The Electrochemical Society
Advancing solid state & electrochemical science & technology

Journal of physics : Conference Series

Volume 1874
June 2021

ECS The Electrochemical Society
Advancing solid state & electrochemical science & technology

DONATE

ABOUT ECS | MEMBERSHIP | PUBLICATIONS | PROGRAMS | MEETINGS

PUBLICATIONS

ECS DIGITAL LIBRARY

JOURNALS >

AUTHOR INFORMATION >

MEETING PUBLICATIONS >

PUBLICATIONS ARCHIVE >

INTERFACE >

BOOKS/MONOGRAPHS >

PREPRINTS >

SUBSCRIBE

ECS ONLINE STORE

LIBRARY RESOURCE CENTER

EMAIL SIGN UP

Journal of The Electrochemical Society

About JES

Journal Links
» Visit JES website
» Submit an article to JES
» Track my article
» JES Focus Issues
» Leadership Collections
» Technical Scope
» Subscription information

JES is the flagship journal of The Electrochemical Society. Published continuously from 1902 to the present, JES remains one of the most highly-cited journals in electrochemistry and solid state science and technology.

Metrics

- **2019 Impact Factor: 3.721** [2019 Journal Citation Reports (Clarivate Analytics, 2020)]
- **5-Year Impact Factor: 3.719** [2019 Journal Citation Reports (Clarivate Analytics, 2020)]
- **Ranked #5 in Materials Science, Coatings and Films, and #12 in Electrochemistry** [2019 Journal Citation Reports (Clarivate Analytics, 2020)]
- **Cited half-life of >10 years –** the highest value awarded by the Journal Citation Reports and the value JES has had for the past 10 years.
- **Review Speed:** Average time from initial submission to first decision: 33 days
- **Publication Speed:** Average time from acceptance to online publication: 10 days (online publication is final paginated fully-citable version of record)

Journal Editorial Board
Editor-in-Chief

Robert Savinell
Case Western Reserve University
Cleveland, OH, USA

Technical Editors

Doron Aurbach
Bar-Ilan University
Ramat-Gan, Israel
Batteries and Energy Storage

David E. Cliffel
Vanderbilt University
Nashville, TN, USA
**Physical and Analytical Electrochemistry,
Electrocatalysis, and Photoelectrochemistry**

Gerald S. Frankel
The Ohio State University
Columbus, OH, USA
Corrosion Science and Technology

John Harb
Brigham Young University
Provo, UT, USA
Electrochemical Engineering

Takayuki Homma
Waseda University
Tokyo, Japan
Electrochemical/Electroless Deposition

Ajit Khosla
Yamagata University
Yamagata, Japan
Sensors

Janine Mauzeroll
McGill University
Montreal, QC, Canada
Organic and Bioelectrochemistry

Xiao-Dong Zhou
University of Louisiana at Lafayette
Lafayette, LA, USA
Fuel Cells, Electrolyzers, and Energy Conversion

Associate Editors

Michael Adachi
Simon Fraser University, Canada

Rohan Akolkar
Case Western Reserve University, USA

Brett Lucht
University of Rhode Island, USA

Stephen Maldonado
University of Michigan, USA

CONFERENCE SERIES

The open-access *IOP Conference Series* provides a fast, versatile and cost-effective proceedings publication service for your conference. Proceedings are an important part of the scientific record, documenting and preserving work presented at conferences worldwide.

Key publishing subject areas include: physics, materials science, environmental science, bioscience, engineering, computational science and mathematics.

More info
About us
Authors
Organizers
Request quote
View forthcoming volumes
Contact us

Publish your proceedings with IOP

From plenary to poster papers, large or small events, core physics to multidisciplinary, we can accommodate them all. Papers are widely indexed and discoverable across all major discovery services. *IOP Conference Series* receives more than 4 million article downloads per year, with all articles open access and free to download in perpetuity. Learn more

Request a quote

View published volumes

Journal of Physics: Conference Series (JPCS)

IOP Conference Series: Materials Science and Engineering (MSE)

IOP Conference Series: Earth and Environmental Science (EES)

Journal of Physics: Conference Series

Table of contents

Volume 1874

2021

‹ Previous issue   Next issue ›

The 1st International Recent Trends in Engineering, Advanced Computing and Technology Conference (RETREAT) 2020 1-3 December 2020, Paris, France

Accepted papers received: 24 March 2021
Published online: 15 June 2021

Open all abstracts

Preface

Papers

Focus Issues in ECS Journals

Journal of The Electrochemical Society (JES) Focus Issues Online
ECS Journal of Solid State Science and Technology (JSS) Focus Issues Online

---

ECS publishes virtual focus issues in order to highlight scientific and technological areas of current interest and future promise that are expanding rapidly or have taken a new direction.

