

# THE JAVA PROGRAMMING COURSE IN ACCREDITED BUSINESS SCHOOLS IN THE UNITED STATES

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*With industry's continuing demand for Java™ programmers, it is important to know if those responsible for the business school's IT curriculum are responding to the need for Java programmers. This study examines the extent to which Java programming is offered in Association to Advance Collegiate Schools of Business (AACSB) accredited business schools and also examines how Java is taught. Highlights of the findings include: sixty-eight percent of the respondents said their institutions provide an introductory Java course; two thirds of those respondents have offered Java for less than five years. Java is typically offered at the junior level and has the prerequisites of Fundamentals of Information Systems and another programming course. The prerequisite programming course most frequently mentioned was Visual Basic (VB). The course topics that had the highest number of classroom hours are: object-oriented programming; sub procedures and function procedures (methods); applets and servlets; and arrays. Over 77% of those offering Java require it as part of a major.*

To keep Information Technology (IT) programs relevant to industry needs, curriculum planners should provide continual assessments of how well the IT curriculum is producing graduates with the appropriate knowledge and skills. In 1994, it was estimated that by 2001 more than 80 percent of organizations would be using object-oriented development ("Corporate IS," 1994). That 1994 prediction has proven to be correct (Evans Data Corporation, 2003). Today, Java™ programming is widely used in industry to accommodate object-oriented development; in addition, Java's widespread use is positioned to become even more pervasive in the future (Benander, Benander, & Sang, 2004; Hotle, Iyengar, Sinur, & Cantara, 2004; de Raadt, Watson, & Toleman, 2002; Seidner, 2004). With the continuing demand for Java programmers, it is important to know if the business school's curriculum is keeping up with today's demand for Java programmers.

The determination of what programming language skills graduates should possess has been an ongoing challenge for IT faculty. COBOL's historical popularity in business schools' IT curricula during the first decades of the IT major reflected COBOL's widespread use in industry

and government (Arnett & Jones, 1993; Bauman, Pierson, & Forcht, 1991; Beheshti & Mattson, 1993; Laribee, 1992; Lee, Trauth, & Farwell, 1995; Rose 1995; Schwartz, 1997; Srinivasan, Guan, & Wright, 1999).

As the 1990's brought the advent of object-oriented programming in industry, C++ and Visual Basic (VB) were introduced in the business school curriculum. In 1998, Hardgrave and Douglas published the results of their longitudinal study of both computer science and IT programs in the United States and Canada. Results of their study indicated that between 1992 and 1996 IT programs increased their coverage of object-oriented education in the curriculum. By 1996, adding a C++ course was the primary way in which IT programs were incorporating object-oriented education (Hardgrave & Douglas).

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Studies have indicated a demand for IT graduates with knowledge of the Visual Basic programming language (Aggarwal, 2001; Chappell, 1999; Perkins, 2000; Schwartz, 1997; Spain, 1996; Swoyer, 1997). IT curriculum leaders responded by introducing VB into the IT curriculum. In a 2002 survey of Association to Advance Collegiate Schools of Business (AACSB) accredited business schools in the U.S., 60 percent of the respondents said their institutions provide VB as an introductory programming course (Kruck & Teer, 2002).

In today's business and industry environment, the Java programming language is widely used. In a Gartner Group survey of professionals at 400 organizations, 80 percent of the respondents said their organizations use Java (Rodgers, 2001). It was also estimated by the Gartner Group that in 2000 there was a worldwide group of 1 million Java developers (Driver, 2004).

Throughout the U.S., to what extent are those responsible for the business school's IT curriculum responding to the need for Java programmers? This study examines the extent to which the Java programming language is offered as a course in AACSB accredited business schools throughout the U.S. The study also examines how the Java course is being taught. A brief description of Java's benefits and the extent of use in industry of this programming language are discussed next.

