Integration of ORACLE APEX Environment in Database Courses of Computer, Informatics and Telecommunications Engineering Department of International Hellenic University

Athanasios Angeioplastis,[1] Alkiviadis Tsimpiris,[1] Dimitrios Varsamis,[1] Alenka Baggia,[2] Robert Leskovar[2]

[1] Department of Computer, Informatics and Telecommunications Engineering, International Hellenic University, Serres, Greece
aagiop@gmail.com, atsimpiris@ihu.gr, dvarsam@ihu.gr
[2] University of Maribor, Faculty of Organizational Sciences, Kranj, Slovenia
alenka.baggia@um.si, robert.leskovar@um.si

Abstract The aim of this work is to present the integration actions of ORACLE APEX in the curriculum of the undergraduate course "Databases" of the 5th semester of studies at the Department of Computer, Informatics and Telecommunications Engineering (CITE) of the International Hellenic University (IHU). Particularly in the laboratory part of the course, students get acquainted with using different relational database management systems. The tools and capabilities offered by the ORACLE APEX information system had to be integrated into the laboratory part of the course. Students acquire knowledge and skills in developing applications in the APEX environment. For this there were developed a) a quick guide for using the ORACLE APEX environment in Greek, b) laboratory exercises with a case study where for four weeks the students are invited to complete the parts of the laboratory exercise with SQL commands as well as with the low coding tools provided has ORACLE APEX and c) a questionnaire was designed for the students to evaluate their experience in the different database management environments taught. In the laboratory part of the course, students learn how to create a complex database, develop forms, reports, statistics in a web-based environment of APEX. The first impressions of the students show a full acceptance and adoption of ORACLE APEX over the popular RDBMS taught.

Keywords:
keyword,
keyword,
keyword,
keyword,
keyword

Univerzitetna založba Univerze v Mariboru

DOI https://doi.org/10.18690/um.fov.3.2023.2
ISBN 978-961-286-722-5

1 Introduction

Courses focusing on database fundamentals are offered in all IT-related departments, but also in engineering, accounting, and generally in departments dealing with data management (Nagataki et al., 2013). Typically, the content of these courses covers topics related to data models, database design and introduction to the SQL language (Conklin & Heinrichs, 2005; Robbert & Ricardo, 2003). More recently, due to the rapid production of data from various sources, there is a need to manage these huge amounts of data, and the teaching of NoSQL database systems, which are based on a different design from structured SQL databases, is a hot topic (Dietrich et al., 2008; Garcia-Molina, 2008). Also, at a more advanced level of study, there are courses that include topics related to DB architecture, transactions, concurrency, reliability, distribution, parallelism, replication, query optimization, as well as the design of comprehensive case studies aimed at solving a real business problem (Abid et al., 2015; Domínguez & Jaime, 2010). There are research papers that propose evaluation methods in both the theoretical and laboratory parts of the database course. (Kawash et al., 2020). There are proposals for teaching this course (30-50 hours) with the aim of learning both theoretically and in the laboratory to understand the concepts of designing a DB and the commands needed to implement a relational DB. (Cvetanovic et al., 2010). The increasing use of cloud computing combined with big data is leading to the adoption of new tools that students can use and apply to their future clients after graduation (Ishaq et al., 2022; Manzoor et al., 2020; Baggia et al., 2018).

One tool that could introduce students to cloud computing concepts for database and application development is Oracle APEX. Oracle APEX is the world's most popular enterprise low-code application platform that enables students to build scalable, secure enterprise applications that can be deployed anywhere - in the cloud or on-premises. (Oracle,2023; Baggia et al., 2019).

In this work, laboratory exercises and a short user manual of ORACLE APEX in Greek were developed and included in the teaching of the course "Databases" of the 5th semester of the CITE Department of IHU. At the end of the course, a questionnaire was distributed to the students in order to record their opinion on their experience of using APEX and to evaluate the teaching method.

The rest of the article is structured as follows: Section. 2 presents the capabilities offered by Oracle APEX. Section 3 presents the research methodology for this study. Section 4 describes the results of the process of integrating ORACLE APEX into the laboratory part of the department's NE course and the student's experience of using Oracle APEX. Section 5 summarises the conclusions of the study.

