THE EFFECT OF PERSONALITY TYPE ON THE USAGE OF A MULTIMEDIA ENGINEERING EDUCATION SYSTEM

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Abstract — *Multimedia education has quickly entered our classrooms and offices providing tutorials and lessons on many different topics. The assumption that most people interact with these multimedia systems in similar ways can easily be made, but are these assumptions valid? What factors determine whether students will embrace computer-based multimedia-augmented learning? One factor may be a student's personality type. This paper explores the reasons why some students may enjoy learning using computer-based educational delivery systems while others may have absolutely no enthusiasm for this type of learning, and how that enthusiasm may relate to the students' personality types. The paper first explains the Digital VideoJockey – Version 2 (DVJ2) educational multimedia system in place at the School of Electrical and Computer Engineering at Purdue University, and then discusses the learning needs and expectations of different personality type characteristics. An analysis of students' personality types and their DVJ2 system usage follows, and a discussion on possible ways to improve the DVJ2 system in light of this analysis concludes the paper.*

Index Terms — Multimedia education, technology-based education, personality type, computer system usage.

INTRODUCTION

Why are some students extremely enthusiastic about using computers and multimedia for their primary or auxiliary source of information in a course—some spending over thirty hours a semester for one course watching digitized video lectures? Why do others so dislike multimedia education that they feel it actually hinders their progress in a class, while others are rather indifferent and only use multimedia systems occasionally?

An answer may lie in a student's personality type. In his work to understand student motivation and learning style, Gordon Lawrence has come to the conclusion that personality type is fundamental to how individuals interact with their surroundings [4]. In this paper, we will explore how a particular educational multimedia testbed system addresses different types of learners. The intent is to explore whether certain personality types are more likely to use this type of educational resource. Based on these findings, we can begin to identify how the learning needs of different personality types are being met, as well as determine certain learning needs that are not being met and propose remedies for the perceived deficiencies.

This paper is organized in the following manner. After a brief description of related work, a general introduction of the Digital VideoJockey – Version 2 (DVJ2) system is presented. Described next are the learning needs and expectations of different personality type characteristics, along with an explanation of how the students' types were evaluated and how students' statistics were collected. The results of statistically analyzing the relationships between students' system usage statistics and their personality type are then presented. An analysis of how the DVJ2 system matches the needs of different personalities is then provided, followed by some concluding remarks on improvements that could be made in light of this analysis.

RELATED WORK

Many book chapters and papers have been published on educational methods and students' personality types. Most notable are chapters in [4] and [11] and the books [3] and [8]. Very little research, however, has been conducted that attempts to understand the connection between computer usage and personality type. Reference [2] has a section in which the authors briefly describe the types of computer activities that appeal to students with certain personality types. Also Fuller, Norby, Pearce, and Strand published a paper studying the types of professors that like to teach Internet-based courses [3].

THE DVJ2 SYSTEM

The DVJ2 system is a fully digital educational multimedia delivery testbed system developed at the School of Electrical and Computer Engineering at Purdue University. On-line since 1998, DVJ2 delivers high resolution (640x480, 30 fps) MPEG videos at a 2.5 Mbs streaming rate to networked PC clients. The server runs Starlight Networks *Starworks* Video Server under Windows NT, and employs a fiber-arbitrated RAID storage subsystem. The current license permits up to

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forty 2.5 Mbs video streams to be served simultaneously. A direct conection to the campus ATM fabric permits the DVJ2 system to be used anywhere in the world a high enough bandwidth network link is available. To facilitate logging of usage statistics, DVJ2 employs a helper (plug-in) application for Netscape Navigator and Microsoft Internet Explorer browsers. In this study, most students used any one of a number of PCs available in the Electrical & Computer Engineering labs at Purdue to view the videos (note that MPEG-1 format is used to facilitate software decoding of the videos; "older" PCs had been equipped with special MPEG decoding cards, which no longer appear to be necessary gievn the inherent multimedia capabilities of current PCs).