Calls for Papers are available for the following focus issue(s):

- JSS: Selected Papers from the International Conference on Nanoscience and Nanotechnology 2021 (ICONN-2021) – Submission deadline: May 5, 2021
- JSS: Dedicated to the Memory of George Blasse: Recent Developments in Theory, Materials and Applications of Luminescence – Submission deadline: July 28, 2021
- JES: 18th International Meeting on Chemical Sensors (IMCS 18) – Submission deadline: August 4, 2021
- JES: Solid Oxide Fuel Cells (SOFCs) and Electrolysis Cells (SOECs) – Submission deadline: August 8, 2021

Look for Calls for Papers coming soon for focus issues on these topics:

- JES: Modern Electroanalytical Research in the Society for Electroanalytical Chemistry (SEAC) – Accepting submissions: June 3, 2021
- JES: Energy Storage Research in China – Accepting submissions: July 22, 2021
- JES: Women in Electrochemistry – Accepting submissions: August 5, 2021
- JES: Advanced Electrolysis for Renewable Energy Storage – Accepting submissions: September 9, 2021
- JES: Biosensors and Nanoscale Measurements: In Honor of Nongjian Tao and Stuart Lindsay – Accepting submissions: October 7, 2021
- JES: Electrochemical Separations and Sustainability – Accepting submissions: November 5, 2021

Articles are published in a standard issue of the journal as they are accepted. If selected at submission, accepted papers are published online in the ECS Digital Library within 24 hours of scheduling for publication. The version of record is published online within approximately 10 days of final acceptance.

OPEN ACCESS: As part of the Author Choice Open Access program, authors can select to have their papers published as open access. If open access is selected at the time of submission, authors must agree to pay an article processing charge (APC) if the paper is accepted. ECS members receive a 75 percent discount on all APCs. All discounts are applied at the time of payment. Authors from ECS Plus subscribing institutions are eligible to have APCs waived. Check if your institution subscribes to ECS Plus. There are no article processing charges for focus issue articles submitted before the end of 2020 that are accepted for publication.

If you would like to propose a future focus issue, please complete the Request to Publish Form and submit to publications@electrochem.org.

Why Publish with ECS

Free Your Bright Ideas

SUBMIT TO JES | **SUBMIT TO JSS**

Authoritative & Comprehensive

ECS has been publishing continuously since 1902, and our portfolio contains works by renowned scientists, inventors, and Nobel Laureates. ECS currently publishes 2 peer reviewed journals, with papers selected by a prestigious group of Technical Editors.

Journal of The Electrochemical Society | ECS Journal of Solid State Science and Technology

Rigorous Peer Review

ECS maintains the highest standards of peer review, making *Journal of The Electrochemical Society* one of the most highly-cited journals in our field. ECS is the only nonprofit society publisher with top publications in electrochemistry and solid state science and technology.

Fast Turn-Around

ECS journals are in continuous publication, and our lag time from acceptance to version of record publication is 10 days or less. This means your article is available online *fast*.

Visibility & Discoverability

In 2019, the ECS journals in the ECS Digital Library received over 2.9 million full-text article downloads—that's because publishing in our journals provides your research with immediate and worldwide dissemination to more than 2,000 academic, research, and corporate libraries. Our journals are included in major indices such as:

Web of Science | Chemical Abstracts (CAS) | Scopus | Google Scholar

Editors' Choice Recognition

A select set of distinguished articles are honored with the "Editors' Choice" designation. These articles are recognized as being transformative within the electrochemical or solid state community, and are published as Open Access so as to achieve the widest possible dissemination.

Long-Term, High-Impact

- JES 2019 Journal Impact Factor: 3.721
- Ranked #5 in Materials Science, Coatings and Films, and #12 in Electrochemistry
- JES Cited half-life of >10 years – the highest value awarded by JCR
- JSS 2019 Journal Impact Factor: 2.142

Author Choice Open Access

ECS's two peer reviewed journals offer the option of Author Choice Open Access. We strive to keep our APC low, and offer a range of member and institutional discounts. By 2024, ECS plans to make our research freely available to all readers, while remaining free to publish – in other words, complete Open Access. Publishing with ECS will help us achieve our mission to Free the Science.

Awards for Young Authors

Every year ECS recognizes the best papers published by authors under 31 years of age through our young author awards. ECS currently offers 2 of these awards—the Norman Hackerman Young Author Award, and the recently established Bruce Deal & Andy Grove Young Author Award. Recipients are awarded a cash prize, travel grant, and complimentary ECS membership.

Stay informed with the free ECS enews.

ECS Transactions

About ECST

Links

» Visit ECST website
» Author instructions
» Editor instructions
» Publish with ECST
» Subscription information

ECST is the official conference proceedings publication of The Electrochemical Society. This publication features full-text content of proceedings from ECS meetings and ECS-sponsored meetings. ECST is a high-quality venue for authors and an excellent resource for researchers. The papers appearing in ECST are reviewed to ensure that submissions meet generally-accepted scientific standards.

Journal Editorial Board
Editor

Jeffrey W. Fergus
Materials Research and Education Center
275 Wilmore Laboratories
Auburn, AL 36849, USA
Tel.: +1.334.844.3405

Editorial Advisory Board

ECS Publications Archive

The following ECS journals have ceased publication, and now are preserved as an archive. All archived publications are available to browse through the ECS Digital Library, or using the links below.

ECS Electrochemistry Letters

About EEL

EEL was launched in 2012 and was published until the end of 2015. It was dedicated to the rapid dissemination of peer-reviewed and concise research reports in fundamental and applied areas of electrochemical science and technology. EEL is preserved as an archive.

