Research Paper

Studying Students' Knowledge of the Benefits, Challenges, and Applications of Big Data Analytics in Healthcare

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\textbf{ABSTRACT}

The purpose of this study was to evaluate the students' familiarity from different universities of Mashhad with the benefits, applications and challenges of Big Data analysis. This is a cross-sectional study that was conducted on students of different fields, including Medical Engineering, Medical Informatics, Medical Records and Health Information Management in Mashhad-Iran. A questionnaire was designed. The designed questionnaire evaluated the opinion of students regarding benefits, challenges and applications of Big Data analytics. 200 students participated and participants' opinions were evaluated descriptively and analytically. Most students were between 20 and 30 years old. 43.5% had no work experience. Current and previous field of study of most of the students were HIT, HIM, and Medical Records. Most of the participants in this study were undergraduates. 61.5% were economically active, 54.5% were exposed to Big Data. The mean scores of participants in benefits, applications, and challenges section were 3.71, 3.68, and 3.71, respectively, and process management was significant in different age groups \((p=0.046)\), information, modelling, research, and health informatics across different fields of studies were significant \((p=0.015, 0.033, 0.001, 0.024)\). Information and research were significantly different between groups \((p=0.043\) and 0.019\), research in groups with / without economic activity was significant \((p=0.017)\) and information in exposed / non-exposed to Big Data groups was significant \((p=0.02)\). Despite the importance and benefits of Big Data analytics, students' lack of familiarity with the necessity and importance is significant. The field of study and level of study does not appear to have an effect on the degree of knowledge of individuals regarding Big Data analysis. The design of technical training courses in this field may increase the level of knowledge of individuals regarding Big Data analysis.

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1. Introduction

Today, with the advent of various technologies, a huge amount of data that is known as Big Data in being generated especially in healthcare. Big data analytics has become a hot topic and has been the focus of many academic communities and the subject of many students’ research (Achariya & Ahmed, 2016, Alharthi et al., 2017). This type of data has features such as high volume and diversity and due to these features, they cannot be managed and analysed using conventional hardware and software. Analytics for analysing Big Data are known as Big Data Analytics and have many benefits including useful data pattern discovery and important features extraction (Nahr et al., 2021, Nazari et al., 2021). This analysis has many applications in various medical and insurance industries (Archenaa & Anita, 2015). In addition to the many benefits of these analytics, there are challenges that if ignored, the results will change, such as a lack of expert staff, lack of familiarity with the tools and methods required, data type, security issues, budget and etc (Gharachorloo et al., 2021, Manogaran et al., 2017). Understanding the benefits, challenges, and applications of this area can be helpful in conducting useful and efficient research (Belle et al., 2015, Nozari et al., 2021). Due to the importance of Big Data analysis in various industries and the fact that students and their research are related to industry and applied research, this field in Iran is in the early stages of research and unfamiliar with the concepts is severely felt. The purpose of this study is to investigate students' familiarity with the different Benefits, applications, and challenges of Big Data.

2. Method

This cross-sectional study was designed for 200 students of Ferdowsi University and Mashhad University of Medical Sciences. Mashhad is the largest city in eastern Iran with a population of about three million, located on the border with Afghanistan and Turkmenistan on the Silk Road. Mashhad has two major universities, Ferdowsi and Medical Sciences, which students in engineering and basic sciences study at Ferdowsi University and students in medical sciences such as medical Records, Health Information Management and Medical Informatics study at Mashhad University of Medical Sciences.

