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# Adopting Complex Networks to Detect Cheat Cases in Electronic exams

**Mahmood Alfathe [1], Ali Othman al janaby [2], Azhar Abdulaziz [3] and Manar Kashmola [4]**

[1]*Department of Computer Networks and Internet, College of Information Technology , Ninevah University , Mosul, Iraq*
[2]*Department of Communication Engineering, College of Electronics Engineering, Ninevah University, Mosul, Iraq*
[3]*Department of Software Engineering, College of Information Technology, Ninevah University, Mosul, Iraq*
[4]*Department of Computer Science, College of Computer Science and Mathematics, University of Mosul, Mosul, Iraq*

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**Abstract:** For Electronic education considerations, sometimes it is crucial to rely on solutions, even though these solutions have more negative than positive results. One of the most sensitive areas in remote studies is the morals and honesty of the students, precisely when they perform online tests or exams. This study will suggest a monitoring system to avoid cheating with electronic exams depending on the distributed geo-information of students' devices and the integration of complex networks' analysis. This investigation was conducted in a class with equal gender distribution. There were 34 females and 34 males attended the class. The number of e-learning and e-test sessions varied for every student. According to the study, some students only get e-test sessions rather than e-learning sessions. In this instance, the students were removed in order to provide a distribution of honesty ratings that is typical. Following the computation of each student's honesty percentage, the results were distributed regularly according to the total number of students. The findings indicate that when considering the differences in honesty scores for the two genders, distant E-tests perform better with female students than with male students. There are several possible explanations for this, one of which is the social structure of the students. In Middle Eastern cultures, it is common knowledge that men enjoy greater freedom and space than women. This had an impact on the ability of male students to congregate in one place, as this study demonstrated when IP-address physical locations were compared. It was discovered that many students had abnormalities with their Electronic-Study-Profile when taking the E-test, but that the same students also had similarities with the E-Test-Profile. Compared to the male pupils, female students also showed anomalies in their E-Test-Profiles.

**Keywords:** Electronic learning , electronic exams ,COVID-19 ,Networks.

## 1. Introduction

Electronic learning has been introduced as an option to many educators as the internet has become an essential service for users almost all over the world for many reasons, such as the vital distance between students and schools, students who do not have sufficient time to attend university or school, and many other factors [1]. Many universities adopted this technology in the early 2000s [2], while others used it as a complementary service, yet traditional education was the basic and only way to fulfill university requirements, which could not be completed without having students physically present at universities' classes to do tests [3].

In 2020, when the Corona pandemic was discovered and announced as a health threat [4], social distancing and the lockdown all over the world in action had a direct effect on all life activities, and one of these was education [5].

At that phase, remote teaching was globally enforced by education institutions and universities as a result of the decision between halting education or continuing with full-time remote teaching to find a substitute solution for traditional education [6]. Remote teaching and learning at that time was considered a first-time experience for many educators and students, and there were many struggles for both parties (students and teachers) [7]. After all, things went smoothly with E-classes, home works, and even E-labs using simulations, until the teaching staff had to go through the testing phase [8]. Electronic tests, despite the available monitoring systems such as visual monitoring through web cameras or audio using microphones, had many weak points [9], which the majority of students had discovered, and many of them used these vulnerabilities to pass tests or exams in different ways as they became "cheating methods" [10]. This was an education worldwide problem for the whole education system, as students' results during these

*E-mail address: mahmood.alfathe@uoninevah.edu.iq , ali.mohammed@uoninevah.edu.iq , azhar.abdulaziz@uoninevah.edu.iq ,manar.kashmola@uomosul.edu.iq*

E-tests could be crucial to the future lives and careers of the students, which in turn will determine both their economic status and their position in society for all graduates [11].

Cheating in academic environments will increase the chances of dishonest behavior in workplaces after graduation, as clearly described in the study performed by [12]. Many suggestions or paid solutions were introduced to overcome this problem; on the other hand, numerous numbers of schools did not have dedicated budgets planned to buy monitoring software, did not have any real solutions, or even considered the “cheating methods” discovered and used by students as cheating [13].