Journal Links

» Visit EEL website
» Subscription information

ECS Solid State Letters

About SSL

SSL was launched in 2012 and was published until the end of 2015. It was dedicated to the rapid dissemination of peer-reviewed and concise research reports in fundamental and applied areas of solid-state science and technology. SSL is preserved as an archive.

Journal Links

» Visit SSL website
» Subscription information

Electrochemical and Solid-State Letters

About ESL

ESL was the first rapid-publication electronic journal dedicated to covering the leading edge of research and development in the field of solid-state and electrochemical science and technology. ESL was a joint publication of ECS and IEEE Electron Devices Society. Volume 1 began July 1998 and contained six issues, thereafter new volumes began with the January issue and contained 12 issues. The final issue of ESL was Volume 15, Number 6, 2012. Preserved as an archive, ESL was later replaced by SSL and EEL.

Journal Links

» Visit ESL website

» Subscription information

ECS Proceedings Volumes

About ECS PVs

ECS PVs contain papers presented in symposia at ECS and topical meetings up until mid-2005. PVs provided up-to-date views of specialized topics and frequently offered comprehensive treatment of rapidly developing areas. Preserved as an archive, ECS PVs were later replaced by *ECS Transactions*.

Select proceedings volumes have been fully digitized on an article-level and are available directly through the ECS Digital Library. All other volumes are available to browse or download in full through Google Books.

Links

» Visit ECS PVs website

» Proceedings collections

PAPER • OPEN ACCESS

Association rule mining method for the identification of internet use

Association rule mining method for the identification of internet use

Wahyu Wibowo[1], Natalia Permata Sari[1], Regina Niken Wilantari[2], Shuzlina Abdul-Rahman[3]

[1]Institut Teknologi Sepuluh Nopember, Surabaya, East Java, Indonesia, 60111

[2]University of Jember, Jember, East Java, Indonesia, 68121

[3]Faculty of Computer and Mathematical Sciences, University Teknologi MARA, 40450, Shah Alam, Selangor, Malaysia

email: wahyu_w@statistika.its.ac.id

Abstract. Internet penetration in the majority of Indonesian cities has exponentially increased, as seen from the increasing number of internet users in schools, businesses and society in general. The purpose of internet use varies to include searching for information, sending emails, chatting, entertainment, as well as buying and selling goods/services, among other reasons. However, it is compelling to note that one of the factors affecting internet use is gender. Hence, this research aims to reveal the different patterns in internet use by considering gender differences. The data comes from the National Social Economic Survey conducted in the East Java Province, and association rule is used for the data mining method. The results from examining one itemset show that both male and female genders mostly use the internet to access social media. However, the outcomes are different for other itemsets. The results from analysing two itemsets based on male and female groups reveal that both genders use the internet for financial services and news. The use of association rule mining to examine three itemsets demonstrates that most male users simultaneously access emails, financial services and news. Meanwhile, most female users access financial services, goods/services and news.

1. Introduction

The internet, as a product of technological sophistication and advancement in science and technology, is an indispensable medium for the dissemination and exchange of information in this day and age. The internet is a form of information globalization that transcends time and space, and has positively impacted today's world. In other words, the internet has eliminated many obstacles in the search for information. The convenience of getting information is associated with the development of devices to use the internet, such as computers and mobile phones. Hence, the internet has become a global channel to facilitate the communication network. Billions of people worldwide use the internet for different purposes, from fulfilling personal and organizational needs to being a necessity in running a corporation. Indonesians across the country have been using the internet, not only in businesses but also in schools where it is an integral part of learning activities. The internet can also be easily accessed from homes [1]. One indicator of internet development is the number of people, ranging from children to adults, who have smartphones that allow them to effortlessly use the internet. Additionally,

these smartphones also have various advanced features to support user experience when connecting to the internet.

The positive impacts of the internet include accessibility to accurate and coherent information, serving as a medium for various kinds of entertainment (such as games and movies), and making communication more convenient (such as the ease in exchanging data/messages via social networks/emails) [2]. Several benefits and advantages of the internet are perceived by internet users in every province in Indonesia. Based on the results of a survey conducted by the Indonesian Internet Service Providers Association (APJII) in 2017 to determine the penetration and behaviour of internet users in Indonesia, the number of users in the country has increased by 8%, to 143.26 million. This number is equivalent to 54.68% of the total Indonesian population of approximately 262 million. Based on the use of internet services by the Indonesian people, chat applications are the most accessed (89.35%), followed by social media (87.13%). In contrast, the least accessed services are banking and the sale of goods (each at 7.39%). Additionally, internet service users come from diverse backgrounds, different gender groups, and both urban and rural areas.

The internet offers a multitude of services, and the background description addressed earlier in this section raises an interesting point about the patterns and relations to be found in the types of internet services accessed by the people in the East Java Province. This research aims to reveal the internet utilization patterns of the different gender groups through the association rule mining method. The results of the analysis will be useful for website or e-commerce owners in conducting internet marketing or to other websites related to the internet service offering that was first accessed by the user. Several internet service providers and user groups have raised their interest in how all these groups use internet services. This research on and analysis of internet service users are aimed to bring to light the patterns in utilization trends based on the types of service first and last used.