A questionnaire was designed to assess the level of the knowledge of students in Mashhad universities about the benefits, applications and challenges of Big Data analysis. The questionnaire contains close-end questions with a five-point Likert scale. The basic items of the questionnaire were based on literature searches in Google Scholar, Science Direct and EMBASE databases and were designed and validated by the Delphi method with the participation of 10 experts from various fields (Medical Informatics, Biostatistics, HIT and Computer Science). The questionnaire was designed in the form of 3 general items of benefits, applications and challenges. Benefits included information with 5 questions, modelling with 3 questions, data with 5 questions, and process management with 6 questions. Application questions consisted of health service delivery with 17 questions, research with 4 questions, health, information with 16 questions, essential medicine with 15 questions, health financial with one question, leadership and governance with 6 questions and challenge included 9 questions. The questions are listed in Table 1:
| Items               | Questions                                                                 | Category       | Subcategory                                                                 |
|--------------------|---------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------------|
| Advantages         | In your opinion, which advantages are related with Big Data analysis?      | Information    | Generating new knowledge                                                   |
|                    |                                                                           |                | Sharing information                                                         |
|                    |                                                                           |                | Displaying and summarizing information                                      |
|                    |                                                                           |                | Extracting information and delivery for better results                     |
|                    |                                                                           |                | Using meaningful information                                                |
| Modeling           |                                                                           |                | Predicting disease epidemics                                                 |
| Data               |                                                                           |                | Increasing confidence                                                       |
|                    |                                                                           |                | Discovering and exploring behavioral pattern or activities                  |
|                    |                                                                           |                | Decreasing ambiguity                                                         |
|                    |                                                                           |                | Increasing reliability                                                       |
|                    |                                                                           |                | Reducing uncertainty                                                        |
|                    |                                                                           |                | Improving data quality                                                       |
|                    |                                                                           |                | Managing massive volumes of data                                             |
| Process management |                                                                           |                | Improving clinical trial quality                                             |
|                    |                                                                           |                | Improving operational efficiencies                                           |
|                    |                                                                           |                | Interpreting easiness                                                       |
|                    |                                                                           |                | Improving entity detection                                                   |
|                    |                                                                           |                | Managing communications that are seemingly unrelated                        |
|                    |                                                                           |                | Improving the ability of intelligent systems                                |
| Applications       | In your opinion, Which applications are related to Big Data analysis?      | 1. Health Service Delivery | Disease screening                                                           |
|                    |                                                                           |                | public health                                                               |
|                    |                                                                           |                | Disease earlier diagnosis                                                    |
|                    |                                                                           |                | Patient-centered services                                                    |
|                    |                                                                           |                | Therapeutic approaches improvement                                           |
|                    |                                                                           |                | Surgery                                                                      |
|                    |                                                                           |                | Rehabilitation                                                               |
|                    |                                                                           |                | Clinical operations analysis                                                 |
|                    |                                                                           |                | Primary care                                                                 |
|                    |                                                                           |                | Readmissions management                                                      |
|                    |                                                                           |                | Health care delivery                                                         |
|                    |                                                                           |                | Disease management                                                           |
|                    |                                                                           |                | Cause of disease detection                                                   |
|                    |                                                                           |                | Decompensation management                                                    |
|                    |                                                                           |                | Blood transfusion management                                                 |
|                    |                                                                           |                | Triage management                                                            |
|                    |                                                                           |                | Health care data management                                                  |
| 2. Research        |                                                                           |                | Prediction                                                                   |
|                    |                                                                           |                | Disease pattern analysis                                                     |
|                    |                                                                           |                | Side effects discovery                                                       |
|                    |                                                                           |                | Research & development & Innovation                                          |
| 3. Health Information |                                                                           |                | personalized medicine                                                       |
|                    |                                                                           |                | PHR (Personal Health Record) and HER                                         |
|                    |                                                                           |                | EBM (Evidence Base Medicine)                                                 |
|                    |                                                                           |                | Patient monitoring                                                           |
|                    |                                                                           |                | Web and social media                                                         |
|                    |                                                                           |                | IOT (Internet Of Things)                                                     |
|                    |                                                                           |                | Semantic standards                                                           |
|                    |                                                                           |                | Biometric                                                                    |
|                    |                                                                           |                | Patient profile analytics                                                    |
|                    |                                                                           |                | CPOE (computerized physician order entry)                                   |
|                    |                                                                           |                | Health informatics                                                           |
|                    |                                                                           |                | Coding management                                                            |
|                    |                                                                           |                | IT infrastructure management                                                 |
|                    |                                                                           |                | Quality measurement                                                          |
|                    |                                                                           |                | Bioinformatics and genetics                                                   |
|                    |                                                                           |                | Comorbidity Discovery, Adverse events Discovery                              |
|                    |                                                                           |                | Diagnosis                                                                    |
| Section | Russian Medicines | English Medicines |
|---------|------------------|------------------|
| 4.(Essential) Medicines | Precision medicine | CDSS(Clinical Decision Support System) |
| | Sensor processing | RFID(Radio-Frequency identification) |
| | Signal processing | Drug discovery & clinical Research |
| | Vision augment | GPS(Global Positioning System) |
| | Mobile health | Telemedicine, E-health, Remote healthcare system |
| | Information Support | Mobile health |
| | Image processing | RFID(Radio-Frequency identification) |
| | BCI(Brain Computer Interface) and smart home | Precision medicine |
| | Recommender systems | Sensor processing |

