

E-government and the Digital Divide: A study of English-as-a-Second-Language Users' Information Behaviour

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1 Abstract

Internet-based technologies are increasingly used by organisations and governments to offer services to consumers and the public in a quick and efficient manner, removing the need for face-to-face conversations and human advisors. Despite their obvious benefits for most users, these online systems may present barriers of access to certain groups in society which may lead to information poverty.

In this study we consider the information behaviour of ten ESL (English as a Second Language) participants as they conduct four search tasks designed to reflect actual information seeking situations. Our results suggest that, despite a perception that they have a good understanding of English, they often choose documents that are only partially or tangentially relevant. There were significant differences in the behaviour of participants given their perceived confidence in using English to perform search tasks. Those who were confident took riskier strategies and were less thorough, leading to them bookmarking a larger proportion of non-relevant documents. The results of this work have potentially profound repercussions for how e-government services are provided and how second-language speakers are assisted in their use of these.

2 Introduction

The rise of Internet-based technologies has transformed the ways in which society interacts with and utilises information. The proliferation of electronic services (e-services) in the wake of this has provided companies and users with 24 hour access to a wide array of useful facilities. Although somewhat behind the consumer market, governments are slowly embracing this change, as seen by the UK government's 'digital by default' initiative, where a number of public services have been digitised and moved online [7].

The average user, who has access to the Internet via a plethora of technologies, and views it as an everyday tool, could and should see these changes as no great burden. For those in society, however, who are not aware of the existence of these changes; accepting or comfortable of the changes; or adept in the use of

such technologies this raises concerns around the barriers that may be erected and the risk this poses of segregating service users, especially those in vulnerable groups [8].

One such group, and the focus of this paper, are those who use English as a second language (ESL). Searching for information when you don't know the subject, the technical terminology or where to look are just some of the challenges that we can face in our day to day lives. However, consider the same challenges but when the user is in a unfamiliar culture or setting; has an incomplete grasp of the language, where even the slightest variations in meaning can significantly change search results; and may lack the awareness and experience of the reliability of sources being sought after and used.

There are many scenarios in which people may rely on face-to-face encounters with staff or the knowledge and experience of their friends, family or community members when their own was lacking. However, in instances where these social groups may not be attainable or their knowledge and experience is also deficient can have dire repercussions for those members of society who already face significant barriers [12]. In an effort to address these concerns the UK government are currently running both standard services (face-to-face, postal and over the telephone) and digital services simultaneously but it is not inconceivable that standard services will (eventually) be phased out.

Before such an eventuality, all attempts must be made to try and to facilitate those most at risk of being segregated and to understand any issues they may have in accessing and using these services. It is with this in mind that this paper seeks to identify the current information seeking behaviours of ESL users when performing e-government-related tasks, and to ascertain where and why issues arise during this process, in an effort to aid that facilitation.

3 Related Work

Recent research has considered the problems encountered by certain user groups when faced with the need to access and understand important sources of information. In a study of refugees trying to access e-government services, Lloyd et al. [12] found that the information poverty they experience was a product of the social exclusion of the participants as a result of barriers e-services can erect. Such information poverty can lead to "limited support networks, [an] inability to access the labour market, alienation from society and poorer educational outcomes" [15]. The study suggested that many issues stem from the fact that the community receiving the refugees has pre-existing assumptions about how information is best disseminated, assumptions which may not hold true for the refugees themselves.

A number of studies have looked at multilingual IR, with a rising number of studies investigating the information seeking behaviour of users in relation to language proficiency, notably when English is the foreign language [2, 3, 13]. Research by [2] focused on web content (or lack thereof) in the user's native language and the impact it had on user satisfaction through cognitive load.

They also discussed the need for context (e.g. domain knowledge of the user group) when considering information quality and multilingualism. In related findings, Marlow et al. [13] showed that the perceived and actual difficulty of tasks increased as familiarity with the second language decreased.

The IT literacy and abilities of the user are important factors when it comes to searching in a foreign language [5]. When compared to searching in their native tongue, users required significantly more time, submitted more query reformulations and viewed/assessed a greater number of websites. Those with only an intermediate grasp of the foreign language struggled with query reformulation, although they did not find identification of relevant results quite so difficult.