## 2. Literature review

Many studies suggested solutions to overcome E-exams’ weak points; others implemented studies to suggest new strategies to improve students’ honesty [14][15]. Trusting the electronic exam system is an essential factor in acquiring accurate results. E-exams present a serious challenge for all educators to validate students; qualifications to determine their credibility towards certificates or degrees [16]. The survey perused by [17] in his academic study, which included almost 800 educational institutions, discovered that 93% of educators believe that students have a greater chance to cheat compared to the opportunity of cheating during normal tests, and they also believe this problem could not be solved during COVID-19. The work presented in [18] shows that online teaching has a wide range of academic dishonesty among students. This study’s personality, cognitive aspects, and teaching styles also have a direct effect that can lead to cheating in e-exams. The review conducted by [19] confirms that the title of fraud cases in E-exams is the most popular title in the literature on E-learning. In this matter, collecting teachers’ opinions suggests that e-exam environments have more drawbacks than the actual environments. Also, [20] shows in their study that e-exams provide more facilitation for cheating [21]. Their work proved that the suggestions provided could reduce the level of electronic cheating. They also admitted that no system can stop electronic cheating, but their work remarkably reduced the cheating. The study performed by [22] believes there are not enough tools to combat electronic cheating as students have started to learn a high level of methods used for cheating compared to face-to-face classes [23]. Their study stated that research related to online academic dishonesty (OAD) is very rare, hence the need for more research in this field [24]. It was statistically proven in the work presented that electronic cheating is present between students and can directly affect students’ behavior. An analysis of the search engine data done by [25] has proved that students’ requests for exam cheating have been found during the pandemic. The problem of electronic cheating was in Ninevah University’s spot during COVID-19. Finding a good plan to overcome the accompanying problems, including dishonesty and non-moral competition between students during the electronic tests, was a must-do action from the university.

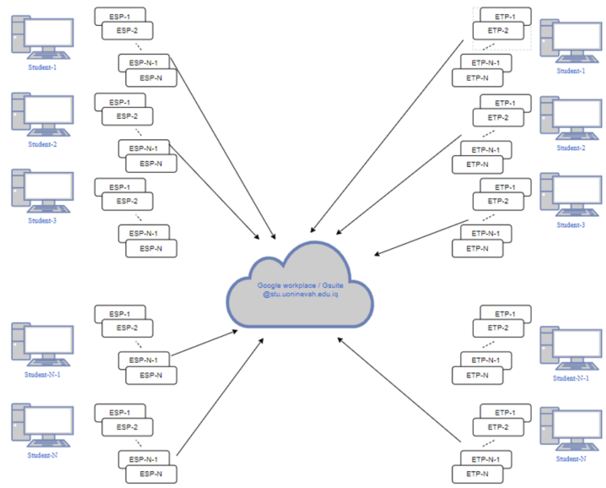


Figure 1. Google education services store users’ sessions’ details.

## 3. E-learning system architechture

Ninevah University, as well as many other universities, adopted the education version of “G-Suite” provided by Google LLC, which included at that time the basic requirements to successfully create E-classes and E-tests. Ninevah University consists of seven colleges with more than 5000 faculty and students. All faculty have an email ID under the domain ”uoninevah.edu.iq,” and all students have an email ID under the subdomain ”@stu.uoninevah.edu.iq.” All faculty have access to create e-classes and enroll students in these classes, along with the ability to create tests through Google Forms or scanned papers that are considered students’ answers. The major problem is the insufficient ability to monitor students and prevent them from gathering at the same place or practicing the exams as groups in pre-agreed places. At that time, students practicing exams gathered in groups in the same places without staff monitoring, which was the main problem. Google education services have the ability to save each session for each user during any session established between any user under the domain of Ninevah University, @uoninevah.edu.iq, or @stu.uoninevah.edu.iq, as shown in Figure 1.