## JAVA

Sun Microsystems introduced the first commercially successful version of Java in 1995 (Sun Microsystems, Java Platform); James Gosling is credited with being the creator of the Java programming language (Holloway, 2004).

The rapidly growing popularity of Java can be traced to its numerous benefits (Benander et al., 2004; McAllister, 2004; Mohamed, 2004). The specific benefits of Java are described as follows:

*Simple:* Java omits many rarely used, poorly understood, confusing features of C+...

*Object-Oriented:* ... it facilitates the clean definition of interfaces and makes it possible to provide reusable software...

*Network-Savvy:* Java has an extensive library of routines for coping easily with TCP/IP protocols...

*Robust:* Java puts a lot of emphasis on early checking for possible problems, later dynamic checking, and eliminating situations that are error prone.

*Secure:* Java is intended for use in networked/distributed environments ... a lot of emphasis has been placed on security.

*Architecture Neutral:* Java was designed to support applications on networks ... with a variety of CPU and operating system architectures.

*Portable:* Unlike C and C++, there are no "implementation dependent" aspects of the specification.

*Interpreted and High Performance:* Java byte codes are translated on the fly to native machine instructions and not stored anywhere.

*Multithreaded:* Java has a sophisticated set of synchronization primitives . . . that are easier to use and are more robust.

*Dynamic:* In a number of ways, Java is a more dynamic language than C or C++. It was designed to adapt to an evolving environment (Sun Microsystems, 2002).

In the most current survey, 57 percent of the 600 developers who responded worked on Web applications during 2002; 87 percent of the same group anticipated developing applications for the Web in 2003 (Evans Data Corporation, 2002). Additional aspects that are driving the demand is the Internet and e-business boom and that Web application usage is expanding from only one

department within an organization to use by the entire organization (Evans Data Corporation).

As Web applications expand, the use of Java also continues to grow (McAllister, 2004). A 2003 Evans Data survey found that Java is the Web services developers' favorite programming language (Evans Data Corporation, 2003). By using Java, programmers can now do things with the Web that were not possible previously. Java is important in unifying and accelerating deployment of services to the Web.

In a recent study, Java was named as one of the skills needed by technical employees in order to implement e-business applications (Ge & Sun, 2000). For new e-business application development initiatives in 2003, the Gartner Group estimated that Java, along with Microsoft technologies, was utilized in 75 percent of the applications (Rodgers, 2001).

#### CONTRIBUTION OF THIS STUDY

This increased use of Java in organizations has created a demand for employees with Java skills. Presently, there is a shortage of individuals with those skills and organizations have a hard time finding qualified Java programmers (Hotle et al., 2004; Seidner, 2004).

With the unmet need for Java programmers, a need exists to examine the IT curriculum. Since academia should strive to be responsive to industry needs, it would be helpful to know to what extent IT curriculum planners have responded to the need to design curriculums that will equip IT graduates with Java programming skills.

In addition, a need exists to examine how the Java programming course is being taught. Research has indicated that more attention needs to be given to how to teach technology skills effectively (Lambrecht, 2000). Information on how the Java course is being taught would be of assistance to those teaching Java or preparing to teach Java for the first time.

To examine those curriculum issues, the authors performed a study of the Java course in business schools accredited by AACSB. The purpose of this research was twofold. First, the study was designed to obtain information

regarding the extent to which the introductory Java course is being offered in AACSB accredited business schools. The second purpose was to obtain a profile of how the Java course is currently being taught.

Numerous individuals can use the information obtained from this research. Both the business community and the administrative academic community should have an awareness of what is currently being done to meet the increased demand for employees with Java skills. IT faculty, as well as faculty responsible for concentrations in Accounting Information Systems and Marketing Information Systems, can use the results of this research. Faculty and curriculum planners in those three areas will find this information helpful as they endeavor to keep their curriculum in line with the growing needs of business and industry. The data describing how Java is being taught in universities throughout the U.S. can provide valuable insight to those who are teaching Java. The remainder of the paper summarizes the related literature, describes the method used in this study, presents the results, and offers some implications for curriculum planners.