Data mining is a process that uses statistical and mathematical techniques, artificial intelligence, as well as machine learning to extract and identify useful information and related knowledge from an assortment of large databases. The association rule mining method is an approach used to determine the meaningful relations between items in a specified dataset. Association rule is one of the techniques used in data mining to find an associative rule (or meaningful relationship) between a combination of items [3]. The first step in the association rule is to find the combination that most often occurs in an itemset, while the second step is to define conditions and results. One application where the association rule is used is the market basket analysis, which is a process to analyse buying habits by finding associations between different items that usually appear together in a consumer's "shopping basket" [4]. For instance, with the use of association rule, a convenience store owner can ascertain consumers buying patterns. For example, if items A and B are purchased, there is a 50% chance that the consumer may also buy item C. This pattern is highly significant in the transaction data.

The scope of this research is to observe the patterns in internet utilization trends by the people in East Java Province in one sector, namely the types of internet service accessed by them. The analysis will distinguish between genders, male and female. This research contributes towards understanding the use of association rule analysis on the types of internet service to benefit internet service managers (such as website owners), as well as application and e-commerce organizers, in product positioning and advertising on their website pages.

The remainder of this paper is organized as follows: Section 2 describes data mining, association analysis and past studies. Section 3 presents the data used in this research, while Section 4 addresses the results and discuss the findings. Finally, Section 5 concludes the paper.

2.   Literature Review

Data mining is a term used to describe the bid to find hidden knowledge in databases. In other words, data mining is a semi-automatic process that uses statistical and mathematical techniques, artificial intelligence, as well as machine learning to extract and identify useful and potential information stored in large databases [3]. Additionally, data mining can be interpreted as a process to

find meaningful relationships, patterns and trends by investigating a large amount of stored data by using pattern recognition techniques, such as statistical and mathematical techniques [5]. Data mining contains the search for desired trends or patterns in large databases to assist with future decision-making. These patterns are recognized by using specific tools to provide a useful and insightful analysis of the data that can then be studied more thoroughly by using other decision support tools.

Association rule is a data mining technique used to find links or connected patterns between attributes of items. The association rule is usually applied to binary data, such as items purchased in a minimarket, to gauge the likelihood of a consumer buying one item together with another. For instance, when buying tea, a consumer is also likely to purchase sugar. The association rule is also often referred to as the market basket analysis as it determines which products are frequently purchased together. The Apriory algorithm's principle is that when an itemset appears frequently, then all subsets of that itemset will also appear frequently. This principle refers to the nature of support measures where the support of an itemset never exceeds its data subset support, and this is known as the anti-monotone support trait [6].

The significance of the associative rule can be determined by two parameters: support and confidence.

a. **Support** indicates the percentage when a combination of items appears together in the database, a measure that shows the level of dominance of an item/itemset in the entire transaction (for instance, the prevalence of items A and B being purchased together).

b. **Confidence** indicates the strength of the relationship between items given the associative rule, a measure that shows the conditional relationship between two items (for instance, the frequency of item B being bought together with item A) [9].

Association analysis is defined as a process to find all associative rules that meet the minimum requirements for support (minimum support) and confidence (minimum confidence).

Several studies have been conducted to examine internet use. Machine learning methods are used to identify the determinant factors of internet access [7, 8]. The study of internet use among students shows that the younger generation has accepted the internet as a convenient method to retrieve relevant information, and at the same time, as one of the means for entertainment and research [9]. An analysis of the social and psychological effects of the internet reveals that it offers easy access to information and facilitates communication. However, it has been noted that the internet also poses some risks, especially to young users [10]. Additionally, a study on the purposes of internet use among Turkish high school students based on gender has demonstrated that highly frequent internet use, low GPA and high levels of family income correlate significantly with problematic internet use among male users [11]. Association rule learning has also identified that demographic characteristics significantly relates to the use of traditional and internet-based meal ideas [12]. Network analysis has identified that the use of technology can increase the volume of product sales. However, this increase varies for different products and technologies [13]. In bioinformatics, association rule can be used to discover the itemsets of genetic variants known as Single-Nucleotide Polymorphism [14]. Meanwhile, an algorithm in the frequent itemset mining is also developed to speed up the searching process in a high-dimensional dataset by utilizing graph theory [15, 16].

3. Data

The variables of this research were obtained from the National Socio-Economic Survey in East Java, as presented in Table 1. This survey is conducted annually by Statistics Indonesia across 34 Indonesia provinces. The East Java Province is selected as the study location to be representative of Indonesia.

Table 1. Variables of research

Variable	Information
News	Obtaining information/news
Assignment	Doing school-related assignments
Email messaging	Sending/receiving email
Social media	Facebook, Twitter, and LINE, etc.
Purchasing	Purchasing goods/services
Selling	Selling goods/services
Entertainment	Entertainment (downloading, playing games, and/or watching TV shows, movies or videos)
Finance	Online financial facilities (e.g., e-banking)
Goods/services	Obtaining information regarding goods/services
Others	Others

4.   Results and Discussion

This section presents the analysis and discussion of the results of the association rule in terms of types of internet services used by communities in East Java categorised by gender.

