Addressing Different Learning Styles With Game Maker and XNA

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ABSTRACT
Post-graduation courses in game development are by its own nature multidisciplinary, since they include classes about texturing, 3D modeling, audio production, and others, along with the core programming classes. Such characteristic attracts students from different graduation courses; including courses with quite different teaching styles from Computer Science courses (such as Arts courses). This paper discusses some different learning style models and associated teaching techniques, and presents an approach on how to integrate students with different learning styles in game development post graduation courses through the use of Game Maker and XNA.

Categories and Subject Descriptors
K.3.2 [**Computers and Education**]: Computer and Information Science Education --- *Computer science education, Information systems education, Curriculum*; K.8.0 [**Personal Computing**]: General --- *Games.*

General Terms
Human Factors, Theory, Experimentation, Languages.

Keywords
Game Maker, XNA, Teaching Styles, Learning Styles, Post-graduation courses.

1. INTRODUCTION
Post-graduation courses in game development are by its own nature multidisciplinary, since they include classes about texturing, 3D modeling, audio management, and others, along with the core programming classes. Such characteristic attracts students from different graduation courses; including courses which teaching styles are quite different from Computer Science courses (such as Arts courses).

While is not our post-graduation course goal to turn non-Computer Science students into expert game programmers, we believe that it's important for all students to understand the basics on game programming and establish a common vocabulary before they start specializing in his own areas (graphics or programming).

To integrate students with such different backgrounds presents many challenges, and we believe that the most difficult ones are to keep the students interested and to help them to learn whichever are their backgrounds and learning styles.

In this paper we start by analyzing some common learning styles models and describing some practical teaching techniques, which can be applied in any kind of class.

In the second part, we present our approach on how using Game Maker and XNA to fulfill different learning styles and thus motivate students with largely different backgrounds.

While there is still space for improvements in the suggested approaches; and still we need to follow up the use of these methods in future classes to prove their benefits, the first results point to improved students' results, satisfaction and commitment.

2. LEARNING STYLE MODELS
Looking for theoretical formulations to help us defining which pedagogical methods would be best to integrate students with largely different backgrounds, we find out that dozens of models for understanding and organizing learning styles were developed, and there is no consensus on each one is best. Worst yet, there is a huge controversy about the theoretical basis for learning styles, and even around the concept of what the term "learning styles" really means. For the scope of this paper, we will stick to Rita Dunn's definition for learning styles [1]: "Learning Style is the way in which each learner begins to concentrate on, process, and retain new and difficult information".

While there are some studies pointing out that the learning styles theory do not have a solid instrumental base, and even that instruments used to assess some learning style models may be biased [2], there are also a number of studies presenting significant data about the

validity of such models and instruments, such as the use of Index of Learning Styles [3] to asset the students preferred learning styles according to Felder-Silverman model [8] for teaching and learning styles in engineering education.

Despite learning style theory and associated models having or not the proper theoretical background, it's almost a consensus that taking approaches to address a broader range of learning styles improve students commitment and effectiveness, when compared to classical classes, which are mostly lecture-based. Therefore, the approach suggested in this paper is to understand some of the most common learning models and use them as if they are proven practices, since the students will surely benefit from fresh approaches on teaching styles; while remaining open to review this position if any new, improved theory and models appear.

In the next section we present a very brief description of some of the most common learning style models, along with some insights about teaching styles that can be used do address different learning styles on each model.

2.1 VAK Models

The concepts on VAK (Visual – Auditory – Kinesthetic) models where developed by psychologists early last century, such as Montessori in 1912, Fernald in 1943, Strauss & Lehtinen in 1947 and Gillingham & Stillman in 1960 [4], and presents some variations and extensions such as VAP (Visual–Auditory–Physical), VAKT or VACT (Visual–Auditory–Kinesthetic/Tactile), VARK (Visual–Auditory–Reading–Kinesthetic), and others.

While the original theorists were looking for ways to teach children with learning difficulties, their principles where later extended to broader audiences, including all ages students.

The basic idea behind this theory is that people learn through three different channels, and each person has a dominating or preferred learning style. The following table presents some teaching techniques to support to each style.

Table 1. Teaching techniques for VAK learning styles

Learning Style	Teaching Technique
V – Visual	▪ Present slides with key points; ▪ Use diagrams, charts and illustrations; ▪ Use a mind map or hierarchical representation to show how the presented concepts are related.
A - Auditory	▪ Usual lecture classes are fine for them; ▪ Present questions so they can talk and explain their point of view; ▪ Include groups discussion activities;
K - Kinesthetic	▪ Include group activities, and let the student reorganize the classroom to provide some movement and physical activity; ▪ When possible, provide physical samples for the topics explained (such as toys or miniatures); ▪ Give candies or other gifts for right answers; ▪ Provide handouts, and suggest them to highlight the key points.