2 Oracle Application Express (APEX)

Oracle today makes its popular APEX low-code development platform available, as a managed cloud service that developers can use to build data-driven business applications quickly and easily. It is already used by 500,000 developers through a browser-friendly environment to create modern web and mobile applications. Initially the APEX platform was only available as part of the Oracle database, but after many improvements today APEX Application Development is available as a standalone service and works with a variety of web applications (Geller & Spendolini, 2017). A recent study by (Pique Solutions, 2019) showed that developers could build enterprise applications almost 40 times faster with Oracle APEX service without having to learn complex programming technologies. It provides integration of the application with the database, reducing the communication time between the application and the database by 10 times, resulting in much faster response times. In addition, application developers can take full advantage of the power and simplicity of SQL in building complex queries. One of the advantages of APEX is that it does not require client software, it does not require user maintenance, it requires minimal code, it allows end users to interact with their data through tools such as interactive reporting, interactive grid, different types of charts, the analysis maps and functions (Riaz, 2018). It also enables developers to embed SQL, PL/SQL, HTML, JavaScript and CSS to enhance their application. With a web browser with the help of Oracle Apex end users are able to create but not limited to: Model database objects, Load/unload data, Create REST interfaces on that data, Create applications on those database objects, Implementation and development of applications. Quickly create reports, forms, charts, calendars, etc. Additionally, one of the main advantages is the high degree of independence and security of the platform from the client's side (Geller & Spendolini, 2017). Figure 1 shows the basic options provided to the user after creating the necessary Workspace.

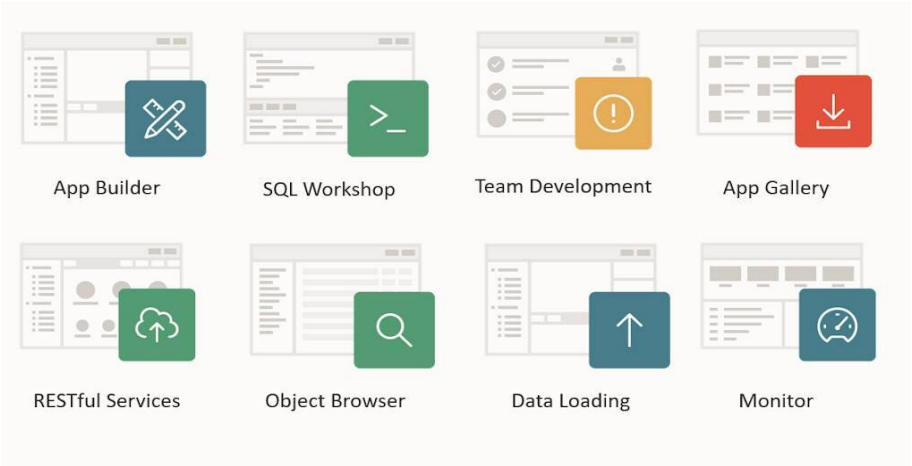

Figure 1: The ORACLE APEX Home Environment

3 Methodology

The methodology used to easily introduce students to the Oracle APEX environment is described in Figure 2. The first step was to research and investigate new tools for the design of databases and the implementation of web applications. This search revealed the difference of the Oracle APEX environment for low-code programming and rapid web application development, and as a result, this environment was chosen for applications in the laboratory part of the database course. First of all, a short Oracle APEX User's Guide was developed in Greek language, describing the basic features and tools provided by this platform, so that students can use it and solve problems related to the use of these tools. Targeted tools provided by the Oracle APEX environment were chosen in order to enable students to put into practice the knowledge they have learned until the 5th semester of their studies. Two laboratory exercises were then designed to take students step by step through the creation of a database and tables, either using SQL statements or by importing a data file and creating the corresponding forms, reports and statistics. In order to integrate these exercises into the laboratory part of the course, the teaching program of the laboratory part was modified. Finally, the students were asked to answer a questionnaire designed to record their opinions, attitudes and

experiences in using this new environment. Finally, the statistics of this small survey were recorded. The number of students who participated in this process was 40.

