting back to the notion of a hobby: is everything we learn in order to master our hobby out of pure curiosity? Reflecting on my own internal dynamics, learning to play the cello at this stage of my life, with a lot of intrinsic motivation, for the sake of playing itself, I found myself investing huge amounts of energy in learning to read musical notation. I am not even a bit curious about notation. The only energy that keeps me learning it is the desire to play. The biggest distinction between “intrinsic” and “extrinsic” here is the relationship between the task and the knowledge – I need that specific knowledge in order to perform this most desirable task.

Isolating the notation learning task from the cello learning experience – presenting the most relevant question in curricular learning – can we assemble learning experiences that will connect curricular content and desirable tasks, so that when children perform the tasks (for the sake of the task itself), they will need content knowledge to do that and learn it for the sake of improving their performance? I argue that yes, we can.

The idea of intrinsic relationship between content and the game has been long discussed in the literature. Lepper and Malone (1987) have made a distinction

between the “fantasy” and the “content”. Identifying the “story” part of the educational game as “fantasy”, they refer to “endogenous” fantasy in which the content is embedded in the fantasy and “exogenous” fantasy in which content and fantasy are unrelated. The unique contribution of this paper is its unique interpretation of the link between task and content and the model it proposes for carrying these important ideas into a classroom application that every teacher can use in the design of curriculum-based learning activities. That link can be illustrated in the following statement: Make content (curriculum) a required tool for performing a desired task towards a desired goal.

Presenting this model to active teachers, usually generate a high level of interest with some frequently asked questions like: I am a Junior-high Math teacher. I have to prepare my students to a standardized test. How can I devote time to “games”? How can you apply the model and still prepare them for the test if what I need is to get them to exercise solving formulas?

Without stating my views of standardized tests and learning (it requires another article), an illustration of the model will show how everything is connected:

1. Find (with the students) a desired goal like “Plan and built a soccer field model for the school” (or any other project).
2. Design tasks and roles in the construction of the model and the real thing
3. Draw plans; calculate areas, materials, quantities…
4. Discover the tools you need including mathematic and geometry formulas
5. To use the tool, you need to master it

So: Mastering the use of a formula is required in order to use the formula in performing a desired task (assuming the task is desired) towards a desired (asuuming it is) goal.

Can teachers compete with professionally produced adventure games? How feasible is the model providing the lack of resources, diversity of students and overworked teachers? To answer the feasibility questions I will try to face to basic issues: Teacher's motivation and the nature of the game like learning environment.

How about teachers' need?

As presented in Table 1, the model is a double layer model. It is used in the design phase by the teacher or the student teacher and it is used at the product level – by the student. Teachers' task is the design of curriculum-based, learning modules. The task of designing a game like environment, where there's a constant need of creative ideas, keeps the designers (I've tried it with my own students) at a high level of interest and engagement. Can we assume that once this model becomes a general practice in lesson design, teachers' energy will be maintained? I feel that as long as teachers will see the results of their work sparkling in the eyes of their students, their engagement will remain high. This assumption is an important challenge for future research.

Are all games alike?

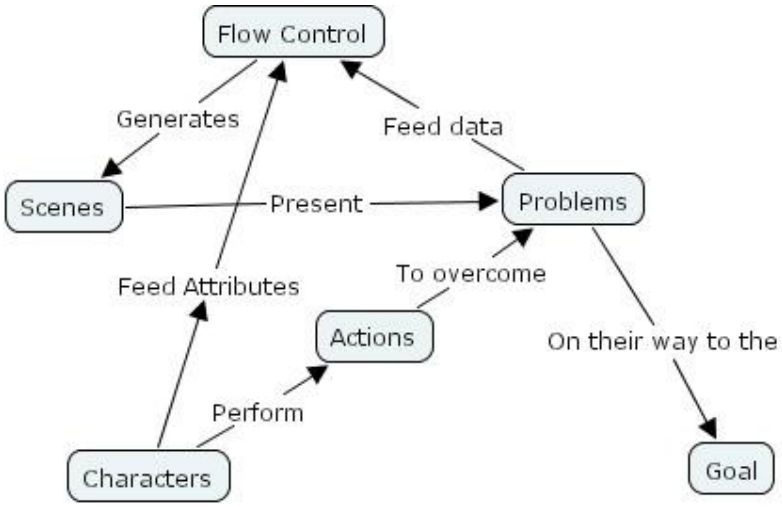
The need to generalize for the sake of theoretical articulation has brought some strange impositions into the games and motivation literature. Is an "arcade" type game similar to an interactive movie-like game? As this model relies on the link between

the task and the knowledge required to perform the task, the game genres that it is focused on are "adventure" games (Quests), RPG (Role Playing Game) (Wikipedia, 2005) and simulation games.