4.1   *Association Rule Mining of the Male Gender Group*

The results of the association rule analysis are shown in terms of the types of internet service used by male users in the East Java Province in 2017. This study used a minimum support of 0.01 and a minimum confidence of 0.01. A total of 500 rules were obtained from 15,907 male internet users. The total rules obtained were then evaluated for each itemset, where one itemset was evaluated by the highest support value, as shown in Table 2:

Table 2. Results of one itemset with the highest value of support

No	Internet service	Support	Confidence	Lift	Total
1	Social media	0.792	0.792	1.00	12593
2	News	0.657	0.657	1.00	10445
3	Entertainment	0.500	0.500	1.00	7946
4	Assignment	0.252	0.252	1.00	4006
5	Email messaging	0.187	0.187	1.00	2977
6	Goods/service	0.113	0.113	1.00	1807
7	Purchasing	0.052	0.052	1.00	829
8	Selling	0.046	0.046	1.00	733
9	Finance	0.045	0.045	1.00	714
10	Others	0.013	0.013	1.00	205

The ten internet services listed in Table 2 had a lift ratio ≥1, which meant they were eligible for the research. The results in Table 2 demonstrate that the first five internet services were the most commonly used by male users among people in East Java in 2017.

The first line item shows 79.2% of males used the internet to access social media. In the second line item, 65.7% used it to obtain information or news. In the third line item, 50% used the internet to access entertainment (downloading, playing games, and watching TV shows, movies or videos). In the fourth line item, 25.2% used it for school-related assignments. In the fifth line item, 18.7% used the internet to send and receive email messages.

Further analysis was conducted on the two itemsets that had minimum support and minimum confidence, and the results are shown in Table 3 below. The five rules were sorted by the highest confidence value and a lift ratio ≥1:

Table 3. Results of two itemsets sorted by the highest value of confidence

No	Internet service 1	Internet service 2	Support	Confidence	Lift	Total
1.	Finance	News	0.042	0.934	1.42	667
2.	Goods/services	News	0.103	0.914	1.39	1,652
3.	Finance	Social media	0.040	0.887	1.12	633
4.	Purchasing	Social media	0.046	0.882	1.11	731
5.	Goods/services	Social media	0.100	0.876	1.11	1,583

In the first rule, "Finance" and "News" were accessed simultaneously by 4.2% of males, equivalent to 6,672 internet users, with 93.4% confidence that those who used the internet for online financial facilities (e.g., e-banking) would also use it to obtain information/news. The second rule had internet services related to "Goods/services" and "News" accessed simultaneously by 10.3% of males, or 1,651 internet users, with a confidence level of 91.4%, These results indicate that those who used the internet for information about goods/services also used it to obtain information/news.

In the third rule, "Finance" and "Social media" were accessed simultaneously by 4% of males, equivalent to 633 internet users, with a level of confidence of 88.7% that those who used the internet for online financial facilities (e.g., e-banking) would also use it for social media. The fourth rule had internet services related to "Purchasing" and "Social media" accessed simultaneously by 4.6% of males, or 731 internet users, with 88.2% confidence. These results indicate that those who used the internet to purchase goods/services also used it for social media.

In the fifth rule, internet services for "Goods/services" and "Social media" were accessed simultaneously by 10% of males, equivalent to 1,582 internet users, with a confidence level of 87.6% that those who used the internet for information about goods/services would also use it for social media.

The next analysis is for the behaviour patterns of male internet users in the East Java Province for three itemsets. The results are presented in Table 4 by exhibiting the five rules that were established from the highest confidence value and a lift ratio of more than 1:

Table 4. Results of three itemsets sorted by the highest value of confidence

No	Internet service (I, II)	Internet service (III)	Supp	Confidence	Lift	Total
1.	Email messaging, Finance	News	0.028	0.966	1.47	450
2.	Email messaging, Goods/services	News	0.043	0.960	1.46	679
3.	Finance, Goods/services	News	0.019	0.955	1.45	298
4.	Entertainment, Finance	News	0.024	0.955	1.45	380
5.	Purchasing, Finance	Social media	0.013	0.948	1.20	201

Table 4 displays the results for the first rule pattern, where 2.8% of males equivalent to 450 internet users, had accessed "Email messaging", "Finance" and "News" simultaneously, with a level of confidence of 96.6%. These results demonstrate that those who used the internet to send/receive email and access financial facilities (e.g., e-banking) also used it to obtain information/news. The second rule built was for internet services related to "Email messaging", "Goods/services" and "News", and they were accessed simultaneously by 4.3% of males, or 679 internet users, with 96% confidence that those who used the internet to send/receive email messages and obtain information about goods/services would also use it to obtain information/news.

The third rule found that internet services for "Finance", "Goods/ services" and "News" were accessed simultaneously by 1.9% of males, equivalent to 298 internet users, with a confidence level of 95.5%. These results reveal that those who used the internet for financial facilities (e.g., e-banking) and information about goods/services also used it to obtain information/news. The fourth rule pattern

shows the internet services for "Entertainment", "Finance" and "News" were accessed simultaneously by 2.4% of males, or 380 internet users, with a level of confidence of 95.5% that those who used the internet for entertainment (downloading, playing games, and/or watching TV shows, movies or videos) and financial facilities (e.g., e-banking) would also use it to access information/news.