The growth of E-Learning has been spontaneous, lacking a comprehensive understanding of the various elements that make up a typical e-learning system and their interconnectedness. The establishment of a well-defined architecture is crucial in order to define competitive landscapes and facilitate the development of standards. To date, there are existing proposals for standardizing information models, including learning object metadata, learner profile, and content packaging. These standards play a crucial role in enhancing interoperability and reusability among e-learning content and system components by providing the necessary data structure. Additionally, there are also standards pertaining to the conceptual component model of e-learning architecture, such as the LSTC of IEEE [26]. The E-learning system's functional architecture encompasses the various components and objects that are involved in its operation. These components work together to facilitate the movement of objects between them. Several proposals have been put forth for the functional model, including SCORM [27]. A comprehensive functional model of a learning management system is defined, while Sun Microsystems also introduces its own functional model [28]. A standard E-learning system typically separates the learning process into two distinct components: a content management system and a learning management system. This division aims to enhance functional clarity and ensure comprehensive coverage of all e-learning function components. The definition of the learning objects exchanged between each component is established, which is connected to the existing learning standards. Currently, there is a wide range of e-learning products available in the market, each utilizing various platforms that lack compatibility with one another. An instance of this is the lack of interoperability between distributed object systems like Microsoft's COM family and the OMG CORBA standard. Both of them posed various security and administrative difficulties when implemented online, and neither fully satisfied the scalability requirements set by the Internet. Web Services offer a standardized method of communication between diverse software applications, operating on various platforms and/or frameworks. The enthusiasm surrounding Web Services stems primarily from the potential of harnessing a blend of XML, the Web, SOAP and WSDL specifications, along with protocol stacks that are yet to be defined, in order to tackle numerous challenges faced by these technologies. 1. Web Services have been developed with the aim of establishing a standardized reference architecture. This architecture not only facilitates interoperability and extensibility among various applications but also enables their integration to carry out more intricate operations. The primary objective behind the creation of Web Services is to establish a standard reference architecture. This architecture plays a crucial role in promoting interoperability and extensibility among different applications, while also facilitating their combination for the execution of more sophisticated operations [25].

The fundamental purpose of Web Services is to provide a standardized reference architecture. This architecture serves to enhance interoperability and extensibility among diverse applications, enabling them to be seamlessly integrated for the execution of complex operations [29].

## 4. Classification of e-learning standards

The primary objective of e-learning interoperability standards is to establish standardized data structures and communication protocols for e-learning objects and cross-system workflows. By incorporating these standards into their offerings, vendors enable e-learning users to confidently select content and system components from multiple sources, based on their quality and suitability. This classification encompasses five distinct categories for learning standards and specifications.

### A. *Meta data*

To ensure efficient indexing, storage, search, and retrieval of learning objects across multiple repositories, it is crucial to maintain a consistent labeling system for learning content and catalogs. This labeling system, known as learning object metadata, plays a vital role in supporting these processes. Notably, the Learning Object Metadata (LOM) developed by IEEE Learning Technology Standards and Dublin Core Metadata are among the prominent standards being implemented. Additionally, various organizations have embraced and customized the LOM framework to suit their specific needs [7].

### B. *Content packaging*

To enable seamless transfer of courses across various learning systems, content packaging specifications and standards play a crucial role. Key initiatives in this domain include the IMS Content Packaging specification, the IMS Simple Sequencing specification and the ADL Sharable Content Object Reference Model (SCORM) [27].

### C. *Learner profile*

Learner profile information encompasses various aspects such as personal data, learning plans, learning history, accessibility requirements, certifications and degrees, as well as assessments of knowledge and the status of participation in current learning. The IMS Learner Information Package (LIP) specification stands as the primary endeavor to standardize learner profile information [30].

### D. *Learner registration*

To ensure a personalized learning experience, it is essential to gather learner registration information. This data enables the learning delivery and administration components to identify the appropriate offerings for each learner. Additionally, it provides valuable insights about the learning participants to the delivery environment. In the field of e-learning, two initiatives are currently addressing these requirements: The IMS Enterprise Specification and the Schools Interoperability Framework. These initiatives focus on facilitating the exchange of this specific type of data within the K-9 educational environment [30].

### E. *Content communication*

Upon the launch of content, it is crucial to establish effective communication by transmitting learner data and previous activity information. The ADL is currently undertaking the development of the SCORM project, which aligns with the CMI specification of the Aviation Industry CBT Committee, to facilitate this process.

## 5. Functional model of e-learning system

The online education marketplace Figure 2 should have four main components:

- A web-based application for simplifying development. A web application is a crucial component of an online learning platform, integrating features like

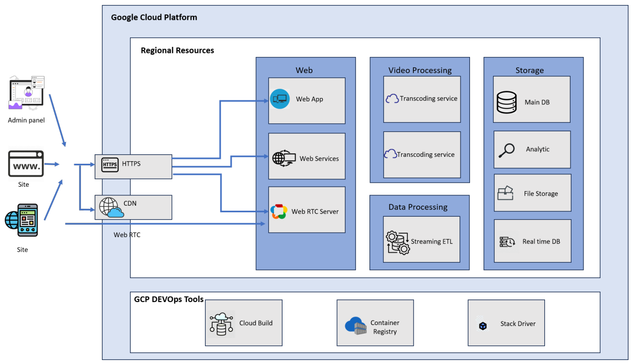


Figure 2. online education marketplace.