The menu of videos is presented on web pages that are hyperlinked to the video files on the video server. When a video is selected for viewing, the DVJ2 helper (plug-in) application is launched and students have full control of the video just as with video tapes (play, scan forward, scan backward, pause, stop, etc.). Students have access to all of the lecture videos for the entire course throughout the semester, and multple students can view the same video concurrently. The videos have highlight points (like media bookmarks) that allow quick access to different parts of the media. As part of the course material, students have a Lecture Workbook that has templates ("skeletons") of the lecture notes. Students are expected to annotate their personal copy of the Lecture Workbook as they follow the material presented to them.

The mission of the DVJ2 testbed system has several facets. First, the system was developed to provide students with convenient, creative, and innovative technology-based methods to help them learn engineering course material, gain alternate perspectives on certain topics, and review for exams. Also, the system was deployed to better understand how students use multimedia educational systems and evaluate the effects of information technology on students' learning. Finally, deployment of the DVJ2 system was intended to help acclimate students to technology-based systems and methods that are used for life-long learning. Many corporations and institutions have embraced the use of multimedia educational systems for on-the-job, just-in-time learning. By allowing students to experience how thoughtfully developed multimedia educational systems can be used to conveniently learn pertinent material, the use of technology-based systems as a viable method for life-long learning is promoted.

Analyzing how students use the DVJ2 system has reinforced some expectations of how students use educational multimedia systems, while rebutting other expectations [9, 10]. As we expected, students generally followed the structure of the course material when they viewed lecture videos [10]. However, a surprising number of students accessed modules that were related but much earlier or later in the course coverage. Also surprising was the fact that over fifty percent of all video sessions are shorter than 300 seconds (five minutes) [9, 10]. This finding suggests that students often played sections of lecture videos that gave them the information they needed, perhaps to answer a homework question or to clarify a concept that they did not understand in a lecture.

THE DVJ2 SYSTEM AND PERSONALITY TYPE

Type theory was developed by Carl Jung as a means for explaining how individuals prefered to interact with the world around them. The applications and theory was extended by Katherine Briggs and Isabel Briggs Myers [11]. According to type theory, there are four dimensions that constitute an individual's personality type. This section explores these four dimensions and how one might expect students with each of these type dimensions to interact with educational multimedia systems.

As in most analyses of personality type, there is no clear-cut answer for what types of students will do well with an educational multimedia environment and which will not. In every set of students, there will be a spectrum of degrees as to how much each student likes or dislikes using the multimedia systems. However, by knowing a student's personality type, we should be able to predict, to some degree, how much each student will either embrace or reject such a method of learning. We must also keep in mind, though, that just because a student is a certain personality type does *not* mean that the student cannot and/or does not function in an alternate mode. For example, extroverted students usually spend time contemplating ideas on their own as an introverted student prefers to do, but the extroverted student might just not be as comfortable or as energetic about doing so as the introverted student is.

Let us first look at each of the four type dimensions and discuss how the different types might interact with the DVJ2 system.

The student's natural interests are shown in the extroverted-introverted dimension [4].

- **Extroverted types** focus on people and things, are active, and rely on the environment for stimulation. They prefer discussion and group work [4].
- **Introverted types** are reflective, are more in tune with their inner world, and focus on ideas and concepts [4].

The DVJ2 system is more interactive than reading (which is a very introverted method of learning), yet not as extroverted as discussions with other students and teachers. Also, the main method of asking questions is e-mail, which is not as personal as an extrovert may prefer. For introverts, DVJ2 offers time to reflect and draw relationships since students can pause (and rewind) the media. So there is more time for introverted reflection than in a regular lecture. These factors would make an introvert more likely than an extrovert to use the DVJ2 system.

The sensing-intuition preference reveals the student's basic learning style [4].

- **Sensing types** generally trust in the conventional and customary way of doing things. They prefer practical experience over theory and rely on concrete experiences to learn. They also prefer to learn by systematically acquiring facts and developing relationships between those new facts and old facts they have already acquired [4].
- **Intuitive types** prefer to see abstract, symbolic, and theoretical relationships and see future possibilities. They are interested in the new and untried and they rely on inspirations and prefer to learn material in "fits and spurts" of grasping meanings and relationships. Also they like learning on their own initiative [4].