2.2 Kolb's Model

Kolb's theory [5] states that learning is a four-stage cycle: Concrete Experience (CE); Reflective Observation (RO); Abstract Generalization (AG) or Conceptualization and Active Experimentation (AE) or Testing. According to Kolb, the learning process typically initiates with a concrete experience and then go on cycling through all stages, in the presented order; but he also states that depending on the student preferred learning style, the learning can initiates in any stage.

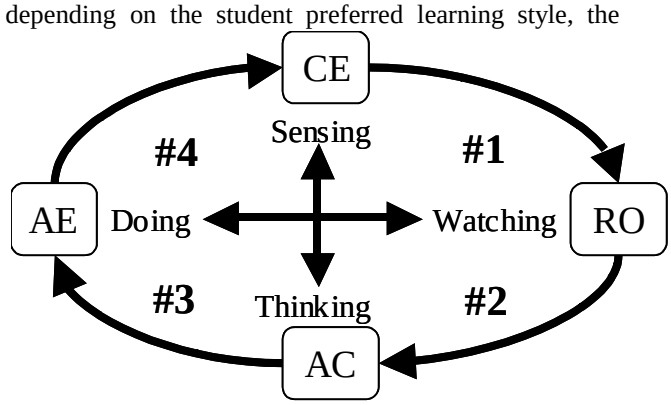

Figure 1. Kolb's Experimental Learning Model

Kolb organized these styles in two main axes, relating them according to the stage where the learning is more prolific for each student: Sensing/Feeling (for CE stage) x Thinking / Concluding (for AG stage), and Reviewing/Watching (for RO stage) x Doing/Planning (for AE stage). Figure 1 presents a graphical representation of Kolb's Experimental Learning Model, along with numbers representing each type of learner according to Kolb's theory, detailed in the next list:

- #1 – Diverger or reflector: strong in concrete and observation areas, these are the students who learn by matching what is being taught against his experiences and interests;
- #2 – Assimilator or Theorist: strong in abstract and observation areas, these are the students who learn by relating topics and organizing ideas in a logical way;

- # 3 – Converger or Pragmatist: strong in abstract and experimentation areas, these are the students who learn by experimenting in a practical way the abstract concepts learnt in classroom;
- # 4 – Accommodator or Activist: strong in concrete and experimentation areas, these are the students who learn by exploring new ideas based on the material presented in class.

In the following table we present some teaching techniques meant to fulfill the needs of each type of learner as classified by Kolb's Experimental Learning Model.

Table 2. Teaching techniques for Kolb's model

Learning Style	Teaching Technique
Diverger	▪ Include time for reflection and students' comments after lectures; ▪ Ask students how they would apply the presented knowledge to solve problems they faced.
Assimilator	▪ Present an overview on how the current topic relates to other topics viewed in class; ▪ Provide homework including theory reading.
Converger	▪ Ask students for ideas on practical applications on the presented topic; ▪ Include practical exercises – in class or home – applying the knowledge presented in class; ▪ Give the leaner some freedom to try out and ask for doubts on topics beyond class.
Accommodator	▪ Include group activities with practical applications about the subjects viewed in class; ▪ Offer challenging exercises, where the student must look for a creative solution.

2.3 MBTI Model

The Myers Briggs Type Indicator® (MBTI) is the most widely commented and used model based on Carl Jung's ideas about distinct personality patterns[6]; followed closely by Inscape Publishing DISC® (Dominance, Influence, Steadiness, and Conscientiousness) Model.

In MBTI, learners are scored in one of four dimensions, and the results indicate their learning preferences:

- Extroversion x Introversion: talking, interacting with people and environment *versus* reading, listening and reflecting;
- Sensing x Intuition: Understanding and memorizing facts and details, like practical approach *versus* looking for inspiration, trying to understand associations and general concepts;
- Thinking x Feeling: Understanding the logical rules behind the facts, making personal judgments *versus* looking for others' opinions, favor results which affect people;
- Judging x Perception: Having a good idea about where each piece fits in a whole, organizing things out *versus* having space to explore, to go beyond the pre-organized concepts, looking for related data beyond the presented scope.

Since learners can be strong in any combination of these dimensions, there are sixteen MBTI classifications for learners, which are well explored and detailed by Lawrence [6]. A good summary of Lawrence's concepts is presented in Appalachian State University web site [7].