In contrast to this, Bogers et al. [3] focused on the differences in behaviour between native and non-native English speakers when searching for books. Although the study found non-natives spent more time on task than native speakers, it revealed very little difference between the two groups in relation to the number of queries, query length, depth of results inspection or books added to the bookbag. They surmised this could be as a result of their users' experience in searching for books in English and having acceptable foreign language skills.

Jozsa et al. [10] considered the differences between native language and foreign language information seeking tasks. From the study they identified two different search strategies: superficial/cursory and in-depth, with little difference in performance when applying an in-depth strategy in both languages. Alternatively, it was found the superficial strategy in a foreign language performed much worse than in the native language. One explanation being that foreign language users, who may not be as familiar with nuances in the language, may miss signs of such subtle markers when not thoroughly analysing a document and thus may gather a lower quality result set.

Extant research in the field goes some way to disclosing the search behaviours of multilingual searchers but focuses predominately on “why” rather than “how” they search and how well they perform [14]. It is with this in mind that this paper looks to identify the ways in which second language users approach a number of important search tasks, the problems they face in doing so and which factors impact on these behaviours.

4 Methodology

To investigate the behaviour of (and ascertain the performance of) second-language speakers of English we required a number of contextually-relevant search tasks; the kinds that such users might need to conduct in a foreign country. Identification of the types of services ESL users would use was made by involving 7 international PhD students at a UK university, 6 of whom also took part in the study described in this work, in a pilot study. The students were recruited and tasked with identifying: what a government service entailed; which would be deemed most useful (to the group); and the information needs, information sources and skills that would be required to successfully utilise the e-service. From this information, four search tasks were designed to reflect re-

alistic information seeking situations in an attempt to be relevant and a more interesting search experience for the participants [6]. The tasks in full are:

1. *Your friend from Peru and their family (2 members) are coming to visit you for 6 months while you are in the UK. Develop a list of instructions to help them apply for the necessary visas.*
2. *A family member is coming to the UK to live and wants information on housing. They have heard there are a number of options and have asked you for advice. Identify the options available to them and recommend which they should choose. Give reasons to support your recommendation.*
3. *Your friend just got back from a trip abroad and suddenly developed a high fever. A dry cough, chills, and breathing difficulties soon followed. What could they have? They have no insurance and have asked your advice on what to do. Provide them with recommended actions.*
4. *Your elderly neighbours have heard about the UK government's 'digital by default' initiative and are concerned about whether this will affect them and their friends at the local community centre. They have asked you to find out more about it. Use your best judgement to highlight what would impact them with reasons for your choices.*

All 4 tasks were assessed by the participants as being relevant or partially relevant to them with task 1 receiving the highest average relevance score and task 4 the lowest.

4.1 Procedure

Use of log data is common in IR studies but is limited when establishing context in the use of the search facility [1]. Therefore, in this study we take a mixed methods approach [5], utilising recorded observation to gather a rich data set of user searching strategies. Although perhaps viewed as being a poorer method than that of direct observation [9], it was preferred due to a desire to obtain both anecdotal and self-reported assessment of behaviour as well as query log information from the sessions. To further complement this data a semi-structured discussion was conducted post study with thematic analysis used to help explore participant experience and their search patterns.

Each session followed the same process of each participant filling in a demographic questionnaire which collected information on their area of study; age; gender; nationality; language(s) spoken and proficiency; IT use; search engine use in English and their native tongue; search engine competency and preference and their own awareness of existing UK governmental services.

Each task was allotted ten minutes for completion with up to five minutes for the participants to read the task and complete the pre- and post-questionnaires. This allowed for no more than one hour in total. Tasks were distributed to participants using a Latin square design to account for task fatigue and potential learning effects [11]. Prior to beginning each task, participants were asked to fill in a pre-task questionnaire [6] (see Table 1) to gauge their domain knowledge,

Q1	I have searched about this topic before
Q2	I know about this topic
Q3	I am interested in this topic
Q4	It will be difficult to find information about this topic

Table 1. Pre-task questions.

interest in the topic and the perceived difficulty of the task using a five-point Likert scale where 1 is “Not at all” and 5 is “Very”.