The fifth rule presents 1.3% of males, equivalent to 201 internet users, simultaneously accessed internet services related to "Purchasing", "Finance" and "News" with 94.8% confidence that those who used the internet to purchase goods/services and access financial facilities (e.g., e-banking) also used it to access information/news.

The analysis results for four itemsets are presented in Table 5, the top five rules sorted by the highest confidence value:

Table 5. Results of the four itemsets analysis based on the highest value of confidence

No	Internet service (I, II, III)	Internet service (IV)	Support	Confidence	Lift	Total
1.	Purchasing, Entertainment, Goods/services	Social media	0.019	0.978	1.23	305
2.	Email messaging, Entertainment, Goods/Services	News	0.030	0.975	1.48	475
3.	Email messaging, Social media, Finance	News	0.025	0.971	1.48	397
4.	Purchasing, Selling, Entertainment	Social media	0.011	0.968	1.22	184
5.	Email messaging, Entertainment, Finance	News	0.017	0.968	1.47	270

The first rule pattern was that 1.9% of males, or 305 internet users, had simultaneously accessed internet services for "Purchasing", "Entertainment", "Goods/services" and "News" with 97.7% confidence. These results demonstrate that those who used the internet to purchase goods/services, for entertainment (downloading, playing games, and/or watching TV shows, movies or videos) and to seek information about goods/services also used it to access information/news. The second rule built found that internet services for "Email messaging", "Entertainment", "Goods/services" and "News" were accessed simultaneously by 3% of males, equivalent to 475 internet users, with a confidence level of 97.5% that those who used the internet for email messaging, entertainment (downloading, playing games, and/or watching TV shows, movies or videos) and to obtain information regarding goods/services would also use it for information/news.

The third rule found that 2.5% of males, or 397 internet users, had simultaneously accessed the services for "Email messaging", "Social media", "Finance" and "News" with a confidence level of 97.1%. These results reveal that those who used the internet for email messaging, social media (Facebook, LINE, etc.) and financial facilities (e.g., e-banking) also used it to access information/news. The fourth rule was that the types of internet service for "Purchasing", "Selling", "Entertainment" and "Social media" were accessed simultaneously by 1.1% of males, which is equivalent to 184 internet users, with a level of confidence of 96.8% that those who used the internet to purchase goods/services, sell goods/services, and for entertainment (downloading, playing games, and/or watching TV shows, movies or videos) would also use it for social media (Facebook, LINE, etc.).

The fifth rule found 1.7% of males, or 270 internet users, simultaneously accessed the services for "Email messaging", "Entertainment", "Finance" and "News" with 96.8% confidence. These results showcase that those who used the internet for email messaging, entertainment (downloading, playing games, and/or watching TV shows, movies or videos) and financial facilities (e-banking) also used it to access information/news.

4.2   *Association Rule Mining Method of the Female Gender Group*

In total, there were 13,702 female internet users among the people of the East Java Province in 2017. A total of 666 rules were built, and each itemset examined. The results of the analysis for one itemset, sorted by the highest support value, are presented in Table 6. The ten internet services had a lift ratio of ≥1, which means they were eligible for use. As shown by the results, the first five internet services were the most commonly used among the group of female users in East Java in 2017:

Table 6. Results of one itemset sorted by the highest value of support

No	Internet service	Support	Confidence	Lift	Total
1.	Social media	0.799	0.799	1.00	10945
2.	News	0.633	0.633	1.00	8673
3.	Entertainment	0.440	0.440	1.00	6031
4.	Assignment	0.312	0.312	1,00	4279
5.	Email messaging	0.190	0,190	1.00	2605
6.	Goods/services	0.126	0.126	1.00	1732
7.	Purchasing	0.094	0.094	1.00	1283
8.	Selling	0.047	0.047	1.00	644
9.	Finance	0.045	0.045	1.00	612
10.	Others	0.012	0.012	1.00	161

The first line item, social media, had as many as 79.9% of female internet service users. The second line item had 63.3% of female users accessing the internet for information/news. In the third line item, 44% of female internet service users used it for entertainment (downloading, playing games, and/or watching TV shows, movies or videos). The fourth line item shows that 31.2% of female users accessed the internet for school-related assignments. The fifth line item reveals that 19% of female internet users used the internet to send/receive email messages.

The two itemsets that met the minimum support and minimum confidence were analysed. The results are presented in Table 7; the five rules were ranked by the highest confidence value, and a lift ratio of >1:

Table 7. Results of two itemsets sorted by the greatest value of confidence

No	Internet service (I)	Internet service (II)	Support	Confidence	Lift	Total
1.	Finance	News	0.041	0.908	1.43	556
2.	Goods/services	News	0.113	0.898	1.42	1,555
3.	Purchasing	Social media	0.083	0.892	1.12	1,144
4.	Finance	Social media	0.040	0.887	1.11	543
5.	Goods/services	Social media	0.111	0.880	1.10	1,525

In the first rule, "Finance" and "News" were accessed simultaneously by 4.1% of females, or 556 internet users, with a confidence level of 90.8% that those who used the internet for financial facilities (e.g., e-banking) would also use it to access information/news. In the second rule, "Goods/services" and "News" were accessed simultaneously by 11.3% of females, equivalent to 1,555 internet users, with 89.8% confidence. These results demonstrate that those who used the internet to access information regarding goods/services also used it to obtain information/news.