| Section | Russian Medicines | English Medicines |
|---------|------------------|------------------|
| 5.Health Financing | Cost Reduction & Insurance service | Cost Reduction & Insurance service |

| Section | Russian Medicines | English Medicines |
|---------|------------------|------------------|
| 6.Leadership and Governance | R & D in medications | R & D in medications |
| | Hospital quality monitoring | Hospital quality monitoring |
| | Resource management | Resource management |
| | Resource management | Resource management |
| | Operational management | Operational management |
| | Business and organizational and Strategic management | Business and organizational and Strategic management |

| Challenges | English Medicines |
|------------|------------------|
| In your opinion, what challenges there are in big data analysis | Lack of knowledge about appropriate for the purpose |
| | Lack of IT infrastructure |
| | Lack of expertise about appropriate tools and algorithms |
| | Variable and scalable data |
| | Lack of data quality |
| | Data uncertainty and missing data |
| | Unstructured data |
| | Security and privacy issue |
| | High cost |

The validity and reliability of the questionnaire were confirmed by the presence of 10 validity experts and the reliability was confirmed by Alpha Cronbach's 92.1%. The questionnaires were then distributed to 200 students. Students of Medical Engineering, Medical Informatics, Medical Records and Health Information Management participated in the study. Data were collected to ensure that participants answered all the questions. 200 questionnaires were completed. Data entry and analysis were performed using EXCEL (v. 2007) and SPSS (v. 21).
3. Results

For this study, 200 students participated and the results are shown in Table 2.

| Variables          | Items                        | Frequency (percentage) of student (n=200) |
|--------------------|------------------------------|------------------------------------------|
| Age                | <20 year                     | 22 (11%)                                 |
|                    | 20-30 year                   | 113 (56.5%)                              |
|                    | 30-40 year                   | 46 (23%)                                 |
|                    | >40 year                     | 19 (9.5%)                                |
| Gender             | Male                         | 126 (63%)                                |
|                    | Female                       | 73 (36.5%)                               |
|                    | Missing                      | 1 (0.5%)                                 |
| Field of study     | Medical Engineering          | 70 (35%)                                 |
|                    | MI                           | 43 (21.5%)                               |
|                    | HIT                          | 82 (97.5%)                               |
|                    | Missing                      | 5 (2.5%)                                 |
| Degree             | BA                           | 77 (38.5%)                               |
|                    | MA                           | 73 (36.5%)                               |
|                    | Professional doctorate       | 43 (21.5%)                               |
| Prior field        | HIT, HIM, Medical Record     | 55 (27.5%)                               |
|                    | MI                           | 12 (6%)                                  |
|                    | C-E-M*                       | 33 (16.5%)                               |
| Work experience    | 0 year                       | 87 (43.5%)                               |
|                    | 1-5 year                     | 62 (31%)                                 |
|                    | 5-10                         | 24 (12%)                                 |
|                    | >10                          | 27 (13.5%)                               |
| Activity           | Yes                          | 123 (61.5%)                              |
|                    | No                           | 70 (35%)                                 |
|                    | Missing                      | 7 (3.5%)                                 |
| Exposure           | Yes                          | 81 (40.5%)                               |
|                    | No                           | 109 (54.5%)                              |
|                    | missing                      | 10 (5%)                                  |

Most students were between 20 and 30 years old. 63% of them were male and 43.5% had no work experience. Current and previous field of study of most of the students were HIT, HIM, and Medical Records. Most of the participants in this study were undergraduates. 61.5% were economically active. 54.5% were exposed to Big Data. The mean scores of participants in benefits, applications, and challenges section were 3.71, 3.68, and 3.71, respectively (SAS-challenge, SAS-advantage and SAS-application). Examination of SAS-challenge, SAS-advantage, and SAS-application by variables of age, gender, field of study, Prior field, work experience, with / without activity, exposure / non-exposure to Big Data can be seen on Table 3.
Table 3. Comparison of mean of SAS-challenge, SAS-advantage and SAS-application across different age groups

| Questions | Age         | n   | Mean ± SD(n) |
|-----------|-------------|-----|--------------|
| Advantages| <20 year    | 22  | .6986±.11620 |
|           | 20-30 year  | 113 | .7522±.12519 |
|           | 30-40 year  | 46  | .7574±.12829 |
|           | >40 year    | 19  | .7252±.12159 |
|           | Total       | 200 | .7449±.12508 |
| Applications| <20 year    | 22  | .6989±.12051 |
|           | 20-30 year  | 113 | .7413±.13019 |
|           | 30-40 year  | 46  | .7528±.1257 |
|           | >40 year    | 19  | .7147±.12070 |
|           | Total       | 200 | .7368±.12462 |
| Challenges| <20 year    | 22  | .6869±.15257 |
|           | 20-30 year  | 113 | .7392±.16566 |
|           | 30-40 year  | 46  | .7744±.15188 |
|           | >40 year    | 19  | .6982±.18948 |
|           | Total       | 200 | .7377±.16466 |