The DVJ2 system caters to both sensing and intuitive students. By having outlines and menus of the modules, sensing types are presented a systematic learning tool. Also, sensing types are learning by doing by using the Lecture Workbook to fill out examples as they are presented in the on-line media. However, the sensing students may not be satisfied with the number of examples that are on-line. ("You can never cover too many examples.") Also, they may want more tangible examples and/or exercises to help them learn. Intuitives can learn at their own pace and can go exploring with the DVJ2 system. The cross-references and highlight points within the media allow the intuitive students to forge their own learning path at their own pace.

The thinking-feeling dimension shows the student's tendencies of commitment [4].

- **Thinking types** are quite analytical and logical in making judgments. They rely on facts to learn. They need a logical order in how material is presented. Thinkers need to reach a sense of mastery of the material and need to "persist and prevail" in reaching their goals [4].
- **Feeling types** take subjective values into account when making judgments. They tend to rely on personal relationships with teachers and other students to learn. These students need support and approval from their instructors and other students and also need to be needed and be helpful to others. They work best in groups and work especially well with friends [4].

In this dimension the thinking types have the advantage as with any technology-based educational system that places distance between the teacher and the student. Professor-student interaction is not as available as in a conventional lecture as feeling types would like.

Work habits are shown through the judging-perceiving dimension [4].

- **Judging types** work toward goals and want a clear work plan to follow. They need structure and orderly sequences of study. Within this need for structure, they also like to see their accomplishments through meeting milestones and goals. In meeting these milestones, they look for systems of accountability that are established and made known [4].
- **Perceiving types** resist closure and want to be able to keep all options open. They sometimes procrastinate and get things done in a rush as the deadline nears. They need variety and flexibility in instruction and look to be spontaneous and follow their curiosity [4].

In this dimension both types of students are equally well served. Judging types have an orderly structure with which to study using the media hierarchy of the DVJ2 modules. But, there is no direct method of accountability for watching DVJ2 media; students, though, are held accountable to learning the material with other class activities such as homework, labs, and exams. Perceiving students have a great deal of flexibility with the media on the DVJ2 system. However, the possibility of procrastinating can be detrimental to the student's learning if they try to watch more media than the time before an exam would allow. Again, though, these students are ultimately held accountable by their performance on homework, labs, and exams.

So overall, what do these observations tell us about who will most likely use or not use the DVJ2 multimedia system? The three dimensions that seem to determine best whether students will like using educational multimedia system are the extrovert-introvert, thinking-feeling, and judging-perceiving dimensions since they determine the students' natural interests and learning style [4], and the DVJ2 system gives one of the dimensions of each duple an advantage. Of these four combinations, the type that are probably going to use educational multimedia the most are I-TJ because the educational multimedia best fits their learning style. Interestingly, I-TJ is also the "typical" engineering student [11].

GATHERING THE DATA

Data for this study was collected on both the students and the DVJ2 system that they were using. The data on the students was obtained through two surveys and from the class grading database.

Each of the two surveys was conducted as "Bonus Exercises". The first was a student profile survey, which asked personal data and academic background. The second survey was done online using the Kiersey Temperament Sorter (http://www.keirsey.com/cgi-bin/keirsey/newkts.cgi). This is a set of 70 questions that are used to determine a student's Kiersey Temperament. The Kiersey Temperament Sorter also outputs a type characterization akin to the Meyers-Briggs Type Indicator (i.e., a four-letter construct) which is the data that was used for this study. The output includes both the personality type dimension and the degree to which a student embodies each of the four dimensions. These degrees have ranges from I+20 to E+20 for the Introvert/Extrovert dimension, N+20 to S+20 for the

iNtuitive/Sensing dimension, T+20 to F+20 for the Thinking/Feeling dimension, and J+20 to P+20 for the Judging/Perceiving dimension. For example, the output for a student might be E+0 N+6 T+10 J+14 while another student might be I+20 S+4 F+2 P+10. We chose to use the Kiersey Temperament Sorter because it was much easier to administer to the students and the results were very similar to the full Meyers-Briggs Type Indicator test. Finally, the student grading database, including a class grade point average and a weighted percentage score, was also included into the overall array of data that is compiled on the students.