In the third rule, "Purchasing" and "Social media" were simultaneously accessed by 8.3% of females, or 1,144 internet users, with a level of confidence of 89.2% that those who used the internet to purchase goods/services would also use it to access social media. In the fourth rule, "Finance" and "Social media" were accessed simultaneously by 4% of females, equivalent to 543 internet users, with a confidence level of 88.7%. These results showcase that those who used the internet for financial facilities (e.g., e-banking) also used it to access social media.

In the fifth rule, 11.1% of females, or 1,525 internet users, simultaneously accessed the internet for "Goods/services" and "Social media", with 88% confidence that those who used the internet for information regarding goods/services would also use it to access social media.

The results of the analysis for the behaviour patterns of female internet users in the East Java Province for three itemsets are presented in Table 8. The five rules were ranked by the highest confidence value, and a lift ratio of more than 1:

Table 8. Results of three itemsets sorted by the greatest value of confidence

No	Internet service (I, II)	Internet service (III)	Support	Confidence	Lift	Total
1.	Finance, Goods/services	News	0.021	0.976	1.54	281
2.	Email messaging, Finance	News	0.024	0.954	1.51	333
3.	Email messaging, Goods/services	News	0.047	0.954	1.51	639
4.	Entertainment, Finance	News	0.023	0.948	1.50	313
5.	Purchasing, Finance	News	0.017	0.945	1.49	239

As shown in Table 8, in the first rule, 2.1% of females, or 281 internet users, simultaneously accessed "Finance", "Goods/services" and "News", with a confidence level of 97.6% that those who used the internet for financial facilities (e.g., e-banking) and information about goods/services also used it to obtain information/news. In the second rule, "Email messaging", "Finance" and "News" were accessed simultaneously by 2.4% of females, equivalent to 333 internet users, with 95.4% confidence. These results reveal that those who used the internet to send or receive email messages and access financial facilities (e.g., e-banking) would also use it to obtain information/news.

In the third rule, "Email messaging", "Goods/services" and "News" were simultaneously accessed by 4.7% of females, or 639 internet users, with a level of confidence of 95.4% that those who used the internet to send/receive email messages and obtain information regarding goods/services would also use it to access information/news. The fourth rule states that the services relating to "Entertainment", "Finance" and "News" were accessed simultaneously by 2.3% of females, equivalent to 313 internet users, with a confidence level of 94.8%. These results demonstrate that those who used the internet for entertainment (downloading, playing games, and/or watching TV shows, movies or videos) and financial facilities (e.g., e-banking) also used it for information/news.

In the fifth rule, 1.7% of females, or 239 internet users, simultaneously accessed internet services related to "Purchasing", "Finance" and "News" with 94.5% confidence that those who used the internet to purchase goods/services and access financial facilities (e.g., e-banking) would also use it to obtain information/news.

The results of the behaviour patterns for female internet users in East Java for four itemsets are presented in Table 9. Five rules were sorted by the greatest confidence value and a lift ratio of more than 1.

In the first rule, 1.4% of females, equivalent to 191 internet users, simultaneously accessed "Email messaging", "Finance", "Goods/services" and "News" with 98.4% confidence that those who used the internet to send/receive email messages, access financial facilities (e.g., e-banking) and for information about goods/services also used it to obtain information/news. In the second rule, services related to "Purchasing", "Finance", "Goods/services" and "News" were accessed simultaneously by 1.2% of females, or 166 internet users, with a confidence level of 98.2%. These results show that those

who used the internet to purchase goods/services, access financial facilities (e-banking) and acquire information about goods/services would also use it to access information/news.

Table 9. Results of the four itemsets analysis sorted by the greatest value of confidence

No	Internet service (I, II, III)	Internet service (IV)	Support	Confidence	Lift	Total
1.	Email messaging, Finance, Goods/services	News	0.014	0.985	1.55	191
2.	Purchasing, Finance, Goods/services	News	0.012	0.982	1.55	166
3.	Social media, Finance, Goods/services	News	0.019	0.981	1.55	257
4.	Entertainment, Finance, Goods/services	News	0.013	0.979	1.55	185
5.	Email messaging, Goods/services, Purchasing	News	0.022	0.977	1.54	304

In the third rule, "Social media", "Finance", "Goods/services" and "News" were simultaneously accessed by 1.9% of females, equivalent to 257 internet users, with a level of confidence of 98.2% that those who used the internet for social media (Facebook, LINE, etc.), financial facilities (e.g., e-banking) and information regarding goods/services also used it to obtain information/news. In the fourth rule, "Entertainment", "Finance", "Goods/services" and "News" were simultaneously accessed by 1.3% of females, or 187 internet users, with 97.9% confidence. These results reveal that those who used the internet for entertainment (downloading, playing games, and/or watching TV shows, movies or videos), financial services (e.g., e-banking) and information regarding goods/services would also use it to acquire information/news.

In the fifth rule, 2.2% of females, equivalent to 304 users, simultaneously accessed "Email messaging", "Purchasing", "Goods/services" and "News" with a confidence level of 97.7% that those who used the internet to send/receive email messages, purchase goods/services, and obtain information regarding goods/services also used it for information/news.