One-way ANOVA test was used to compare the mean of SAS-challenge, SAS-advantage and SAS-application in different age groups with no significant difference in different age groups in these factors. P-Value was 0.228, 0.317, and 0.139 respectively.

Table 4. Comparison of the mean of SAS-challenge, SAS-advantage and SAS-application in different gender groups

| Gender | n   | Mean ± SD(n) |
|--------|-----|--------------|
|        | N   |              |
| Advantages | Male | 126 | .7454±.11719 |
|           | Female | 73  | .7471±.13709 |
| Applications | Male | 126 | .7329±.13281 |
|           | Female | 73  | .7446±.11009 |
| Challenges | Male | 126 | .7383±.17504 |
|           | Female | 73  | .7370±.14741 |

According to Table 4, the Independent t-test was used to compare the mean of SAS-challenge, SAS-advantage and SAS-application in different gender groups with no significant difference in different age groups in these factors.

Table 5. Comparison of the average of SAS-challenge, SAS-advantage, and SAS-application across different fields of study

| field   | n   | Mean ± SD(n) |
|---------|-----|--------------|
|         | N   |              |
| advantages | Medical engineering | 70  | .7302±.13611 |
|           | MI  | 43           | .7760±.12040 |
|           | HIT | 82          | .7488±.11194 |
|           | Total | 195        | .7481±.12348 |
| applications | Medical engineering | 70  | .7236±.11333 |
|           | MI  | 43           | .7778±.13359 |
|           | HIT | 82          | .7337±.12527 |
|           | Total | 195        | .7398±.12416 |
| challenges | Medical engineering | 70  | .7140±.15265 |
|           | MI  | 43           | .8114±.16246 |
|           | HIT | 82          | .7293±.16021 |
|           | Total | 195        | .7419±.16167 |
In Table 5, the results of the One-way ANOVA test were showed which compare the mean of SAS-challenge, SAS-advantage and SAS-application in different fields, but the mean of SAS-application and SAS-advantage were not significant. The mean of SAS-challenge was significant in different disciplines. The mean of SAS-challenge in medical informatics was higher than other majors (Fig. 1).

Fig. 1. Mean of Benefits, applications and challenges in terms of the different fields of study

Table 6. Comparison of the mean of SAS-challenge, SAS-advantage, and SAS-application between different levels of study

|                 | Degree | n   | Mean ± SD(n)       |
|-----------------|--------|-----|--------------------|
| Advantages      | BSC    | 77  | .7270±.12249        |
|                 | MSC    | 73  | .7521±.13956        |
|                 | PHD    | 43  | .7718±08582         |
|                 | Total  | 193 | .7465±12313         |
| Applications    | BSC    | 77  | .7249±.13235        |
|                 | MSC    | 73  | .7415±.12568        |
|                 | PHD    | 43  | .7602±.09684        |
|                 | Total  | 193 | .7390±.12285        |
| Challenges      | BSC    | 77  | .6987±.16116        |
|                 | MSC    | 73  | .7461±.17661        |
|                 | PHD    | 43  | .7953±.12388        |
|                 | Total  | 193 | .7382±.16345        |
One-way ANOVA test was used to compare the mean of SAS-challenge, SAS-advantage, and SAS-application at different levels of study that the mean of SAS-application, SAS-advantage, and SAS-challenge were not, according to Table 6. Significant P-Value were 0.142, 0.313, and 0.006 respectively.