The DVJ2 system logfiles convey a great deal of information on system usage. A software program was written to extract users' actions on the system and profile what each user did each time they used the DVJ2 system. These user profiles include the following statistics:

- Number of video viewing sessions (from the first play to a stop action);
- Total seconds spent viewing videos;
- Number of video viewing sessions that lasted more than 20 minutes;
- Average duration of a video viewing session;
- Average number of commands per minute during video viewing sessions;
- Forward transitions, backward transitions, and forward jumps; and
- Jump ratio.

The last two items need some more explanation. The chronological sequence in which the class covers topics sets the "order" in which the videos should be watched in order to follow the topic sequence. So by using this "order," a forward transition occurs when a user views a certain lecture video, and then in the user's subsequent video session, the user views the immediate next video. A forward jump occurs when a user views a certain lecture video, and then in the user's subsequent video session, the user views a video which is not the immediate next video. Finally, a backward transition is a transition to a previous video in the "order" regardless of whether the video is the immediately previous video or not. Using these definitions, the jump ratio is equal to the number of forward jumps plus backward transitions divided by the total number of forward transitions, backward transitions, and forward jumps. This calculation provides the fraction of the times a student did not follow the prescribed sequence in viewing the videos. The intent in making these distinctions in video viewing sequences and calculating the jump ratio is that it can be expected that students with certain personality type dimensions are more likely to follow a prescribed sequence in viewing the videos, i.e., they prefer to learn the material in a "linear" fashion, while others do not. From the discussion in the previous section, it can be expected that intuitive students and perceiving students will have higher jump ratios, while sensing students and judging students will have lower jump ratios.

STATISTICAL ANALYSIS RESULTS

The user statistics were collected for the Fall 1998 and Spring 1999 semesters of a core junior-level course, *Microprocessor Systems and Interfacing*. The Fall 1998 and Spring 1999 semesters were taught in the same format, with the class split into two sections. One section was a traditional lecture series in which the class met for fifty minutes three times a week with a "normal" lecture. The other section required that students watch the lecture material on the DVJ2 system. This section met twice a week: once for an optional help session and once for a recitation in which quizzes were administered and homework was collected and discussed. Because the formats for these two semesters were identical, the data from them were combined. If a student from the Fall 1998 semester was retaking the course in the Spring 1999 semester, that student would have two statistic data sets in the combined data set. More details about the DVJ2 systems and these experimental course formats are published in [5, 6, 7]. Both of the Fall 1998 and Spring 1999 semesters had enough respondents, 122 out of 131 enrolled students and 100 out of 106 enrolled students respectively, to allow statistical analysis, so the combined data set was N = 222.

A series of multiple factor analysis of variances (MANOVA) were performed. For each of the MANOVAs, the four factors were each of the four dimensions of the personality type. The dependent variable was set to each of the following:

- Number of video viewing sessions (from the first play to a stop action),
- Total seconds spent viewing videos,
- Number of video viewing sessions that lasted more than 20 minutes,
- Average duration of video viewing sessions,
- Average number of commands per minute during video viewing sessions,
- Jump ratio, and
- Class grade point average.

The class grade point average is the students' classwork scores mapped onto a 4.0 to 0.0 scale. The p-values of these MANOVAs are presented in Table 1. In all of the tables presenting the p-values, an "S" next to the p-value means that that relationship is statistically significant. Only two of relationships of the MANOVA analyses yielded any significant correlations; the rest of the p-values were relatively high. These two significant correlations were for the jump ratio and the N-S and J-P personality type dimensions. As was discussed in the previous section, the intuitive students and the perceiving students generally had higher jump ratios, while the sensing students and the judging students generally had lower jump ratios.