While is beyond the scope of this paper go through teaching techniques recommended to all MBTI types, table 3 presents some approaches for each dimension of the model.

Table 3. Teaching techniques for MBTI's model

Learning Style	Teaching Technique
Extroversion	▪ Ask for students' opinion; ▪ Make students explain what was taught in their own words; ▪ Group classroom dynamics.
Introversion	▪ Provide home or class exercises with time to think and explore; ▪ Offer extra material for reading at home.
Sensing	▪ Present the goals and the final results before entering the details; ▪ Provide hands-on exercises to reinforce the theoretical points.
Intuition	▪ Present some extra and exciting ideas on how the knowledge presented can be applied; ▪ Present concepts and ideas with some degree of abstraction; ▪ Provide homework that allows exercising the imagination.
Thinking	▪ Present an organized view of the topics; ▪ Provide feedback on student results and objective suggestion on how to improve.
Feeling	▪ Provide classroom dynamics which allow students interact with each other in small groups; ▪ Show examples on how the subject being taught can improve people's life.
Judging	▪ Provide exercises with clear goals;

	▪ Present the objective criteria which will be used to evaluate students; ▪ Organize the classes and present their planned schedule to students.
Perception	▪ Provide liberty to students to suggest new exercises or to ask about topics beyond the class schedule; ▪ Break down complex activities or exercises in small assignments with their own deadlines to keep them on track.

2.4 Felder-Silverman Model

Felder-Silverman (F-S) learning and teaching styles were first presented as a five-dimension model, focused in engineering education [8], but was later tested in different audiences [3, 9] and adjusted by the authors to comprise only four dimensions:

- Sensory x Intuitive: what type of information does the student preferentially perceive - sensory (external impressions) or intuitive (insights, deductions, etc);
- Visual x Verbal: Which sensory channel is most effective for the student – visual (graphics, charts, etc) or verbal (words, spoken or written);
- Active x Reflective: How the student prefer to process the information – Actively (discussion or practical application) or reflectively (analysis and introspection);
- Sequential x Global: How the student evolves toward understanding – sequentially (in continual steps) or globally (holistically, in large jumps).

The following table presents some suggested teaching techniques to address all Felder-Silverman learning styles.

Table 4. Teaching techniques for Felder-Silverman model

Learning Style	Teaching Technique
Sensory	▪ Present real-world applications on each subject; ▪ Provide hands-on exercises to reinforce the theoretical points.
Intuitive	▪ Present concepts and ideas and show how they are connected; ▪ Provide open-ended homework that allows exercising the imagination.
Visual	▪ Present slides with key points; ▪ Use diagrams, charts and illustrations.
Verbal	▪ Provide reading and writing assignments; ▪ Let the students rise questions and explain what was taught in their own words;
Active	▪ Make students work in groups; ▪ Provide practical, hands-on exercises.
Reflective	▪ Provide homework assignments where the students have to explain his conclusions on the subject; ▪ Provide short breaks or provide time for reading the material between subjects.
Sequential	▪ Divide the lectures in discrete steps, highlighting the key points on each step; ▪ Present the ideas in a logical, organized way, from the simpler to the more complex concepts.
Global	▪ Present reviews on each class, highlighting key topics and how they are related; ▪ Offer links to extra material that can provide different approaches on the subjects taught.

3. CHOOSING THE RIGHT TOOLS

After analyzing some common learning styles models, we had to choose the tools which could provide the wider range of possible learning approaches, or, in other words, choose the tools which are flexible enough to help us addressing different learning styles. The only restriction was to choose only free tools, so all the students could install and learn from them at home free of charge – which let out some popular tools, such as Flash, used for creating games hosted in internet browsers.

The approach for choosing the tools was listing the high-level game creation tools we know about and checking these tools against the "base rules" we wanted to follow in the course disciplines (listed in 4.1 section in this paper), so we can see which tools would be a better fit to our purposes.

The chosen tools were Game Maker and XNA.

Game Maker is a tool that allows creating games in a drag-and-drop environment, created by Mark H. Overmars, from the Department of Computer Science at Utrecht University, in Netherlands. The tool, which includes a powerful programming language for advanced users, is being used to teach students from elementary schools to universities [9].

XNA is a new game-programming framework offered by Microsoft, which provides a very high level of abstraction on the underlying infrastructure, so the programmer can concentrate on his game details. It allows the creation of games that run in Windows operating system and XBox 360 console, with minimal or no changes [10]. XNA simplicity, allied to its multi-platform facility, is generating hype among the non-professional game development community, which is

taking many graduated students back to university in search of game development specialization courses.