The participants were asked to read the description of each task and search for relevant documents/sources, bookmarking any website deemed relevant as they went. At the end of each task the participant was also required to complete a post-task questionnaire (again on a 5-point Likert scale), examples of which can be seen in Table 2.

Q3	The task was relevant to me
Q6	I performed the task to the best of my ability
Q7	I found the task difficult
Q8	I’m confident the content I found satisfied the task
Q10	I’m confident I identified relevant websites
Q11	I’m confident in my ability to read the website content
Q12	I am confident in my ability to understand the content of the websites I visited

Table 2. Selected post-task questions.

4.2 Participants

Participants for the study were sought via university mailing lists, paper adverts and face to face enquiry by the researcher, with the stipulation that contribution was voluntary. Face to face enquiry was the most successful with 70% recruited by this method.

The 10 study participants were all international PhD students from a large UK university who spoke ESL with 80% at a fluent level and 20% competent. All participants were from different countries across Europe (20%), Asia (70%) and Africa (10%) with a total of 11 languages spoken natively, and 15 languages in total up to a competent level. 40% of the participants were female with an average age of 31 ($SD = 3.56$) and 60% were male with an average age of 31.5 ($SD = 3.33$). Each was remunerated for their participation with a £10 Amazon voucher.

4.3 The Study

Morae Recorder was used to capture each participant’s search session (as well as each post-study discussion) including audio and video, with four laptops avail-

able per session resulting in the maximum number of four participants per session. As a result there were a total of three sessions with two sessions of three students and one of four as dictated by participant and technical equipment availability. Using the Chrome browser, each participant was asked to use the Google Search Engine to start each task but were not limited to the search results page. Google Search was chosen over alternatives as it was the only search engine selected as being used by all participants, with the next best being Bing (20% of participants) and four other instances of an alternative search engine.

4.4 Measures and Metrics

Using Morae Manager each recorded session was manually tagged in order to establish several measures and metrics. Total task time was systematically logged when users clicked start task and end task; number of queries was the total number of times queries were submitted by participants or they clicked on a Google-related search link; length of query is the total number of terms per query; number of assisted terms are the number of query terms entered through the assistance functionality; length of time querying is the time from when they click on the search field up to the time they submit the query; time on the Search Engine Results Page (SERP) is calculated from when the SERP page is loaded to when the participant navigates away, either by SERP click or switching tab; link position is dependent on the listing number of the SERP link clicked assuming there are 10 links per SERP page; times bookmarked are the total number of documents bookmarked during that click-through session; The number of times in-site search and in-site link click are the total number per click-through session and the observational notes were key observations about participant search behaviour and are used to back up the quantitative nature of the log data.

To determine the relevance of the bookmarks logged by the participants, all bookmarks were assessed by two native English-speaking IR researchers [10] using a voting strategy and given scores between 1 and 4, where 1 is not relevant, 2 is tangentially relevant, 3 is partially relevant and 4 is totally relevant. Any bookmarks not assigned the same score by the two assessors in the first round were discussed and a single score was agreed, although this only occurred for a very small number of cases. To assess the classification of queries and reformulations, definitions after Chu et al. [5] were used and determined by the same researchers.

5 Results

In total participants bookmarked 267 pages, with an approximately equal split between governmental and non-governmental resources. Only 60.7% of the bookmarked pages were either partially or totally relevant, with 30.7% tangentially relevant and 8.5% non-relevant and there were no significant differences between the median number of bookmarks per task with each task receiving 8 or 9 per

participant on average. Surprisingly, there was little difference in terms of relevance between governmental and non-governmental resources. This was mostly due to some participants bookmarking internal policy documents or documents discussing best practices for civil servant software engineers which were deemed to be only tangentially relevant and unlikely to be of help in the given contexts.

Performance There was considerable variation in performance by different users with the bookmarks of five participants being only relevant in 50% or less of cases. There was also variation in the numbers of pages bookmarked; one participant only bookmarked 3 per task on average with the majority bookmarking 5 or more. Participant F acknowledged their limited bookmarks for the third task as in a real scenario they would not risk the health of another by self-diagnosing, and would instead only refer that person to a health professional in the first instance.