Table 7. Comparison of the mean of SAS-challenge, SAS-advantage, and SAS-application between previous fields of study

|                      | Prior field | n  | Mean ± SD(n) |
|----------------------|-------------|----|--------------|
| Advantages           | HIT         | 55 | .7678±.11516 |
|                      | MI          | 12 | .7675±.06710 |
| Engineering, electronics, math | 33 | .7652±.16349 |
| Total                | 100         |    | .7669±.12796 |
| Applications         | HIT         | 55 | .7503±.11978 |
|                      | MI          | 12 | .7893±.08649 |
| Engineering, electronics, math | 33 | .7548±.12074 |
| Total                | 100         |    | .7564±.11628 |
| Challenges           | HIT         | 55 | .7693±.16136 |
|                      | MI          | 12 | .7889±.13283 |
| Engineering, electronics, math | 33 | .7946±.16150 |
| Total                | 100         |    | .7800±.15728 |

The one-way ANOVA test was used to compare the mean of SAS-challenge, SAS-advantage and SAS-application between the previous fields of study, but according to Table 7, the mean of SAS-application, SAS-advantage and SAS-challenge were not significant.

Table 8. Comparison of the mean of SAS-challenge, SAS-advantage, and SAS-application between different work experiences

|                      | Work experience | n  | Mean ± SD(n) |
|----------------------|-----------------|----|--------------|
| Advantages           | 0 year          | 87 | .7459±.11910 |
|                      | 1-5 year        | 62 | .7620±.13001 |
|                      | 5-10            | 24 | .7154±.14901 |
|                      | >10             | 27 | .7290±.10848 |
| Total                | 200             |    | .7449±.12508 |
| Applications         | 0 year          | 87 | .7426±.12193 |
|                      | 1-5 year        | 62 | .7441±.13534 |
|                      | 5-10            | 24 | .7185±.10836 |
|                      | >10             | 27 | .7176±.12415 |
| Total                | 200             |    | .7368±.12462 |
| Challenges           | 0 year          | 87 | .7367±.16038 |
|                      | 1-5 year        | 62 | .7559±.15951 |
|                      | 5-10            | 24 | .7167±.16671 |
|                      | >10             | 27 | .7177±.17332 |
| Total                | 200             |    | .7377±.16466 |

On Table 8, One-way ANOVA test was used to compare the mean of SAS-challenge, SAS-advantage and SAS-application between different work experiences that the mean of SAS-application, SAS-advantage and SAS-challenge were not significant. P-Value were 0.404, 0.673, and 0.673 respectively.
Table 9. Comparison of the mean of SAS-challenge, SAS-advantage, and SAS-application in groups with / without economic activity

| Activity | N   | Mean ± SD(n)  |
|----------|-----|---------------|
| Advantages | Yes | 123 | .7521±.12231. |
|           | No  | 70  | .7403±.13160. |
| Applications | Yes | 123 | .7454±.12092. |
|             | No  | 70  | .7185±.13357. |
| Challenges  | Yes | 123 | .7478±.17636 |
|            | No  | 70  | .7251±.14521. |

On Table 9, the Independent t-test was used to compare the mean of SAS-challenge, SAS-advantage and SAS-application in the groups with / without economic activity in these factors. P-Value were 0.532, 0.155, and 0.361 respectively.

Table 10. Comparison of the mean of SAS-challenge, SAS-advantage, and SAS-application in groups with / without exposure to Big Data

| Exposure | n | Mean ± SD(n)  |
|----------|---|---------------|
|          | N |               |
| Advantages | Yes | 81 | .7619±.11752 |
|           | No  | 109 | .7359±.13009 |
| Applications | Yes | 81 | .7561±.11112 |
|             | No  | 109 | .7239±.13370 |
| Challenges  | Yes | 81 | .7627±.15108 |
|            | No  | 109 | .7252±.16977 |

According to Table 10, the Independent t-test was used to compare the mean of SAS-advantage, SAS-challenge and SAS-application in the groups with / without exposure to Big Data that there is no significant difference between the groups with / without exposure to Big Data in these factors. P-Value were 0.157, 0.08, and 0.116 respectively. In order to examine the SAS-advantage, SAS-challenge and SAS-application sub-domains, the previous analysis of each sub-domain is repeated in terms of variables such as age, gender, field of study, degree, and so on.

Table 11. Comparison of the mean of SAS-advantage, SAS-challenge and SAS-application domains by age