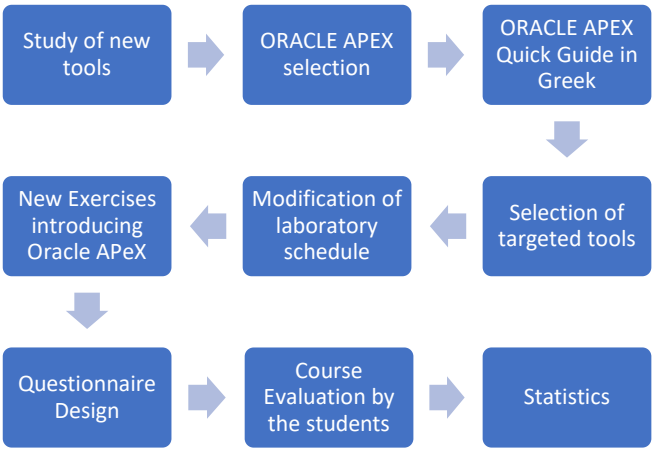

Figure 2: Methodology steps of this work

4 Application

4.1 Introduction to Oracle Apex Quick Guide in Greek

The development of a short guide in Greek to introduce students to the Oracle Apex environment is a necessary process so that students will have a reference and help book for the development of their own DBs and applications. There is also a lot of material available on the Oracle Apex environment in the form of videos, tutorials, tips, slides and exercises. However, this material is mainly available in English. As part of the Erasmus+ BeeAPEX program, in which the team behind this work is also a participant, a unique effort is underway to develop Oracle Apex training material in various languages other than English. The Oracle Apex Quick Guide in Greek, developed for the students of the BYT Department of DIPAE, consists of the following sections, which are presented in Table 1. In addition to the Sort Guide in Greek, eight videos describing the use of Oracle Apex were developed.

Table 1: Table of contents of Oracle Apex Quick Guide in Greek

1. ORACLE APEX workspace 2. Analysis of screen options 3. Apps and Dashboards 4. Administration Menu 5. Help Menu 6. Account Menu 7. Login to App Builder 8. App Builder Home Page 9. Reset and Create Buttons 10. Recent List and Tasks List 11. Login to the application	12. Tool in an application 13. Edit Application Properties 14. Application Home Page Icons 15. Create Page Button 16. Home Page Navigation Bar 17. Comment button 18. Search icon 19. Shared Components 20. Run and Edit page 21. Run Application 22. Page Buttons	23. Import/Export 24. Application wizard 25. Using the Wizard 26. Page Designer 27. Window options 28. Left panel 29. Center panel 30. Right Panel 31. Copy/Delete a page 32. Delete Multiple Pages 33. Runtime Toolbar

4.2 Lab exercises for undergraduate students

The objective of the lab exercises is to introduce and familiarize the students with the ORACLE APEX environment by developing a database and tables using SQL commands for a case study concerning an application that manages data about workers, departments and projects that the workers work on. In order to carry out this exercise, there are specific steps that the students must follow in order to successfully complete the exercise. In the first steps of logging into the ORACLE APEX environment for the first time at https://apex.oracle.com, the students have to apply for a new workspace using their academic email address. In the next steps, using the SQL Workshop option, they can create tables in the ORACLE database space in several ways. In the first lab exercises, students will use the Object Browser and SQL commands. They will learn how to create tables either by using SQL scripts or by using the New Table Form, defining the fields of the tables, the data types, the primary keys and the foreign keys.

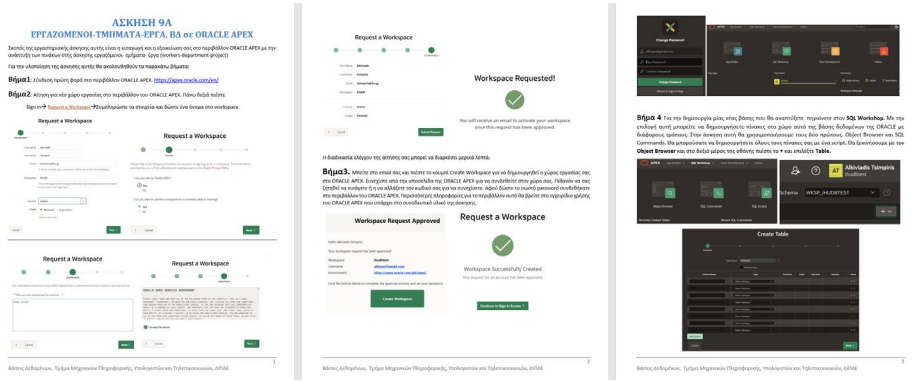

Figure 3: Screen shot of a Lab exercise for ORACLE APEX (Printscreen, own, 2023)

In order to practice with the new environment and SQL commands, they inserted new records into the tables or updated inserted data using SQL commands. A procedure that excited the students was their first application development using the New Page command of ORACLE APEX, where they could select many options offered by the APEX environment, such as forms, reports, statistics. Finally, using low code in their application development, the students run their application and immediately see their work in a web-based application running on the cloud of ORACLE APEX. Screenshots of one of the exercises used by the students for their first application with APEX are shown in Figure 3. The detailed steps of these exercises, combined with the Oracle Apex Quick Guide in Greek, were helpful for the students to complete the desired tasks in the limited lab class time.