When viewing performance by task, the performance of participants was higher during task 1 as was the number of in-site links they clicked (Table 3). In post discussion it was noted that for those participants who found the visa section of the gov.uk website, which utilises a wizard to guide users, the process was simplified and informative and was the cause for the increased number of in-site clicks and performance. They also noted this facility had language selection, although no participant used an alternative language to English. This is found to confirm the notion that lower cognitive effort of the search option (in this case the wizard) can directly affect the preference of said search option [2]. It also highlights the point regarding the language of the in-site links’ diminishing the multilinguality of the web. In this case when users were provided the option of other languages, they still preferred links in English.

Further insights into users predicted performance and their actual performance in this study were also documented in another paper [4].

Task	Average Precision	In-site link clicks
1	0.91	2.37
2	0.70	0.46
3	0.54	0.24
4	0.38	0.37

Table 3. Table of performance by task and use of in-site link clicks.

Language proficiency The level of English proficiency was self-assessed [13] with 80% of the participants declaring themselves fluent and 20% competent with all participants using IT daily and formulating queries (on search engines) in English daily (90%) or a few times a week (10%). Half of the participants had used UK government e-services previously, 30% hadn’t and 20% were unsure what was meant by the term. When judging their own abilities in formulating

queries in English, identifying relevant search results and information on websites (all important skills for these tasks) five participants said they were “very confident” with the remaining five stating that they were less confident. Participants A and F were particularly lacking in confidence when it came to these abilities. It is worth noting that despite Participant F’s low confidence, their self-assessed proficiency in the English Language was fluent. We will refer to the most confident group as “*confident*” and the other group as “*unconfident*” throughout the paper.

5.1 Reading times

There was a considerable difference in reading times between participants, as shown in Table 4, which may be partially explained by the search strategies employed. Participant C in particular had a unique strategy for searching: in two tasks (2 and 4) they entered a URL directly (gov.uk in both instances), bypassing the search engine and using the in-site search functions and click-through to navigate the sites across only one tab. While in the other tasks (1 and 3) they only entered 1 query and again navigated through the use of in-site search and in-site click-through. This has direct influence on the amount of time spent on the SERP as well as the total time on documents, as seen in Table 4.

UserID	Average Precision	Time On Documents
A	0.74	48.19
B	0.69	42.26
C	0.50	291.00
D	0.50	29.27
E	0.57	18.11
F	0.41	24.12
G	0.83	75.32
H	0.92	85.83
I	0.65	62.32
J	0.49	35.13

Table 4. Table of Time on documents vs. average precision of tasks.

One might expect the amount of time needed to read documents to be inversely correlated with the reader’s proficiency in finding relevant information in texts. Comparing the time spent reading documents by participants in the *confident* group with those in the *unconfident* one, we find that the former spent significantly less time (Wilcoxon signed rank test; $p = 0.005$; diff. between medians = 24.5s). It is interesting that, once participant C is removed as an outlier, the time spent reading documents significantly predicts performance ($p = 0.001$, R-squared = 0.754) - for each additional second spent reading documents, the expected performance (in terms of precision) increases by 0.012. This suggests

that when participants actually spent more time assessing the documents they were reading, they were able to more reliably assess relevance.

The strategy employed by participant F, who noted post study that they spent little time reading the documents in an attempt to try and get as many bookmarks, does little for success in the task. The findings of this superficial/cursory strategy would appear to support Jozsa et al [10] but is contradicted by the findings of Rosza et al. [14] where users recommended skimming documents and employing the strategy of using the ‘find’ shortcut (ctr + F) to quickly find keywords on documents. From this perspective this study again supports Jozsa et al. as there was a distinct lack of use of the ‘find’ shortcut with only participant E utilising this function.