| Age       | n | Mean ± SD(n)  |
|-----------|---|---------------|
|           | N |               |
| Information | <20 year | 22 | .7491±.14458 |
|           | 20-30 year | 113 | .7692±.17013 |
|           | 30-40 year | 46 | .7843±.15966 |
|           | >40 year | 19 | .7789±.12534 |
|           | Total   | 200 | .7714±.16057 |
| Modeling  | <20 year | 22 | .7364±.15324 |
|           | 20-30 year | 113 | .7611±.18425 |
|           | 30-40 year | 46 | .7754±.18979 |
|           | >40 year | 19 | .7719±.16226 |
|           | Total   | 200 | .7627±.17954 |
| Data      | <20 year | 22 | .6545±.14790 |
|           | 20-30 year | 113 | .7054±.15538 |
|           | 30-40 year | 46 | .7252±.14910 |
|           | >40 year | 19 | .7137±.17802 |
|           | Total   | 200 | .7382±.15637 |
| Process_Management | <20 year | 22 | .6742±.17516 |
|           | 20-30 year | 113 | .7451±.14399 |
|           | 30-40 year | 46 | .7529±.14633 |
|           | >40 year | 19 | .6667±.20458 |
|           | Total   | 200 | .7317±.15655 |
One-way ANOVA test was used to compare the mean of SAS-advantage, SAS-challenge and SAS-application domains by age groups that process management, according to Table 11, became significant. P-Value were 0.855, 0.861, 0.145, 0.046, 0.172, 0.072, 0.831, 0.315, 0.784, and 0.680, respectively.

Table 12. Mean comparison of SAS-advantage, SAS-challenge and SAS-application domains by gender

| Gender              | n     | Mean ± SD(n) |
|---------------------|-------|--------------|
| Information         |       |              |
| Male                | 126   | .7679±.15380 |
| Female              | 73    | .7739±.17317 |
| Modeling            |       |              |
| Male                | 126   | .7566±.17391 |
| Female              | 73    | .7735±.19076 |
| Data                |       |              |
| Male                | 126   | .7168±.15714 |
| Female              | 73    | .7370±.15605 |
| Process management  |       |              |
| Male                | 126   | .7447±.14168 |
| Female              | 73    | .7183±.16207 |
| Health service delivery |     |              |
| Male                | 126   | .7252±.13799 |
| Female              | 73    | .7357±.12353 |
| Research            |       |              |
| Male                | 126   | .7794±.21441 |
| Female              | 73    | .7932±.17664 |
| Health information  |       |              |
| Male                | 126   | .7268±.15116 |
| Female              | 73    | .7426±.13836 |
| Essential medicines |       |              |
| Male                | 126   | .7328±.15952 |
| Female              | 73    | .7394±.15952 |
| Health financing    |       |              |
| Male                | 126   | .7317±.22650 |
| Female              | 73    | .7699±.19908 |
| Leadership governance |     |              |
| Male                | 126   | .7405±.16874 |
| Female              | 73    | .7516±.15245 |
According to Table 12, the Independent t-test was used to compare the mean of SAS-advantage, SAS-challenge and SAS-application in gender groups with no significant difference in gender in these factors. P-Value were 0.738, 0.525, 0.383, 0.230, 0.592, 0.642, 0.463, 0.761, and 0.234, respectively.

Table 13. Mean comparison of SAS-advantage, SAS-challenge and SAS-application domains by different fields of study

| Field of study         | n     | Mean ± SD(n) |
|------------------------|-------|--------------|
| N                      |       |              |
| Information            |       |              |
| Medical engineering    | 70    | .7354±.18137 |
| MI                     | 43    | .8242±.14688 |
| HIT                    | 82    | .7780±.14113 |
| Total                  | 195   | .7729±.16058 |
| Modeling               |       |              |
| Medical engineering    | 70    | .7238±.20968 |
| MI                     | 43    | .8124±.15753 |
| HIT                    | 82    | .7715±.15539 |
| Total                  | 195   | .7634±.17949 |
| Data                   |       |              |
| Medical engineering    | 70    | .7211±.15692 |
| MI                     | 43    | .7433±.13972 |
| HIT                    | 82    | .7224±.16066 |
| Total                  | 195   | .7266±.15441 |
| Process Management     |       |              |
| Medical engineering    | 70    | .7367±.15739 |
| MI                     | 43    | .7450±.15514 |
| HIT                    | 82    | .7350±.13465 |
| Total                  | 195   | .7378±.14099 |
| Health Service Delivery|       |              |
| Medical engineering    | 70    | .7227±.12854 |
| MI                     | 43    | .7502±.13100 |
| HIT                    | 82    | .7261±.13873 |
| Total                  | 195   | .7302±.13320 |
| Research               |       |              |
| Medical engineering    | 70    | .7321±.17796 |
| MI                     | 43    | .8002±.16873 |
| HIT                    | 82    | .7854±.21907 |
| Total                  | 195   | .7872±.20119 |
| Health Information     |       |              |
| Medical engineering    | 70    | .7212±.13062 |
| MI                     | 43    | .7887±.14366 |
| HIT                    | 82    | .7216±.14812 |
| Total                  | 195   | .7363±.14310 |
| Essential Medicines    |       |              |
| Medical engineering    | 70    | .7181±.13169 |
| MI                     | 43    | .7758±.14452 |
| HIT                    | 82    | .7379±.15266 |
| Total                  | 195   | .7391±.14449 |
| Health Financing       |       |              |
| Medical engineering    | 70    | .7457±.19537 |
| MI                     | 43    | .7549±.22560 |
| HIT                    | 82    | .7512±.22566 |
| Total                  | 195   | .7456±.21423 |
| Leadership Governance  |       |              |
| Medical engineering    | 70    | .7367±.14625 |
| MI                     | 43    | .7713±.19032 |
| HIT                    | 82    | .7394±.16188 |
| Total                  | 195   | .7455±.16304 |