4. ADDRESSING MULTIPLE LEARNING STYLES WITH GAME MAKER AND XNA

Since we found no data about results on applying any of the previously presented teaching techniques in game development courses – which are highly multidisciplinary – we choose to define some "base rules" (listed in 4.1 section in this paper) to be followed in the disciplines of our game development post-graduation course, according to our knowledge on the teaching techniques, on XNA, Game Maker and other similar tools, and previous experiences in previous game development classes.

We expect to follow-up the results of applying the defined rules, according to evaluations on the students and teachers' perception and students' grades, so we can further have information to improve our approach.

This base rules are meant to be strictly followed at the course disciplines on "Introduction to Game Development" (using Game Maker) and "Introduction to Windows and XBox 360 Game Development" (using XNA); so we can have a more precise feedback on if using such approaches would (or will not) effectively improve the students interest and effectiveness.

We also present these rules as suggestions for teachers of the other disciplines of our game development course, so they can eventually improve his teaching styles and be aware of students having different preferred learning styles.

We believe that these disciplines should be the first two disciplines in any game development course, because we believe they prepare the students to the following, more complex disciplines.

4.1 Common Teaching Techniques

Both classes shared some common techniques, as explained in following list:

- Start each discipline by explaining its objectives and presenting some expected results, both from pre-made examples and from students of previous courses. Also presents what will be covered in each class (leaning styles: VAK Visual; Kolb Assimilator; MBTI Thinking and Judging; and F-S Intuitive and Sequential);
- Also in the beginning of the course, present the evaluation criteria (MBTI Judging);
- Start each class by explaining the class objective, agenda and how the topics are related to the general course agenda (Kolb Assimilator, MBTI Sensing and Judging; F-S Intuitive and Sequential);
- Ask the students for new topics they want to be explored in the next classes (Kolb Converger; MBTI Extroversion and Perception; F-S Intuitive);
- Stimulate students to bring to class extra material (magazines, examples, etc) to present and share with their pairs (VAK Kinesthetic; Kolb Converger; MBTI Extroversion and Perception; F-S Intuitive);
- Include reviews at the beginning of each class (Kolb Assimilator; MBTI Thinking and Judging; and F-S Intuitive and Sequential);
- Present the class with slides with key points, including graphical views of the explored concepts when possible (VAK Visual; F-S Verbal and Sequential);
- Provide slide handouts with space for students make their notes, and stimulate them to make such notes, highlighting key points and additional information in the lecture (VAK Kinesthetic; F-S Visual);
- Explore Game Maker visual representation for abstract concepts: Objects and instances, events, sequential flow of execution, selection (if) commands, variables (life, health), etc (VAK Visual; Kolb Accommodator; MDTI Sensing; F-S Sensory, Active and Visual);
- Create practical examples for each class and present them before the theory (Kolb Accommodator; MBTI Sensing and Perception; F-S Sensory and Global);
- Evaluate the students with a practical task: creating a simple game. In Game Maker course, the task is individual (Kolb Diverger; MBTI Introversion and Sensing; F-S Sensory and Reflective), while in XNA, students work in small groups (Kolb Accommodator; MBTI Extroversion, Sensing and Feeling; F-S Sensory and Active);
- Relate the XNA code with visual elements previously taught in Game Maker classes (VAK Visual; Kolb Assimilator; MBTI Sensing; F-S Sensory and Visual);
- In every Game Maker class, provide a classroom dynamic where the student are challenged to use the viewed concepts on creating an objective but open-ended practical result by himself, and continuing the exercise as a homework assignment (Kolb Converger;

MBTI Introversion and Sensing; F-S Sensory, Intuitive and Reflective);

- At XNA course, use a similar classroom dynamic but let the students work in pairs or in small groups (Kolb Accommodator; MBTI Extroversion, Sensing; F-S Sensory, Intuitive and Active).

5. CONCLUSION

While certainly there is space for improvement, using the described teaching techniques do improved the students' motivation and results when compared with previous courses, which started with classic, (mostly) lecture-only classes on introduction to game programming.

Since the supporting material (slides, notes and examples) created for the Game Maker and XNA disciplines is meant to level students' basic knowledge, it's mainly focused in introductory concepts, so we included these classes in the newly created graduation course on digital game development.

We also believe that these disciplines may be successfully used in Computer Science regular graduation courses to help motivating students with different learning styles to understand abstract concepts, and diminish course evasion in the first year.

As a final note, we want to state that the materials from XNA and Game Maker disciplines are open to be used by the academic community, and that we are also open for suggestions on improving our ideas and approaches.

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