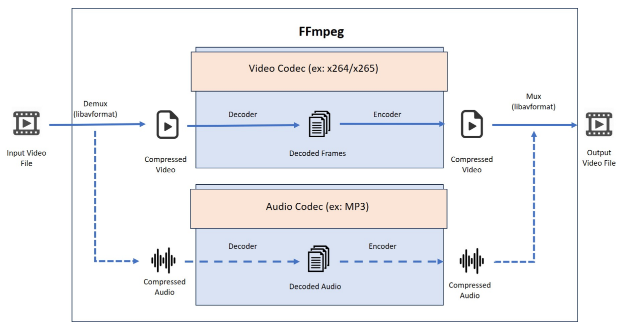


Figure 3. Video Process stack.

user authentication and management. It is typically integrated using APIs. When developing an e-learning web app, there are two options: building a monolithic application for limited content and users, or splitting the back-end into microservices for third-party educational organizations to post and sell their courses. This choice depends on the specific needs and future scaling requirements of the platform.

- video processing for transcoding, uploading, and streaming educational videos on-demand, video services enable users to upload video materials and send transcoded videos to their devices Figure 3 The quality of streaming depends on factors like video formats, device memory, and internet speeds. Video services transcode video files and create multiple versions of the same video in different sizes, allowing users to watch online courses even with slow internet and consuming minimal device memory.

- data processing for receiving events from other parts of the custom eLearning service. Streaming Extract, Transform, Load (ETL) involves the transfer of real-time data between systems, connected to analytics and real-time databases. ETL functions include extract, transform, and load. Extract collects data from a source, transforms it through processes, and loads it to a destination like analytics and real-time databases. These functions are essential for efficient data management and analysis.

- A cloud storage for storing original uploaded on-demand education video files. The storage of a learning platform consists of four main elements: the main database, analytics, file storage, and real-time database. The main database organizes data into columns and rows, ensuring all co-dependent elements work simultaneously. Relational databases, such as CloudSQL, are recommended for this purpose, as they support MySQL, PostgreSQL, and SQL Server. Analytics gathers information about actions happening on the platform and analyzes it to provide insights about users. BigQuery Analytics is recommended for handling massive amounts of data and storing necessary data in separate spreadsheets. This tool can provide detailed reports on popular courses, paid subscriptions, user access, and mobile device usage. File storage stores all materials used by the learning platform, including uploaded video files, transcoded video files, and images. Google Cloud Storage is recommended for all files, as on-premise solutions do not suit a streaming platform's growing needs. It offers low-latency content delivery across the globe and geo-redundant storage with the highest availability and performance level. For real-time storage of videos, The Firebase Realtime Database is recommended. This cloud-hosted NoSQL database allows storing and synchronizing data between users in real-time. Firebase's Android, iOS, and Javascript SDKs allow users to access online courses via web browsers, iOS, and Android devices, and supports offline data access.

## 6. Analysing the problem

### A. Setting up work platform

In this study, the e-learning system adopted by Ninevah University was used to analyze the behavior of the students on a daily basis during e-classes and e-tests. The results of these analyses were used to produce an ”Electronic Behavior” for each student, also known as an ”Electronic Study Profile” or ”ESP,” as each student has a record of geo-information locked to their physical IP address pulled from each E-study session. On the other hand, other analyses at different times during electronic tests produced an ”E-Test Profile” or “ETP” for each student, which shows the geo-information profile of the student during tests. To test the honesty of each student, a comparison is made between ESP and EST. Each comparison will provide a ratio of success depending on the distance between the actual ESP and the ETP. Figure 4. Explain the full architecture of the suggested system.