5.   Conclusion

From the results of the previous analysis and discussion on the two groups representing the male and female genders, it can be concluded from the use of association rule methods for two itemsets that people in all groups use the internet for finance-related activities and news.

The results of the rule-based method built for three itemsets indicate that most users in the male category simultaneously access the internet for email messaging, finance and news. Meanwhile, users in the female category, like the urban group, mostly access finance, goods/services and news.

The results of association rules analysis built for four itemsets demonstrate that most users in the male category use the internet for purchasing, entertainment, goods/services, and social media. Concurrently, most users in the female category use the internet for email messaging, finance, goods/services and news. Both the rural and urban area groups have the same rules established, and most users access the internet for email messaging, entertainment, goods/services and news.

The results of the rule-based technique for five itemsets show that those in the male category mostly use the internet for news, purchasing, sales, entertainment and social media. In the meantime, those in the female category mostly use the internet for school-related assignments, purchasing, entertainment, goods/services and news. In the urban area group, the rules have been established for internet access covering school-related assignments, email messaging, entertainment, goods/services and news. In contrast, the rules for the rural area group have been established for internet access covering email messaging, social media, entertainment, goods/services and news.

Website, application or e-commerce owners are suggested to advertise their products/services based on the results from the established rules built. Internet service offerings most frequently used by

various groups are social media and news. Hence, it will be more effective for website or application (e-commerce) owners to advertise their products with a higher frequency on social media or news platform. For instance, they may advertise their products to target male consumers on social media, and on online news platforms to target female consumers, as well as urban and rural consumers. Additionally, financial facilities (e.g., e-banking) can also be advertised on digital news platforms.

The results of the analysis show that the main use of the internet for both male and female groups is to access news and social media because information and social media are the most accessible form of digital literacy in contrast to financial or banking transactions that require knowledge of financial and banking products. People's habit of accessing information via the internet should be of interest to information business actors particularly in the development of digital-based news platforms. With the increasing internet penetration in almost all communities, access to information on physical paper will subsequently decline.

Acknowledgments

References

[1] Rahmania A, Cahyanto A, Destarina Y. *Internet Sehat*. 1st ed. Depok: Penebar Plus, 2010.

[2] Setiawan I. *Pembinaan dan pengembangan Peserta Didik Pada Institusi Pendidikan Berasrama*. CV. Smart revolution, 2013.

[3] Turban E, Aronson JE, Liang T-P, et al. *Decision Support Systems And Intelliget Systems*. 7th ed. New Delhi: Prentice-Hall, Inc, 2005.

[4] Han J, Kamber M, Pei J. *Data Mining : Concepts and Techniques*. 3rd ed. Wyman Street,Waltham: Morgan Kaufmann Publishers, 2012.

[5] Larose DT. *Data Mining Methods And Models*. Hoboken, New Jersey: JOHN WILEY & SONS, 2006.

[6] Rindengan AJ. Perbandingan Association Rule Berbentuk Biner Dan Fuzzy C-Partition Pada Analisis Market Basket Dalam Data Mining. *J Ilm Sains*; 12. Epub ahead of print 2012. DOI: https://doi.org/10.35799/jis.12.2.2012.717.

[7] Wibowo W, Budiantara IN, Hidayanto BC. Identifying Determinant Factors to Internet Access Using Decision Tree. *Int J Adv Soft Comput its Appl* 2018; 10: 92–103.

[8] Wibowo W, Abdul-Rahman S, Cahyani N. Multilevel Logistic Regression and Neural Network-Genetic Algorithm for Modeling Internet Access. In: Berry MW, Yap BW, Mohamed A, et al. (eds) *Soft Computing in Data Science. SCDS 2019. Communications in Computer and Information Science*. Springer, pp. 169–180.

[9] Hacıoğlu M, KarakaşGeyikb D. An Empirical Research on General Internet Usage Patterns of Undergraduate Students. In: *Procedia - Social and Behavioral Sciences*, pp. 895–904.

[10] Diomidous M, Chardalias K, Magita A, et al. Social and Psychological Effects of the Internet Use. *Acta Inforamtica Medica* 2016; 24: 66–68.

[11] Demirer V, Bozoglan B. Purposes of Internet use and problematic Internet use among Turkish high school students. *Asia Pacific Psychiatry* 2016; 8: 269–277.

[12] E.Doub A, Small ML, Levin A, et al. Identifying users of traditional and Internet-based resources for meal ideas: An association rule learning approach. *Appetite* 2016; 103: 128–136.

[13] De P, Hu Y (Jeffrey), Rahman MS. Technology Usage and Online Sales: An Empirical Study. *Manage Sci* 2010; 56: 1930–1945.

[14] Mutalib S, Mohamed A, Abdul-Rahman S. A Study on Frequent Itemset Mining for Identifying Associated Multiple SNPs. *J Comput Sci Comput Math* 2019; 9: 1–6.

[15] Xiaohu W, Lele W, Feng L. A Fast Search Algorithm Based on Agent Association Rules. *Phys*

Procedia 2012; 25: 1022–1026.

[16] Mohd-Yakop M-A, Abdul-Rahman S, Mutalib S. Novel Row Enumeration Approach of Graph-Based Frequent Itemsets Mining. *Int J Mach Learn Comput* 2018; 8: 324–330.