On Table 13. One-way ANOVA test was used to compare the mean of SAS-advantage, SAS-challenge, and SAS-application domains by field of study, that the mean of SAS-advantage, SAS-challenge, and SAS-challenge in information, modelling, research, and health informatics were significant. P-Value were 0.015, 0.033, 0.726, 0.935, 0.532, 0.001, 0.024, 0.119, 0.922 and 0.500 respectively (Fig. 2 and Fig. 3).
Fig 2. Average of the components of Benefits by field of study

Fig 3. Average of the components of Application by field of study
| Table 14. Mean comparison of SAS-advantage, SAS-challenge and SAS-application domains by different levels of study |
|---------------------------------------------------------------|
| **Degree** | **n** | **Mean ± SD(n)** |
| | | N |
| **Information** | | |
| BSC | 77 | .7356±.17902 |
| MSC | 73 | .7863±.15581 |
| PHD | 43 | .8047±.12443 |
| **Total** | 193 | .7702±.16131 |
| **Modeling** | | |
| BSC | 77 | .7539±.18589 |
| MSC | 73 | .7553±.19470 |
| PHD | 43 | .8155±.13161 |
| **Total** | 193 | .7610±18059 |
| **Data** | | |
| BSC | 77 | .7122±.16066 |
| MSC | 73 | .7332±.16547 |
| PHD | 43 | .7386±.11787 |
| **Total** | 193 | .7260±.15380 |
| **Process Management** | | |
| BSC | 77 | .7277±.13050 |
| MSC | 73 | .7379±.18116 |
| PHD | 43 | .7504±.10193 |
| **Total** | 193 | .7366±.14627 |
| **Health Service Delivery** | | |
| BSC | 77 | .7178±.13130 |
| MSC | 73 | .7289±.14290 |
| PHD | 43 | .7505±.10839 |
| **Total** | 193 | .7293±.13117 |
| **Research** | | |
| BSC | 77 | .7487±.20822 |
| MSC | 73 | .7649±.21192 |
| PHD | 43 | .8558±.14809 |
| **Total** | 193 | .7863±.20112 |
| **Health Information** | | |
| BSC | 77 | .7237±.15430 |
| MSC | 73 | .7408±14471 |
| PHD | 43 | .7462±.12148 |
| **Total** | 193 | .7352±.14352 |
| **Essential Medicines** | | |
| BSC | 77 | .7186±.15838 |
| MSC | 73 | .7450±.14472 |
| PHD | 43 | .7606±.11002 |
| **Total** | 193 | .7380±.14393 |
| **Health Financing** | | |
| BSC | 77 | .7377±.22771 |
| MSC | 73 | .7479±.22367 |
| PHD | 43 | .7581±.17759 |
| **Total** | 193 | .7461±.21505 |
| **Leadership Governance** | | |
| BSC | 77 | .7455±.15284 |
| MSC | 73 | .7406±.17080 |
| PHD | 43 | .7605±.15106 |
| **Total** | 193 | .7470±.15886 |