TABLE 1
SIGNIFICANCE P-VALUES OF MANOVA FOR PERSONALITY TYPE VERSUS VARIOUS STATISTICS

Comparison	Type Dimension	P-Value
Personality Type versus Number of Video Viewing Sessions	E – I	0.6358
	N – S	0.3960
	F – T	0.2166
	J – P	0.3418
Personality Type versus Total Seconds Spent Viewing Videos	E – I	0.9912
	N – S	0.3651
	F – T	0.3965
	J - P	0.7656
Personality Type versus Number of Long Videos	E – I	0.9640
	N – S	0.4469
	F – T	0.3581
	J - P	0.8735
Personality Type versus Average Duration of Video Viewing Sessions	E – I	0.1389
	N – S	0.3032
	F – T	0.7138
	J - P	0.6228
Personality Type versus Average Number of Commands per Minute	E – I	0.7926
	N – S	0.4839
	F – T	0.3698
	J - P	0.7823
Personality Type versus Jump Ratio	E – I	0.5132
	N – S	0.0373 S
	F – T	0.5002
	J - P	0.0167 S
Personality Type versus Class Grade Point Average	E – I	0.1537
	N – S	0.9068
	F – T	0.6674
	J - P	0.1452

TABLE 2
SIGNIFICANCE P-VALUES OF REGRESSION FOR PERSONALITY TYPE DEGREE VERSUS VARIOUS STATISTICS

Comparison	Type Dimension	P-Value
Personality Type Degree versus Number of Video Viewing Sessions	E – I	0.6358
	N – S	0.3960
	F – T	0.2166
	J - P	0.3418
Personality Type Degree versus Total Seconds Spent Viewing Videos	E – I	0.7090
	N – S	0.4762
	F – T	0.4417
	J - P	0.7682
Personality Type Degree versus Number of Long Videos	E – I	0.6173
	N – S	0.7123
	F – T	0.2835
	J - P	0.8511
Personality Type Degree versus Average Duration of Video Viewing Sessions	E – I	0.1784
	N – S	0.5654
	F – T	0.9431
	J - P	0.9487
Personality Type Degree versus Average Number of Commands per Minute	E – I	0.6772
	N – S	0.2260
	F – T	0.3378
	J - P	0.9128
Personality Type Degree versus Jump Ratio	E – I	0.2323
	N – S	0.6136
	F – T	0.3109
	J - P	0.6949
Personality Type Degree versus Class Grade Point Average	E – I	0.6038
	N – S	0.8477
	F – T	0.4921
	J - P	0.0039 S

Also a number of linear regression analyses were performed with the independent variable being each of the personality type dimension degrees, and the dependent variables being the same as in the MANOVA analyses. The p-values of these regression analyses are presented in Table 2. These regression analyses yielded much the same results. In all of the tables presenting the p-values, an "S" next to the p-value means that that relationship is statistically significant. All of the comparisons, except for one, were not closely related since the p-values were once again relatively high. The one comparison that yielded significant regression was the students' class grade point average versus their Judging/Perceiving preference. Generally, the stronger a student prefers operating in a judging mode (and consequently the less they prefer operating in the perceiving mode), the more likely that the student will achieve a higher grade in the class. This finding was statistically significant with a p-value of 0.0039, and it supports the work habits assessment discussed in the "The DVJ2 System and Personality Type" section.

Why are there no strong statistical correlations in the majority of this analysis? There could be any number of explanations, but one may fit well considering the effort that has been expended on the DVJ2 system, and the target course as a whole, in making the material learnable no matter what a student's learning style is. That explanation is that the DVJ2 system does an acceptable job of teaching *all* types of students, and the determination of whether a given student will use the system relies more on the student's motivation, past performance, etc. rather than on the student's personality type.

POSSIBLE IMPROVEMENTS TO THE DVJ2 SYSTEM

As the results in the previous section suggest, the DVJ2 system addresses many of the learning needs of different student types, but there are some opportunities for improvement in the system and its usage. Extroverted students may become frustrated with the DVJ2 system because there is not much personal interaction. However, extroverted students may benefit greatly by working in pairs

or small groups in watching the multimedia. This could be facilitated by setting up "small group" learning/discussion areas in one of the viewing lab facilities.