### B. Method

The G-Suite education version provided the ability for system administrators with sufficient privileges to read logs to help answer the question, “Who did this, where,

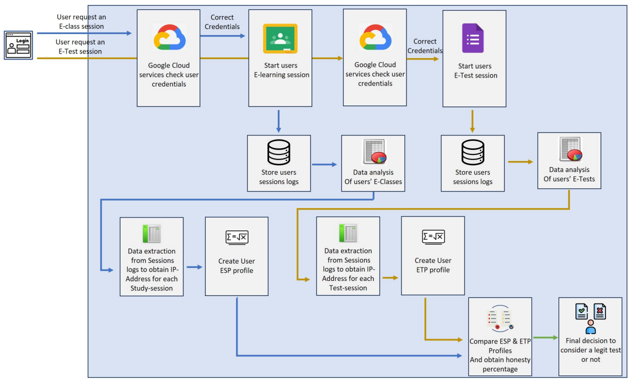


Figure 4. The suggested system architecture.

and when?". At the organization level, Google Workplace provides the following types of logs or audit logs:

1.Google Workspace Admin Audit

2. Google Workspace Enterprise Groups Audit

3. Google Workspace Login Audit

4. Google Workspace OAuth Token Audit

5. Google Workspace SAML Audit

The above logs were considered the dataset that was used to build the system.

### *C. Building esp, and etp*

Figure 5. demonstrates the process of building the ESP and ETP for each student. The first phase included scanning all "Google Workspace Login Audit" logs to gather necessary information related to each student, which was later used to build the ESP and ETP. At the main Google workplace console, in the reporting section, under Audit and investigation, classroom log events, all audit logs are displayed. In this stage, filter search results with specific student email to display logs for only targeted students.

### *D. Exporting results*

All results are exported as comma-separated (CSV) values for further processing, as shown in Figure 6. The second phase can be considered a "normalizing phase," where all unwanted data is eliminated and other data is refined to have the desired information, which consists of the following data:

- Student email.
- IP-address.
- Country.
- City.
- Rebuilt ip-address (1st, and 2nd octet of the IP address).

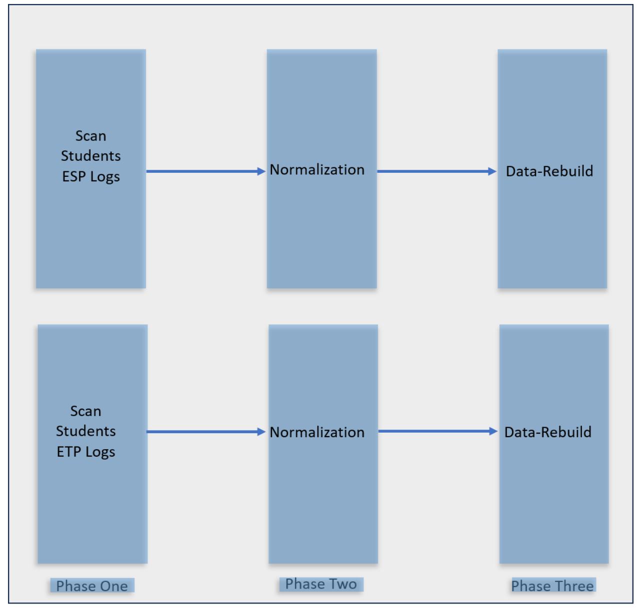


Figure 5. Building students' ESP, and ETP.

All sessions' IP addresses are disassembled into their four octets to build a new IP address that only includes the first and second octets of the original IP address. Rebuilding IP addresses is implemented to only compare the 1st and 2nd octets of the ESP to the 1st and 2nd octets of the ETP. The decision to choose only this part of the sessions' IP addresses was made to separate the network portion from the host portion, as all sessions' IP addresses are type B.

### *E. Comparison phase, and building honesty score*

This phase presents the core of building the student honesty score. Building ESP includes scanning for all study sessions' IP addresses. A counter is used to calculate the occurrence of each Study-IP-address, and then the ratio of each IP-address to the total number of Study-IP-addresses (TNS-IP-address) is calculated by dividing the sum of occurrences by the total number of Study-IP-addresses, as shown in (1).

$$Study{-}IP{-}\ weight = \frac{TNS - IP - address}{\sum\ TNS - IP - adresses} * 100 \quad (1)$$

Building the ETP includes scanning all Exam-IP addresses through Test or Exam sessions and calculating the weight of the Exam-IP address by dividing the total number of occurrences of the Exam-IP address (TNE-IP address) by the total number of all Exam-IP addresses, as shown in (2).