Learning and "Quests"

This paper proposes an adventure game model. It proposes a model for incorporating curricular content into a "Quest[1]"-like environment. "Quest" is a computer-games genre that has been around since the early days of computers and involves the player in a plot in which he plays a role and needs to overcome obstacles on his way to the final goal. Quests are a form of RPG (Role Playing Games).

Let's look at a model of a generic "Quest" game:



[1] Not to be confused with "Web-Quest" – an educational program for the development of inquiry based learning activities.

Figure 2 – Basic Quest Model

A player selects a **character** (a role) and in some games can select attributes to the character like intelligence, physical force, the ability to perform magic, etc. and proceeds to the first **scene**. In the scene, the player is tackled with a **problem** he has to solve by performing an **action**. The action is fed to the **flow-control** engine that generates another problem or another scene, depending on the action, the scene and the character's attributes. The main goal is achieved (or not) through various possible paths.

The motivating power of a Computerized Quest Game is well recognised and the market for different types of computer games is growing: 7.3 Billion Dollars in 2004 - 16% of which is classified under "Role Playing" and "Adventure", 26.9% is classified as "Strategy" – that can be implemented as a "Quest" (ESA 2005). The production costs of a sophisticated Quest game today are enormous. Commercially producing quest game can carry a price-tag of millions of dollars. How can we assume this type of a venture in educational settings?

This paper attempts to show that the essential motivating energies of a quest game are transferable to a classroom setting. Quest-like learning games can be produced by the teacher and the students with no need for additional funds.

Looking at a typical quest of these ages we see real-life like scenes, professional actors as characters, interactive three dimensional graphics and custom composed

music and sound effects, artificial intelligence software engines… Need these be the basic attributes of a highly motivating game?

Attempting to identify motivating "features" of games, Asgari & Kaufman (2004) listed a collection, assembled from the works of Malone, Malone and Lepper, Waal, Snider, Myers, Vorderer & Hartmann, Vockell and Garris. These features are: interactivity, competition, control, curiosity, challenge and feedback. Additional attributes like appearance, imagination, narrative, self-identification and cooperation were added by me, based on my own experience with the "Sweater" game (author, 2005) – a learning adventure game I developed over ten years ago that motivating energies have not faded yet.

Appearance: Introspecting on the times that computer adventure, role playing games were textual only, I can still remember the addicting power they had. I still remember crawling through endless caves in total darkness, being attacked by a vicious troll (and yes, it was all text based), playing for hours, surrounded by maps, lists and friends engaged as I was trying to avoid the next obstacle – and we were adults! It is suggested that the appearance of the game will have a short term effect on the player and will increase the likelihood of initial attraction. As there is no limit to the graphic representation of the game with 3D animation and interactive video, the distinction between games related to their graphic appearance can be found anywhere between the two extremes: No Graphics -------- Highly Graphic. I suggest that it's similar to the distinction between a book and a movie as 'story telling' media.

Imagination: Malone (1981) includes "fantasy" amongst the most important attributes of the game, writing about "intrinsic" game in which the fantasy is an integral part if the game and "extrinsic" in which there is no relationship. In an article with Lepper (Malone and Lepper – 1987) they rename the terms and call it "endogenous" and "exogenous". Asgari & Kaufman (2004) found that fantasy can indeed serve as a "hook" to engage a learner, but cannot sustain motivation and other features of the game should take over as motivators once the "hook" is "hooked". I will argue that the term "fantasy" is not too relevant to the energy of the story beyond the game as an intrinsic motivator. The story is highly important as it places the player in the imaginary setting of the role. The more room there is for the player imagination to produce a vivid image of which the player is a part, the more energy will be carried throughout the game. A good example is Harry Potter. The motivating energy of these books is phenomenal. Children have rediscovered reading all over the world. One might have expected that the books sales will drop once the Harry Potter movies were introduced – but no such thing. Every new book is a new international celebration.

Fantasy: I have not been using the term "fantasy" to describe the game layer of my model as I feel that the term carries unrelated connotations to a learning environment. I will be using the term "story", referring to the story behind the game. I aim to show that if the "story" is the "content", it is paving the road to an endogenous relationship between the game layer and the content layer, saving the need to treat three layers: the game, the content and the story.

Collaboration: Using SDG (Single Display Groupware), a term used to describe collaborative teams using one computer as a shared environment, Stewart (1997) and

Bederson, et al., (1999) show how children prefer working with each other rather than working alone. These findings support the assumed motivational power of the group as can be observed in so many childrens games. Children prefer to play together – why not provide them with this opportunity in school? The Sweater Game is an SDG. Does the implementation of the model require SDG? This question is now being researched amongst others that are presented in the following section.

Current and Future Research Directions

Up to this point, I have argued that there is a need for a better understanding of learning energy in a curriculum based learning environment. I've argued that this energy cannot be searched for in the content, as content is imposed; our hope is to harness it by engaging learners in activities we know they like to perform. As common sense and motivational research show us – children like to play. The model presented in this paper suggests that if play is the task and we can link the task to curricular knowledge that is required to perform the task, children will be engaged, especially if the task leads them towards a desired goal.