#### RELATED LITERATURE

The literature was examined to determine if there was existing data regarding the extent of Java course offerings in U.S. undergraduate business schools or how the Java course was being taught in business schools. In two articles, authors reported that a Java course was included in the undergraduate offerings within business schools (Bartholome & Olsen, 2002; Haney, 2003). While current data regarding the extent to which the introductory Java course is being offered in undergraduate business schools throughout the U.S. were not found, two international studies reported the teaching of Java. In a 2002 ISWORLD survey, 35 of the respondents from 69 universities stated that Java was a required programming language for IT majors; 15 of the 35 academic programs requiring Java require it as the first programming language in their IT program (Watson, 2002).

Another survey examined the extent to which Australian universities were offering a Java introductory course. In 2002, de Raadt et al. compiled results from 37 of the 39 universities in Australia that offered introductory programming courses to determine what programming languages were being taught. The researchers surveyed all disciplines in the universities where programming was being taught; there were 57 respondents from the disciplines of Computer Science/Information Technology, Engineering, and Business. Nine different programming languages were being taught in Australian universities. The most commonly taught programming language was Java; 23 of the 57 respondents said Java was taught in their discipline. VB was the second most popular programming language, with 14 respondents selecting VB. Java was found to be popular across all three disciplines that offer programming languages (de Raadt et al.).

## METHOD

The authors developed a three-page questionnaire to obtain feedback from faculty most familiar with the Java programming language and/or the Java course. The survey instrument incorporated questions pertaining to the Java course including items such as: course history, background of faculty teaching the course, future plans to offer the course, course level, degree requirements, prerequisites, texts used, topics covered, programming assignments, and use of student teams.

To gather a sample for this study, the authors searched the AACSB website for accredited business and/or accounting schools with CIS or MIS programs. This yielded 229 accredited business schools with CIS or MIS degree programs. Then, all schools that had only a graduate CIS or MIS program were removed. The survey was ultimately sent to 194 AACSB accredited schools with CIS or MIS undergraduate programs.

In early 2004, we sent email notes explaining the nature of the survey and the questionnaire itself to the department heads of IT programs (or the person most knowledgeable about the Java

programming language) in the undergraduate business schools in the U.S. accredited by the AACSB. To give the participants an alternative method of completing the survey in the most convenient fashion, we indicated that a website with the same questionnaire was also available.

After a few weeks, a follow-up email questionnaire was sent to all schools for which a response had not been received. A total of 60 completed and usable questionnaires were returned. The survey yielded a response rate of 31 percent.

Several limitations inherent in this study should be noted. First, the values obtained were participants' perceptions and no attempt was made to validate the accuracy of the responses. Second, a non-response bias may exist among the 69 percent who did not respond. Finally, care should be exercised when generalizing the results to schools not accredited by the AACSB or to Java courses taught outside the school of business. The data obtained relate only to courses offered through AACSB accredited business schools. Detailed information on Java courses offered through other schools in the institutions surveyed is not included in this study.

## RESULTS

The results obtained from this study are presented in five categories: extent of course offerings, background of Java faculty, course content, textbooks used, and programming assignments. The number of responses and the percentage of total responses (when appropriate) for each question are also given in table form.

### *EXTENT OF COURSE OFFERINGS*

Table 1 contains the responses to general questions on introductory Java programming courses. Findings indicate that 68 percent of the respondents' institutions provide an introductory Java course in the business school. Java is a comparatively new addition to the curriculum since two-thirds of the schools have offered the course for four years or less. One-quarter indicated that Java programming language is included as part of other business school courses

such as Object Oriented Design and Implementation, Information Systems Concepts and Methods, or Web Design.

While about 68 percent of the respondents stated that the Java programming course was offered in the business school, at some institutions Java instruction is also available elsewhere on campus. Fifty-six percent noted that other departments and colleges, usually in computer science departments, offer Java; the vast majority of respondents to that question indicated that such a course is open to enrollment by business students.