$$Exam{-}IP{-}weight \ = \frac{TNE - IP - address}{\sum\ TNE - IP - adresses} * 100 \quad (2)$$

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Student Email | IP addres | Country | City | 1st | 2nd | 3rd | 4th | 1st+2nd |
| 2 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 14 | 37.238 |
| 3 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 7 | 37.238 |
| 4 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 44 | 37.238 |
| 5 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 44 | 37.238 |
| 6 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 15 | 37.238 |
| 7 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 38 | 37.238 |
| 8 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 31 | 37.238 |
| 9 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 31 | 37.238 |
| 10 | student1@uoninevah.edu.iq | 82.199.22 | IQ | Mosul | 82 | 199 | 220 | 89 | 82.199 |
| 11 | student1@uoninevah.edu.iq | 82.199.22 | IQ | Mosul | 82 | 199 | 220 | 18 | 82.199 |
| 12 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 44 | 37.238 |
| 13 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 44 | 37.238 |
| 14 | student1@uoninevah.edu.iq | 37.238.80 | IQ | Mosul | 37 | 238 | 80 | 19 | 37.238 |
| 15 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 38 | 37.238 |
| 16 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 24 | 37.238 |
| 17 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 24 | 37.238 |
| 18 | student1@uoninevah.edu.iq | 185.16.26. | IQ | Mosul | 185 | 16 | 26 | 75 | 185.16 |
| 19 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 15 | 37.238 |
| 20 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 15 | 37.238 |
| 21 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 15 | 37.238 |
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| 23 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 22 | 37.238 |
| 24 | student1@uoninevah.edu.iq | 82.199.22 | IQ | Mosul | 82 | 199 | 221 | 92 | 82.199 |
| 25 | student1@uoninevah.edu.iq | 82.199.22 | IQ | Mosul | 82 | 199 | 221 | 101 | 82.199 |
| 26 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 33 | 37.238 |
| 27 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 33 | 37.238 |
| 28 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 33 | 37.238 |
| 29 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 16 | 37.238 |
| 30 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 16 | 37.238 |
| 31 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 17 | 37.238 |
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| 38 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 44 | 37.238 |
| 39 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 38 | 37.238 |
| 40 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 27 | 37.238 |
| 41 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 28 | 37.238 |
| 42 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 29 | 37.238 |
| 43 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 29 | 37.238 |
| 44 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 42 | 37.238 |
| 45 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 42 | 37.238 |
| 46 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 32 | 37.238 |
| 47 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 32 | 37.238 |
| 48 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 38 | 37.238 |
| 49 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 24 | 37.238 |
| 50 | student1@uoninevah.edu.iq | 185.16.26. | IQ | Mosul | 185 | 16 | 26 | 75 | 185.16 |
| 51 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 15 | 37.238 |
| 52 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 15 | 37.238 |
| 53 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 22 | 37.238 |
| 54 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 31 | 37.238 |
| 55 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 15 | 37.238 |
| 56 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 31 | 37.238 |
| 57 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 33 | 37.238 |
| 58 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 33 | 37.238 |
| 59 | student1@uoninevah.edu.iq | 37.238.68 | IQ | Mosul | 37 | 238 | 68 | 38 | 37.238 |

Figure 6. Building students' ESP, and ETP.

When the ESP and ETP built for each student are completed, the honesty percentage is produced by calculating the distance between all ESPs and ETPs for each student. The distance is calculated by multiplying the equivalent lecture weight, if found, by the exam weight, as shown in (3). The final honesty score is produced by adding all distance results, as shown in (4).

$$Honesty\% \ = Lecture\ weight * Exam\ weight \tag{3}$$

$$Total\ Honesty\ Score = \sum_{n}^{1} \frac{honesty - score - 1}{honesty - score - n} \tag{4}$$

## 7. Results and discussion

This study was performed on an even-gender-distributed class. The class consisted of 34 males and 34 females. Each student had a different range of e-learning and e-test sessions. The study found some students don't have e-learning sessions; they only have e-test sessions; in this case, these students were eliminated to produce a normal honesty scores' distribution. After calculating the honesty percentage for each student, the results were normally distributed based on the total number of students.