On Table 14, One-way ANOVA test was used to compare the mean of SAS-advantage, SAS-challenge and SAS-application domains by different levels of study that the mean of SAS-advantage, SAS-challenge and SAS-application in information and research were significant that was more significant at PhD level. P-Value were 0.043, 0.064, 0.589, 0.717, 0.427, 0.019, 0.654, 0.269, 0.880, and 0.807, respectively.
According to Table 15, One-way ANOVA test was used to compare the mean of SAS-advantage, SAS-challenge and SAS-application domains by different previous fields of study that the mean of SAS-advantage, SAS-challenge and SAS-application was not significant. P-Value were 0.202, 0.469, 0.772, 0.610, 0.916, 0.122, 0.501, 0.537, 0.420 and 0.749 respectively.
On Table 16, an One-way ANOVA test was used to compare the mean of SAS-advantage, SAS-challenge and SAS-application domains by experience that the mean of SAS-application, SAS-advantage, and SAS-challenge were not significant. P-Value were 0.419, 0.255, 0.327, 0.661, 0.231, 0.592, 0.725, 0.863, 0.167, and 0.270 respectively.
The Independent t-test was used to compare the mean of SAS-advantage, SAS-challenge and SAS-application by economic activity that, according to Table 17, there was a significant difference in different groups in research. P-Value were 0.625, 0.565, 0.205, 0.693, 0.017, 0.167, 0.761, 0.188, 0.649 and 0.133, respectively.

Table 18. Mean comparison of SAS-advantage, SAS-challenge and SAS-application domains by exposure / non-exposure to Big Data

| Exposure / non-exposure to Big Data | N  | Mean ± SD(n) |
|------------------------------------|----|--------------|
| Information                        | 81 | .7970±.14571 |
| Modeling                           | 109| .7545±.16505 |
| Data                               | 81 | .7355±.17177 |
| Process Management                 | 109| .7468±.18851 |
| Health service delivery            | 81 | .7436±.15755 |
| Research                           | 109| .7284±.14613 |
| Health information                 | 81 | .7413±.13150 |
| Essential medicines                | 109| .7182±.13423 |
| Health financing                   | 81 | .8142±.19577 |
| Leadership governance              | 109| .7624±.20940 |
|                                    |    | .7475±.13899 |
|                                    |    | .7218±.15380 |
|                                    |    | .7567±.12935 |
|                                    |    | .7231±.15477 |
|                                    |    | .7704±.20028 |
|                                    |    | .7778±.15330 |

The Independent t-test was used to compare the mean SAS-advantage, SAS-challenge and SAS-application by exposure / non-exposure to the Big Data that, according to Table 18, there was a significant difference between groups of information. P-Value were 0.071, 0.169, 0.486, 0.085, 0.494, 0.236, 0.114, 0.156, 0.020,
The mean of SAS-information was higher among those exposed to the Big Data than those not exposed to the Big Data.

4. Conclusion

Today, with the advent of technologies and the production of huge amounts of data, Big Data analytics have received much attention especially in healthcare. Understanding this field and recognizing its benefits, applications and challenges provide useful background for conducting efficient research. Therefore, the purpose of this study was to evaluate the students' familiarity from different universities of Mashhad with the benefits, applications and challenges of Big Data analysis. Most students were between 20 and 30 years old. Most of them were male and had no work experience. Current and previous field of study of most of the students were HIT, HIM, and Medical Records. Most of the participants in this study were undergraduates. Most of them were economically active and were exposed to Big Data. The mean scores of participants in benefits, applications, and challenges section were 3.71, 3.68, and 3.71, respectively. Considering that the participants in this study are students from the top universities in the country and have done some Big Data research, it is assumed that Mashhad students have a better level of knowledge in the field of Big Data analysis. Yet there should be more opportunities for students, even organizations’ staff to get to know the field more. Training in this field is essential for many disciplines, also conferences could be effective in introducing this field. Students can also provide more familiarity and usage of functional analytics by conducting new researches in this field. In the section of challenges, benefits and application analytics, process management was significantly in different age groups, research, modelling and information and health informatics across different fields of studies were significant. Information and research were significantly different between different levels of studies. Research in groups with / without economic activity was significant and information in exposure / non exposure to Big Data groups was significant. Despite the importance and benefits of Big Data analytics, students' lack of familiarity with the necessity and importance of these analytics in industries and research is significant. The field of study and level of study does not appear to have an effect on the degree of knowledge of individuals regarding Big Data analysis. In future studies, it is suggested that students, practitioners, and other disciplines in different cities and countries evaluate the specific benefits and applications of Big Data analytics and compare the results. Because it will be possible to study in different places and different perspectives. In other businesses, checking their familiarity with Big Data analytics can be helpful in applying management and advertising policies. Big data analytics can play a constructive role in all industries, and today it is widespread in most industries and businesses. Because of the growing trend of data generation, Big Data analytics will become a necessity for all industries and areas in coming years.

Availability of data and materials

These data are available.

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Ethics approval and consent to participate

Ethics approval is under grant number 961731 Publication is permitted by Mashhad University of Medical Science.
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