Over half of the respondents said the introductory Java course was offered at the junior level; less than 20 percent said it was offered at the sophomore level. Before allowing students to enroll in the introductory Java course, most business schools require completion of at least one prerequisite. The most frequent prerequisite courses for entrance into the Java course are Fundamentals of Information Systems and another programming course. The programming course most frequently mentioned as a prerequisite to the Java course was VB or VB.net.

**Table 1. Course Data**

	<b>Number of Responses</b>	<b>% of Responses*</b>
Introductory Java course offered in business school:		
Yes	41	68.3%
No	19	31.7%
Number of years course offered:		
1 year or less	6	15.0%
2-4 years	21	52.5%
5 or more years	13	32.5%
Java included in another course in the business school:		
Yes	14	25.0%
No	42	75.0%
Java offered in another college or department in the university:		
Yes	10	55.6%
No	4	22.2%
Do not know	4	22.2%
Prerequisites required:		
Fundamentals of IS	24	
Personal Productivity with IS Technology	10	
Another programming language	20	
Information Technology Hardware & Software	6	
Others (1 or less mentions)	3	
Prerequisites programming language:		
VB (or VB.net)	12	
C or C++	7	
COBOL	2	
HTML/JavaScript/Perl	1	
Pascal	1	
Java course required in a degree program:		
Yes	23	60.5%
No	15	39.5%
Course level:		
Freshman	4	10.0%
Sophomore	7	17.5%
Junior	21	52.5%
Senior	8	20.0%
Plans to offer a Java course (if one is not currently offered):		
Yes	2	11.8%
Not under consideration	12	70.6%
Do not know	3	17.6%

\* Percent is based on the number of respondents for each question

Sixty-one percent of the surveyed institutions offering Java require it as part of a major. The major most often cited was CIS (including IT, IS, and MIS). About 12 percent of the respondents indicated plans to initiate the Java course at their schools within the next year. Seventy-one percent of the participants in the survey whose schools do not currently offer a Java course said they do not plan to offer one in the future.

## *BACKGROUND OF JAVA FACULTY*

The respondents at universities where the Java course is offered in the business school were asked to answer three questions regarding the background of faculty members who taught Java in their business school. It was determined that the majority of the business school faculty who taught Java had a terminal degree; were full-time faculty; and did not have work experience as a Java programmer. Specifically, the respondents from business school in which the Java course is offered gave these statistics regarding the faculty who teach Java at their business schools: 71 percent have PhDs and the remainder has masters' degrees; 93 percent are full-time faculty; and 37 percent have Java programming work experience.