The most crucial question that needs to be addressed next is related to the diversity of children: How can we match tasks with different children styles? How can we identify different styles of motivation?

Reiss (2004) proposes a theory of 16 basic desires. He identifies 16 motives in human nature that upon satiation produce a internal feeling of joy. Reiss hypothesises that these desires are of different strengths in different people and can be identified to form an individual profile of motivation and developed a scale to measure this profile:

Reiss Profile of Fundamental Goals and Motivational Sensitivities. The next phase in the research of the model proposed in this paper is to test Reiss profile as a mapping tool of different children profiles and match these profiles with suitable engaging tasks. This research is now in progress.

As this paper is an initial introduction to the Theory of Need, it is laying the foundation for extensive research that will be based on this model and the game. One area of research will focus on the role of virtual and face-to-face communication channels in generating learning energies. This research is needed in better understanding intrinsic learning energies and group dynamics in the blooming field of eLearning. Other research foci are the role of energisers that can be brought into an "imposed content" learning environments like engaging tasks: what types of tasks can be assigned within a school environment that will engage children enough to make the curricular content a real need? How are tasks related to learning styles and personal preferences (as mentioned above)? How do different narratives (the story beyond the game) relate to different interests and personalities?

References

Author (1992)

Author (2005)

Asgari, M. & Kaufman, D. (2004). Intrinsic Motivation and Game Design. Paper presented at the 35th Annual Conference of the International Simulation and Gaming Association (ISAGA) and Conjoint Conference of SAGSAGA, 6 -10 September 2004 Munich, Germany

Bederson, B. B., Stewart, J., & Druin, A. (1999). Single display groupware. Department of Computer Science Technical Report CS-TR-4086, Institute for Advanced Computer Studies Technical Report UMIACS-TR-99-75. College Park, MD: University of Maryland.

Computer role-playing game (2005). Wikipedia, The Free Encyclopedia. Retrieved December 6, 2005 from http://en.wikipedia.org/wiki/CRPG#History

ESA (2005). Essential Facts about the Computer and Video Game Industry, Entertainment Software Association.

Lepper, M. R., & Malone, Th. W. (1987). Intrinsic motivation and instructional effectiveness in computer-based education. In R. E. Snow & M. J. Farr (Eds.), *Aptitude, learning, and instruction: Vol. 3. Conative and affective process analyses* (pp. 255-286). Hillsdale, NJ: Lawrence Erlbaum.

Malone, Th. W. (1980). What makes things fun to learn? A study of intrinsically motivating computer games. Ph.D. dissertation, Stanford University

Malone, T., W. (1981). "Toward a Theory of Intrisically Motivating Instruction." Cognitive Science 4: 333-369.

Mills, R. C. (1991). A new understanding of self: The role of affect, state of mind, self-understanding, and intrinsic motivation. Journal of Experimental Education, 60, 67-91.

Reiss, S. (2004). "Multifaceted Nature of Intrinsic Motivation: The Theory of 16 Basic Desires." Review of General Psychology **8** (3): 179-193.

Reiss, S. (2005). "Extrinsic and Intrinsic Motivation at 30: Unresolved Scientific Issues." The Behavior Analyst **28**(1): 1-14.

Stewart, J. (!997). Single Display Groupware. CHI_97 - Conference on Human Factors in Computing Systems, Atlanta, Georgia.

This article discusses the interrelations between ideology, politics, pedagogy and curriculum theory and their possible impact on curriculum transformations. Indeed the development of Secondary School Curricula in Israel supports an observed notion that curricular developments are not independent activities. They are rather organically rooted in conceptions about the nature of society, the place of the individual and the role of education. Changes in curriculum depend also on assumptions about the nature of knowledge, the inherent tension between the process and content of learning, curricular ... Learning about science involves developing knowledge and understanding of: the material and physical world; the impact science makes on life and on the environment; scientific concepts; scientific enquiry. In addition, learners need to develop the accurate use of scientific language. For example: Biology Describing characteristics: Plants have three main organs: leaves, stems and roots.Â These questions encourage learners to express opinions about the effect of science on the environment. In multilingual contexts, it is important to encourage learners to find out about plants found in their home countries as they can learn the names of a wider range of plants, and discussion can take place about conditions in which different plants grow well. 4. From my knowledge of curriculum, and education(as a field) I would say it would be better to look at the learning and behaviour area of psychology, as well as game theory/mechanics. Other aspects that need to be thought of, is what is your goal? Are you looking to make money and have more students enroll? Are you trying to increase retention?Â What is missing from the curriculum that needs to be improved? Is it the curriculum, or the way that it is taught? In general I would say that most curriculum that I have seen largely is out of date, poorly edited, taught verbatim, does not allow for interjection and proper flow or train of thought, and is often created to specifically weed out the unfavourables. Bring things up to date.