4.3 Questionnaire Design

In order to get feedback from the students about their opinions, attitudes and positions regarding their experiences in the ORACLE APEX environment, a short questionnaire was designed, consisting of the questions in Table 2. This questionnaire was given to the students to complete at the end of the 13 laboratory sessions of the semester, after having dealt with two other RDBMS, ACCESS and MS SQLSERVER, in addition to ORACLE APEX. Ten of the questions are closed, Likert-type questions and one of them is an open-ended question where the students were asked to add their comments (question 7) for the improvement of the database laboratory exercises.

Table 2: Questions of the Questionnaire

E1.	Have you heard about developing data-driven applications using APEX before?
E2.	How did you get the information about ORACLE APEX?
E3.	How do you rate the application development using Oracle APEX technology?
E4.	How do you rate the Oracle APEX lab exercises, you attended?
E5.	How do you rate the quality of Introduction Oracle APEX short Guide in Greek?
E6.	How do you consider the selected topics of the short Guide?
E7.	Is there anything, you would add to the Oracle APEX lab exercises?
E8.	How do you rate ORACLE APEX vs MS Access?
E9.	How do you rate ORACLE APEX vs MS SQL Server?
E10.	How likely will you use the APEX technology for the future development?
E11.	Would you like to attend other courses related to the APEX technology?

5 Results

According to the answers of the students to the questionnaire, which they were asked to answer at the end of the 5th semester, useful conclusions can be drawn about their experiences with the use of Oracle Apex. The results are presented in graphs E1-E11 of Figure 3. From E1 and E2, we can see that the vast majority of students had never heard of designing applications with Oracle Apex and learned about it during the workshops of the Database course (34/40). They gave high marks (Good and Very Good, 36/40) to the application development using Oracle APEX (E3) and to the lab exercises they participated in (E4). Regarding the quality of the Introduction to Oracle APEX Short Guide in Greek (E5) and the selected topics of the Short Guide (E6), all students rated them as helpful for the learning process. Regarding the improvement of the lab exercises, in the comments they were asked in E7, they asked for exercises in the form of case studies that are used in everyday life, they also asked for fewer lab exercises with MS Access and more exercises with Oracle Apex. Regarding the comparison of ORACLE APEX vs. MS Access (E8), the vast majority (34/40) considered Apex better, 5 students rated it equal and one student rated it worse. Regarding E9, where they were asked to compare ORACLE APEX vs. MS SQL Server, the answers are similar to E8, where a large majority (32/40) considered Apex better than MS SQL Server and 8 students rated it equal. All of the students stated that they would use the APEX technology for application development in the future (E10) and 35/40 of them would like to attend additional courses related to the APEX technology according to E11.


Yes
No
0
5
10
15
20
25
30
(E1)
Απαντήσεις
(5) From a friend
(4) Internet
(3) The lab
(2) APEX Advertisement
(1) Oracle Academy
0
5
10
15
20
25
(E2)
(5) Very Good
(4) Good
(3) Okay
(2) Poor
(1) Very Poor
0
5
10
15
20
(E3)
(5) Very Good
(4) Good
(3) Okay
(2) Poor
(1) Very Poor
0
5
10
15
20
(E4)
(5) Extremely helpful
(4) Very helpful
(3) Somewhat helpful
(2) Not so helpful
(1) Not at all helpful
0
5
10
15
20
(E5)
(5) Extremely helpful
(4) Very helpful
(3) Somewhat helpful
(2) Not so helpful
(1) Not at all helpful
0
2
4
6
8
10
12
14
16
(E6)
(5) Much Better
(4) Slightly Better
(3) No Difference
(2) Slightly Worse
(1) Much Worse
0
2
4
6
8
10
12
14
16
(E8)
(5) Much Better
(4) Slightly Better
(3) No Difference
(2) Slightly Worse
(1) Much Worse
0
2
4
6
8
10
12
14
(E9)