## *COURSE CONTENT*

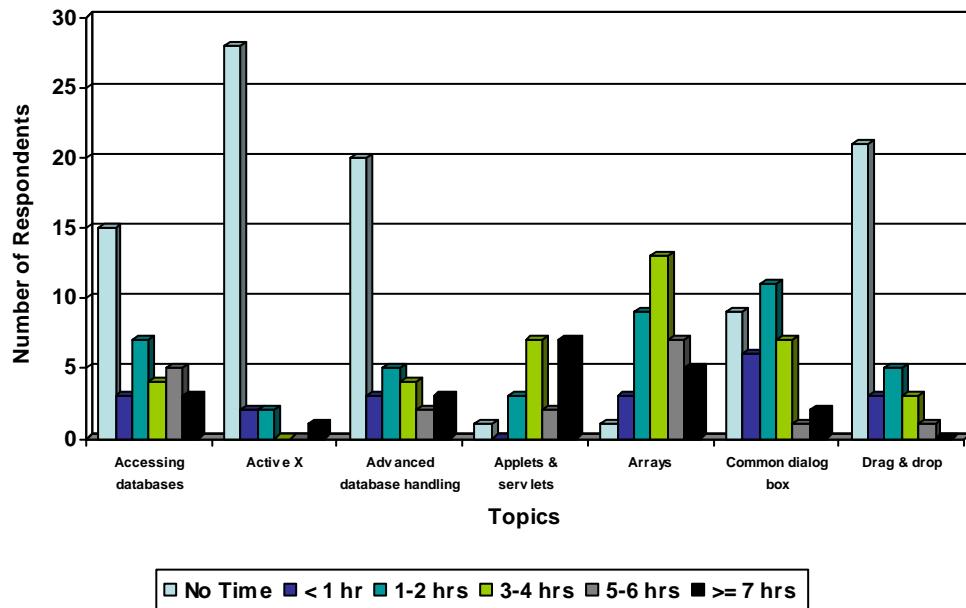
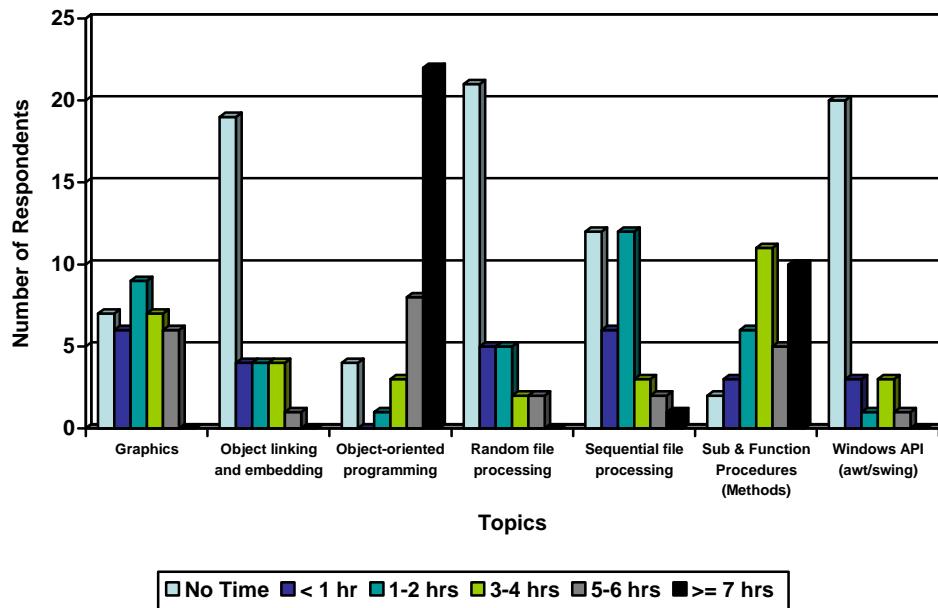
Table 2 shows a list of advanced Java course topics and the classroom hours spent on each topic. Figures 1 and 2 are a visual representation of the same topics and classroom hours spent on each topic. These responses relate only to the topic inclusion in Java courses offered in business schools and do not include basic programming techniques such as control structures (iteration and selection), arithmetic operators, and multiple form applications. These findings cannot be

generalized to courses in other departments or colleges.

As Table 2 shows, topics that ranked in the top four, as measured by the highest number of classroom hours spent on them, are: object-oriented programming; sub procedures and function procedures (methods); applets and servlets; and arrays. Object-oriented (OO) programming is the basic premise of Java—it is an object-oriented programming language and as such it would be almost impossible to teach this programming language without spending considerable time on OO programming. Sub and function procedures (methods) are those the user creates for code reuse and modularity. Java classes define all the common properties of the different objects and provide preprogrammed functionality such as: DateFormat class (converts strings to dates and vice versa; comparing 2 dates); or String class (examines individual characters for comparing strings, for searching strings, and for extracting substrings; converts strings to all upper or lower case). The ability to use Java to create applets and servlets is also one of the features of Java. Applets and servlets are applications that require limited memory resources and those applications are portable between operating systems. Applets are embedded in hypertext markup language (HTML) documents and are executed on the client computer via the browser. Servlets are run on a