5.2 Confidence and Querying

It has already been noted that there is a difference in the reading time of documents amongst the participants - when grouped by confidence the *unconfident* spent significantly more time reading documents than the *confident*. This group also submitted significantly fewer queries ($p = 0.033$; diff. between medians = 2) which appears to contradict the study by Bogers et al. [3] which found non-native speakers to query much more. The lack of confidence also appears to effect query formulation time as well as the time spent reviewing SERPs with the *unconfident* taking significantly longer to submit a query ($p = 0.0025$; diff. = 4.5s) and spending significantly longer on SERPs ($p \ll 0.01$; diff. = 9.5s), supporting the findings of Chu et al. [5].

Surprisingly the *unconfident* were found to use assistive functionality no more than the *confident*, but this was not significant. Although assistive functionality is discussed [14] and the participants recommended using Google suggestions to mitigate spelling mistakes, there is little in the literature on actual usage or lack thereof, and whether this is common among ESL communities. In our own study there were only nine instances of submitted terms with spelling mistakes by six users across tasks two, three and four. Such a small number was also noted by Chu et al. [5] and may be explained by the fact that the *unconfident* submit shorter queries, a behaviour also noted in other studies [14, 3].

The *confident* group had more failed queries (i.e. those with 0 clicks), perhaps suggesting they have the confidence to reject a query by assessing that results are poor. On a per-topic basis the *confident* users submitted an average of 1.6 failed queries, while the *unconfident* group only submitted 0.8. The *confident* group also tended to look deeper into the results lists than the other group - on average the two groups stopped clicking at rank positions 8 and 5 respectively.

5.3 Query Classification

We classified queries based on the definitions of Chu et al. [5] compared against the previously submitted query. “New Query” (1) = no terms in common. “Generalisation” (2) = same query, at least one term fewer. “Specialisation” (3) = same query, at least one term more. “Reformulation” (4) = at least one term in

common and at least one term changed. “Synonym” (5) same as (4) but changed term is a synonym. “Content Change” (6) = same query but different content i.e changing from “Web” to “News”.

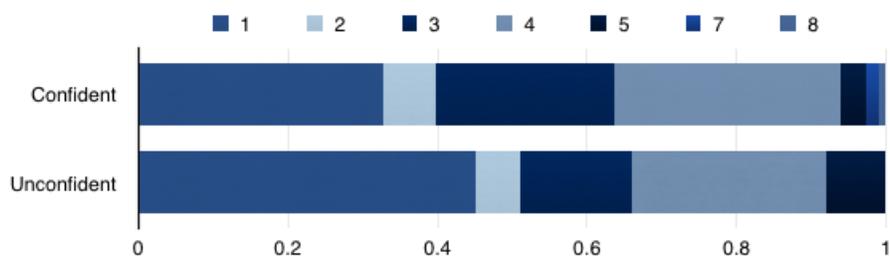


Fig. 1. Query classes by group.

Although not significant, there were differences in the distribution of queries submitted by those in the *confident* and *unconfident* groups over the query classes (as shown in Figure 1). *Confident* searchers used more “reformulations” (30%), “specialisations” (24%), “generalisations” (7%) and “spelling corrections” (2%). Whereas the *unconfident* searchers resorted to more frequently starting a “new query” (45%) and used more “synonyms” (8%). In contrast to the findings of Chu et al. [5], the distribution of classifications reveal that “new queries” and “reformulations” accounted for the majority of queries, approximately 66%.

Behaviours Despite some participants knowing of their existence and acknowledging their usefulness, there were no instances of operator use in this study, although one participant did state that he “probably should use them more”. Whether this is an effect of confidence is debatable, however it is interesting to note that Rozsa et al. [14] also found that participants encouraged the use of operators whilst not necessarily utilising the function themselves.

Most participants used multiple tabs. The extent ranged from intermittent (participants A, B, D, G, H, I) to extreme (participants E, F, J) with those at the lower end of the scale focussing mostly on just one tab with only occasional instances of switching between multiple tabs and the SERP. Those at the extreme end would alternate in short bursts between open documents on separate tabs (up to ten in one instance), SERPs and new search screens.

Four participants (A, B, C, J) used in-site search on websites with a total of six instances, two instances each for task 2, 3 and 4. They choose not to use in-site searches often because the general consensus was that Google was a reliable search facility and they could not say the same about individual websites. Participants E and G stated that they got better results from Google than any in-site search (in the past) and that it was just as quick to go back to the search and start again than use the website’s in-built functionality.