Also we have conducted some tests of teleconferencing equipment in the lab. This equipment will open the opportunity for students to interact and collaborate with professors, TAs, and fellow students while being at different locations. It does not take the place of face-to-face interaction but does bring more life into discussions over the usual e-mail exchanges. The promise of this level of interaction could also be a welcome answer for feeling types that need more personal attention and praise to further their motivation for learning.

To address some of the concerns of the sensing types with regards to hands-on activities, modules could be added to the video library that present more examples. Some of these examples could even be tutorial in nature and could take a student through the steps of actually physically designing and building up a circuit or microprocessor system. These could be along the lines of "virtual" or "work-along" labs. To this end, "video homework solutions" were added to Fall 2001, which have proven to be very popular. All of these improvement efforts, of course, assume that the students actually see the benefit in using the DVJ2 system and actually want to use it. So we can only develop a system that tries to meet the students' needs, but it is up to the students to embrace the technology.

CONCLUSIONS

In this paper we have explored how students' personality types could be a predictor of whether students are likely to use an education multimedia system. We discussed different student types, how these different types prefer to learn, and how these learning preferences are or are not taken into account by the DVJ2 system. Also, we found that with students in the target course at Purdue University using the DVJ2 system, there was some correlation between personality type and system usage. This suggested that the courses using the DVJ2 system were designed to cater to a wide variety of learning styles. Finally, we analyzed how the DVJ2 system could be improved to remedy some of its shortcomings, and discussed what students may be most at risk of not learning enough if they relied entirely on multimedia for their learning material. Hopefully by improving on these shortcomings, the DVJ2 system can be an educational multimedia system that continues to cater to a wide variety of student learning preferences..

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REFERENCES

[1] Bandaru, Mohana Krishna. Interactive Digital Multimedia Delivery for Personal Learning. Master's Thesis, School of Electrical Engineering, Purdue University, 1995.

[2] Fairhurst, Alice M., and Lisa L. Fairhurst. *Effective Teaching, Effective Learning: Making the Personality Connection in Your Classroom.* Davies-Black, Palo Alto, California, 1995.

[3] Fuller, Dorothy, Rena Faye Norby, Kristi Pearce, and Sharon Strand. "Internet Teaching By Style: Profiling the On-line Professor," Educational Technology and Society, Vol. 3, No. 2, April 2000.

[4] Lawrence, Gordon. *People Types & Tiger Stripes: A Practical Guide to Learning Styles*. CAPT, Gainesville, Florida, 3rd edition, 1996.

[5] Meyer, David G., M. Krishna Bandaru, and Christopher C. Niessen. "The *VJ Instructional Multimedia Testbed Systems: Recent Experiences in Development and Utilization," In *1996 Frontiers in Education Conference Proceedings*, Salt Lake City, Utah, November 1996. Paper No. 96-221 (published on CD-ROM).

[6] Meyer, David G., and Richard A. Krzyzkowski. "Experience Using the VideoJockey System for Instructional Multimedia Delivery," In *Proceedings of the 1994 Frontiers in Education Conference*, pages 262—266, San Jose, California, November 1994.

[7] Meyer, David G., Christopher C. Niessen, and Albert I. Reuther. "Experimental Multimedia – Delivered Course Formats," In *Proceedings of 1997 Frontiers in Education Conference*, Pittsburgh, Pennsylvania, November 1997. Paper No. 97-1197 (published on CD-ROM).

[8] Provost, Judith A., and Scott Anchors, eds. *Applications of the Meyers-Briggs Type Indicator in Higher Education.* Consulting Psychologist's Press, Palo Alto, California, 1987.

[9] Reuther, Albert I., and David G. Meyer. "Analysis of Daily Student Usage of an Educational Multimedia System," In *Proceedings of 1997 Frontiers in Education Conference*, Pittsburgh, Pennsylvania, November 1997, Paper No. 97-1203 (published on CD-ROM).

[10] Reuther, Albert I., and David G. Meyer. "Analysis of Student Usage of the DVJ2 Educational Multimedia System." Technical Report, School of Electrical and Computer Engineering, Purdue University, 2002.

[11] Wankat, Phillip C., and Frank S. Oreovicz. *Teaching Engineering.* McGraw-Hill, Inc., New York, New York, 1993.