**Table 2. Topics Included**

<b>Content Areas</b>	<b>Classroom Hours</b>					
	<b>No Time</b>	<b>&lt; 1 hr</b>	<b>1-2 hrs</b>	<b>3-4 hrs</b>	<b>5-6 hrs</b>	<b>&gt; = 7 hrs</b>
Accessing databases	15	3	7	4	5	3
Active X	28	2	2	0	0	1
Advanced database handling	20	3	5	4	2	3
Applets & servlets	1	0	3	7	2	7
Arrays	1	3	9	13	7	5
Common dialog box	9	6	11	7	1	2
Drag & drop	21	3	5	3	1	0
Graphics	7	6	9	7	6	0
Object linking and embedding	19	4	4	4	1	0
Object-oriented programming	4	0	1	3	8	22
Random file processing	21	5	5	2	2	0
Sequential file processing	12	6	12	3	2	1
Sub & Function Procedures (Methods)	2	3	6	11	5	10
Windows API (awt/swing)	20	3	1	3	1	0

**Figure 1. Class Hours of Content Coverage****Figure 2. Class Hours of Content Coverage (Continued)**

web server and provide added functionality, often for accessing databases and dynamically generated HTML to send to the client. Arrays are used in both traditional and object-oriented programming. An array is a user-defined data structure that may contain any number of items of the same data type.

Some of the Java topics that placed toward the bottom of the ranking are not common business programming techniques. For example, little classroom time was devoted to drag & drop and graphics. The lack of time put on these features may indicate that the applications used in the Java courses are similar in nature to those used in other programming courses typically found in business schools. As Java courses in business schools mature, changes in the importance placed on various features of the programming language may occur. Additional topics that placed toward the bottom, such as object linking and embedding (OLE) and Windows Application Program Interface (API), are new and may indicate that class time is limited and, therefore, not all desired topics may be covered in the introductory Java course. The authors found it surprising that file processing placed so low. Again, it may be that there is not enough time to cover this topic in an introductory Java programming course.

#### *TEXTBOOKS USED*

There was little agreement among the respondents to the question on textbooks used. Only 32 participants answered the textbook question. Several of those 32 respondents listed more than one textbook or indicated it varied with no specific book listed or listed a publisher only. There were only two textbooks that were mentioned by more than two respondents. Ten respondents stated they used *Java How to Program* (2005) or *Complete Java Training Course* (2003) both by Deitel and Deitel. Five respondents used *Introduction to Java Programming* (2004) by Liang. All other textbook titles, about a dozen and a half, were mentioned by only one or two respondents.

#### *COURSE ASSIGNMENTS AND STUDENT TEAMS*

The participants were asked to indicate the number of programming assignments and projects completed by students during a semester and whether the students worked in teams. Table 3 provides a summary of the results and indicates the number of programming projects, which ranged from two to thirty, averaging 8.8.

About two-thirds of the respondents indicated that they required documentation of computer programs. Six different types of documentation were reported; the top three are listed in Table 3. The most frequently reported documentation type was UML followed by a distant internal comments and pseudocode.

One survey question was designed to determine if students worked on assignments in teams. Only about one-third of respondents allowed students to work on assignments in teams for an average of three team assignments. The average size of the team was three with the largest being a team size of four. Those results are reported in Table 3. It is interesting to note that a prior study on the introductory VB programming course indicated that 42 percent of VB faculty allow students to work in teams (Kruck & Teer, 2002).

#### *IMPLICATIONS FOR IT CURRICULUM PLANNERS*

Sample data obtained in this study indicate that Java is a comparatively new course offering for IT majors within schools of business accredited by the AACSB. Two-thirds of the schools have offered the course for four years or less. For this brand-new course offering, the authors found that only 37 percent of the faculty teaching Java actually had Java programming work experience.