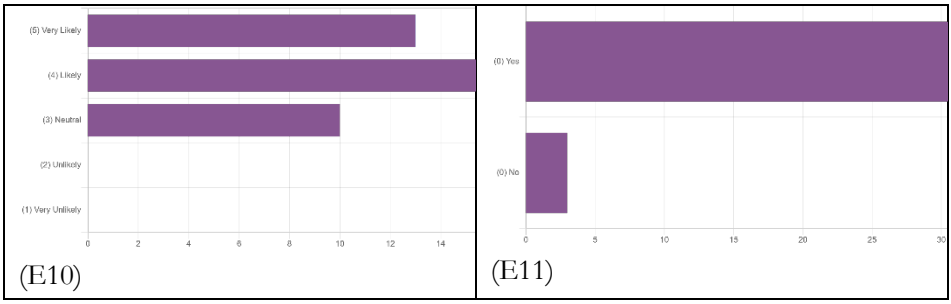

Figure 4: Students feedback for E1-E11 questions

6 Conclusions

This paper presents the methodology used for the integration of ORACLE APEX in the laboratory exercises of the Database course of the Department of Computer Information and Telecommunications Engineering of the International Hellenic University. According to the answers of the students to the questionnaires given to them at the end of the semester, the acceptance of the ORACLE APEX environment was global. The objective of using the tools provided by this platform was fully achieved. The students learned to easily create highly complex web applications with low coding through the ORACLE APEX environment and this fact seemed to excite them and they will continue to use these tools to develop their own applications in the future. Furthermore, when comparing the different RDBMS taught during the semester, such as MS ACCESS and MS SQL SERVER to ORACLE APEX, the students felt that the environment and capabilities provided by ORACLE APEX were better. There was also a demand for more tutorials and lab exercises with ORACLE APEX. This fact encourages us to invite students to participate in new workshops, to organize an Oracle APEX group in IHU, to encourage students to participate in relevant conferences, seminars and workshops to further cultivate knowledge and skills in application design using Oracle APEX.

Acknowledgements

This work was funded by the European Union under the Erasmus+ project "Better Employability for Everyone with APEX" with Project ID: 'KA220-HED-15/21'.

References

Abid A, Farooq MS, Raza I, Farooq U, Abid K. Variants of teaching first course in database systems. Bulletin of Education and Research. 2015;37(2):9–25.

Baggia A., Leskovar R., Rodič B., LOW CODE PROGRAMMING WITH ORACLE APEX OFFERS NEW OPPORTUNITIES IN HIGHER EDUCATION, 3rd International Scientific Conference on Recent Advances in Information Technology, Tourism, Economics, Management and Agriculture – ITEMA 2019 – Bratislava, Slovakia, October 24, 2019

Baggia, Alenka & Mali, Aljaž & Grlica, Andrej & Leskovar, Robert. (2018). Oracle APEX in Higher Education. 10.18690/978-961-286-146-9.3.

Conklin, M., & Heinrichs, L. (2005). In Search of the Right Database Text. Journal of Computing Sciences in Colleges, 21(2), 305-312.

Cvetanovic, Miloš & Radivojevic, Zaharije & Blagojevic, Vladimir & Bojovic, Miroslav. (2011). ADVICE—Educational System for Teaching Database Courses. Education, IEEE Transactions on. 54. 398 - 409.

Dietrich SW, Urban SD, Haag S. Developing advanced courses for undergraduates: A case study in databases. IEEE Transactions on Education. 2008;51(1):138–144. doi: 10.1109/TE.2007.907322.

Dominguez, C., & Jaime, A. (2010). Database design learning: A project-based approach organized through a course management system. Computers \& Education, 55(3), 1312–1320.

Garcia-Molina, H. (2008). Database systems: the complete book. Pearson Education India

Geller A., Spendolini B., Oracle Application Express: Build Powerful Data-Centric Web Apps with APEX, Oracle Press, 2017

Ishaq M, Abid A, Farooq MS, Manzoor MF, Farooq U, Abid K, Helou MA. Advances in database systems education: Methods, tools, curricula, and way forward, Education and Information Technologies, 2022

Kawash, J., Jarada, T., & Moshirpour, M. (2020). Group exams as learning tools: Evidence from an undergraduate database course. Proceedings of the 51st ACM Technical Symposium on Computer Science Education, 626–632.

Manzoor MF, Abid A, Farooq MS, Nawaz NA, Farooq U. Resource allocation techniques in cloud computing: A review and future directions. Elektronika Ir Elektrotechnika. 2020;26(6):40–51

Nagataki, H., Nakano, Y., Nobe, M., Tohyama, T., & Kanemune, S. (2013). A visual learning tool for database operation. Proceedings of the 8th Workshop in Primary and Secondary Computing Education, 39–40.

Oracle. (2023). Oracle Application Express

Pique Solutions, A Time and Motion Analysis Developing Applications Using Oracle APEX versus Traditional Development Approaches, January 22, 2019

Robbert, M. A., & Ricardo, C. M. (2003). Trends in the evolution of the database curriculum. In ACM SIGCSE Bulletin (Vol. 35, No. 3, pp. 139- 143). ACM.