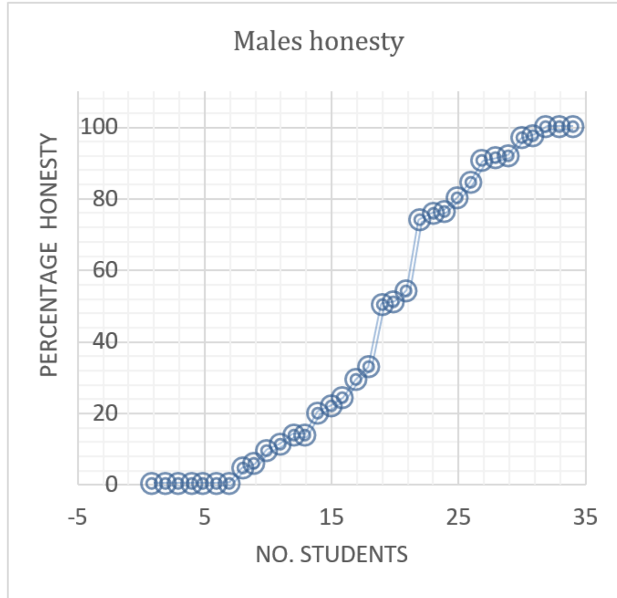


Figure 7. Males honesty scores distribution.

### A. Honesty scores males vs females

In this study, honesty scores were evaluated according to the student gender. The results demonstrate the student's honesty and its distribution.

### B. Males' students result

Figure 7 shows the distribution of the male students' honesty scores. Males' honesty scores start with a (0) zero ESP score with the first 7 students. When scores start to rise, in some areas, scores occur in horizontal positions, while in other areas, scores are grouped in vertical positions, producing almost vertical lines. At the end of the plot, a group of male students scored 100% honesty. Figure 8 shows male' students' honesty recursive at each range of honesty. As we can see, the highest number of occurrences is found with the honesty score (0), while the lowest occurrences of honesty score are 40 and 60, and the 100% honesty scores are counted only three times.

### C. Females' students result

Figure 9 shows the females' honesty score distribution. Females' scores only have 2 students with zero ESP scores. The score distribution almost appears as a diagonal line. The scores compose 4 groups; the biggest group is found with a 100% honesty score. Figure 10 shows the occurrences of honesty scores among female students' scores as shown in the figure, scores' groups vary in value, while the common range is 3 students. On the other hand, the results show the lowest score (0) has 4 female students' students, while the highest honesty score has 5 female students.

## 8. Conclusions and future work

Comparing both female and male students' honesty scores is shown in Figure 11. Female students' honesty

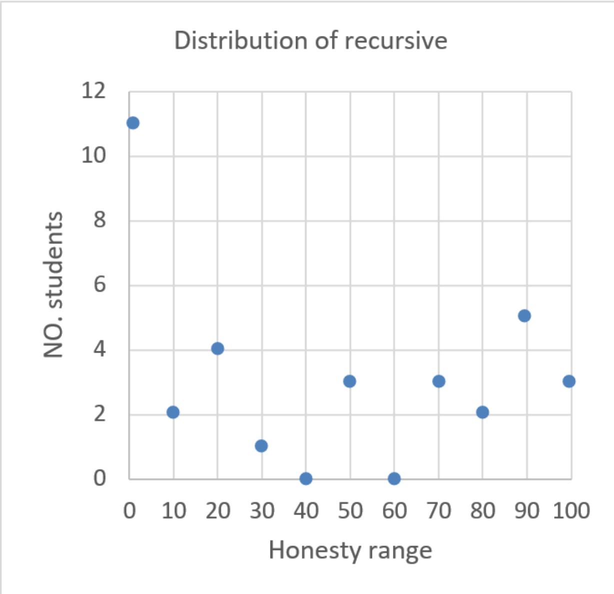


Figure 8. males' scores distribution .