As expected, in this survey of program chairs in accredited business schools, there was a consensus that a high number of classroom hours should be spent on object-oriented programming. However, since Java is a relatively new course, it was expected that relatively little standardization would be found in the number of assigned

**Table 3. Assignments & Groups**

	<b>Number of Responses</b>	<b>% of Responses</b>
Number of programs assigned:		
Minimum	2	
Maximum	30	
Average	8.8	
Mode	10	
Required design documentation and program documentation:		
Yes	24	63.2%
No	14	36.8%
Documentation mentioned more than once:		
Pseudocode	2	
Internal comments	4	
UML	10	
Team assignments:		
Yes	13	33.3%
No	26	66.7%
Number of team projects:		
Minimum	1	
Maximum	6	
Average	3	
Mode	1	
Team size:		
Minimum	2	
Maximum	4	
Average	3.1	
Mode	3	

programming projects and whether students were required to work in teams. These expectations were borne out. The number of programming projects assigned and implementation of teamwork varied greatly from one school to another. As Java becomes more entrenched in business school curricula, a greater degree of standardization in how the course is taught may be expected.

In the past, as the curriculum in a new domain evolves, the widespread adoption of a few textbooks or of similar textbooks has preceded a consensus on how courses should be taught. In the examination of the results of this study, the newness of the Java course is highlighted by the respondents naming many different textbooks and several participants noting that their textbook use varied each semester as they searched for a textbook that would best fit their course needs.

For the universities represented in this survey, over 77 percent of those offering Java

require it as part of a major. The major most often cited was CIS. That so many institutions offering Java require it as part of the CIS major may indicate that Java is beginning to be viewed as one of the “core” courses for a CIS major. Further data are needed to determine if the requirement for Java is an addition to the curriculum or a replacement for a previously required programming class.

The Java course will no doubt continue to evolve as faculty gain more experience in teaching the Java course. The evolution of the Java course should reflect changes made necessary by the introduction of new releases of Java as well as new developments in the

IT and e-business industries. Communication between academicians and IS professionals needs to be maintained to ensure that the topics included in the Java course are closely aligned with the needs of the profession.

The answers from respondents to this empirical study indicate that 68 percent of the AACSB accredited business schools provide an introductory course in Java as part of the undergraduate curriculum. The information gleaned in this study on the extent to which the Java course is being offered at AACSB accredited business schools as well as how the Java course is being taught can provide insight to faculty who are teaching Java and to those who are presently exploring the possibility of offering a Java course.

Thirty-two percent of the respondents stated that their school of business does not offer a Java course. Seventy-one percent of those respondents stated that they did not plan to offer a Java course in their business school. An in depth exploration

of the reasons why the Java course is not currently offered and why a Java programming course is not under consideration at some universities was beyond the scope of this present research. However, as the findings of this study indicated, some of those business schools may not have a need to have a Java course as part of the curriculum because other university academic units outside of the business school are effectively meeting the needs of business students.

#### IMPLICATIONS FOR FUTURE RESEARCH

As the stream of research on the Java programming language in the business school curriculum is continued, it may be helpful to explore the reasons why some universities do not presently offer Java or plan to offer it in the near future. Perhaps some business schools lack the funds necessary to offer and staff an additional course. Another factor is that it could be difficult to find someone with the appropriate skills needed to teach Java. Also, within the AACSB guidelines, there are a limited number of hours available for major courses. Thus, curriculum planners are perhaps struggling with the decision of which major course to eliminate if they were to make room for Java. An additional reason for not offering a Java course could be explained by Java not being viewed as an important part of the skills needed for graduates of a particular IT program in some localities of the country.

A second need for future research is implicated in another finding of this study. At present, 56 percent of the business schools where Java is offered have a prerequisite programming language requirement before students enroll in Java. As industry's programming requirements continue to evolve, a need exists for future data that show what programming languages are required in the IT curriculum and the sequencing of those courses.

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