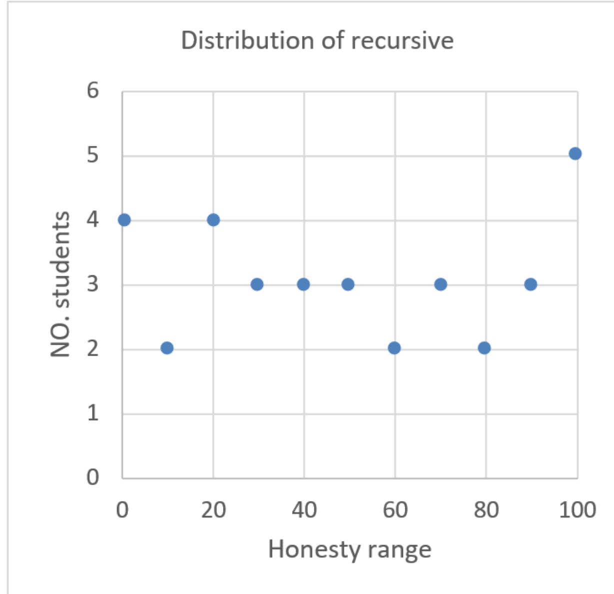


Figure 10. Females' scores distribution.

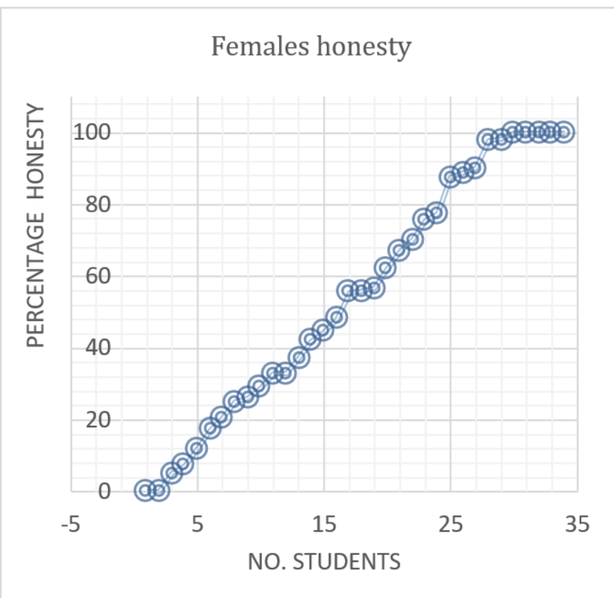


Figure 9. Females students' honesty scores distribution.

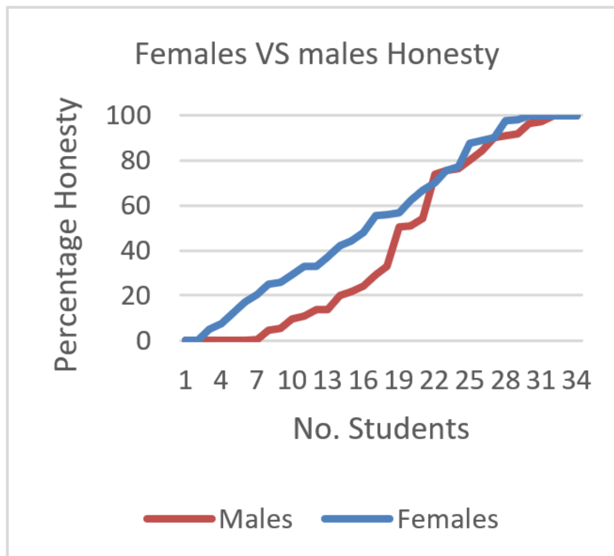


Figure 11. females VS males honesty scores.

scores are shown in the plot with the blue line, while males' scores are shown with the red line. As a result, females' honesty scores show a lead in the scores, as females' scores immediately rise after 2 students, while male students take a count of 7 students to start scoring. Finally, females' scores stabilized at the 100% honesty score, almost with the 27th female student, while with the male students, the 100% honesty score could not be reached until the 30th male student.

The results show that distant E-tests have better results with female students compared to male students when noticing the differences in honesty scores for both genders. This can be related to many reasons, one of which is the student's social system. It is known in Middle Eastern communities that males have more freedom than females. This reflected on the ability of male students to gather in same location, which this study proofed when IP-address physical locations are compared, were its found that many students have abnormalities with their ESP when doing E-test, on the other hand this study shows that same students have similarities with the ETP when performing E-test. Female students also had abnormalities in ESPs when compared to the ETPs. This happened when female students did E-tests, with 75% better honesty scores than male students.

Although this study was conducted on a limited number of students who share the same specialty, this work opens the field to more studies based on the same methodology with the ability to include different Scientific specializations. This will provide a broad range of compression which will result in forming a better way to manage the electronic education, and improve the integrity of such type of education systems.

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