6 Limitations

An obvious limitation of this study is the educational background and number of participants. Although no generalisable hypothesis can be drawn from this limited user representation, the results allow us some insights into the search behaviours of ESL users of E-Government services and, perhaps more interestingly, how perceived confidence relates to these behaviours. Self-assessment of language proficiency has clearly shown an impact with participants identifying concerns over ability, despite high proficiency in English.

Relevance assessment is also a limitation, considering languages' affect on interpretation of information (from both a researcher and user perspective), and must be considered in future studies.

Due to the time-consuming method of obtaining our measurements (manual marking of screen captures), the time spent reading documents was calculated as the the total time on click-through. This could and possibly should be time per document within the click-through to determine whether more time is spent on government or non-government sites and to identify duplication of clicks.

7 Conclusions and Future Work

This study expanded on previous work in multilingual IR from an information seeking behaviour perspective by examining the ways in which ESL users approach a number of important search tasks and the problems they face in doing so. We identified that even among our ESL participants, who had good overall proficiency in English, there were subgroups of participants who were confident and those who were less unconfident in their abilities to formulate queries in English, identify relevant search results and information on websites. We found that these levels of confidence had a number of key effects on the participants' behaviour when completing the tasks. The unconfident group spent more time assessing documents, more time formulating queries (yet submitted shorter queries) and queried less often. In spite of this, they had far fewer failed queries and actually performed better (in terms of precision). We also found differences in the kinds of queries submitted between the groups, with the confident users more likely to reformulate their queries than submit new ones.

The results point to many participants being overly-confident of their abilities and that this over-confidence may have resulted in them taking riskier strategies, being less thorough in their evaluations and, therefore, bookmarking a larger proportion of non-relevant documents. This echoes results from the literature on superficial searching strategies [10] and shows why such strategies might arise. Our results suggest that success in this context may be less dependent on second language proficiency, as one might expect, and may instead hinge on the search strategies employed and the fastidiousness of the user in assessing document relevance, elements which could be taught or where assistance could be given.

In future work we intend to run the same study with native speakers to determine whether their performance is indeed better, as one would expect and

hope, and compare them with the non-native speakers. We would also expect that the behaviour of the native speakers would be more similar to the *confident* ESL participants, however they are likely to also display behaviours not demonstrated by the participants of this study.

References

1. Aula, A., Jhaveri, N., Käki, M.: Information search and re-access strategies of experienced web users. In: WWW'05. pp. 583–592. ACM (2005)
2. Berendt, B., Kralisch, A.: A user-centric approach to identifying best deployment strategies for language tools: the impact of content and access language on web user behaviour and attitudes. *Information Retrieval* 12(3), 380–399 (2009)
3. Bogers, T., Gäde, M., Hall, M., Skov, M.: Analyzing the influence of language proficiency on interactive book search behavior. *iSchools* (2016)
4. Brazier, D., Harvey, M.: Strangers in a strange land: A study of second language speakers searching for e-services. *CHIIR '17* (2017)
5. Chu, P., Józsa, E., Komlodi, A., Hercegf, K.: An exploratory study on search behavior in different languages. In: *IiX'12*. pp. 318–321. ACM (2012)
6. Edwards, A., Kelly, D.: How does interest in a work task impact search behavior and engagement? In: *ACM SIGCHI*. pp. 249–252. ACM (March 2016)
7. Freeguard, G., Andrews, E., Devine, D., Munro, R., Randall, J.: Whitehall monitor 2015. <http://www.instituteforgovernment.org.uk/publications/whitehall-monitor-2015> (2015), accessed: 04 October 2016
8. Helbig, N., Gil-García, J.R., Ferro, E.: Understanding the complexity of electronic government: Implications from the digital divide literature. *Government Information Quarterly* 26(1), 89 – 97 (2009), from Implementation to Adoption: Challenges to Successful E-government Diffusion
9. Ingwersen, P., Järvelin, K.: The turn: Integration of information seeking and retrieval in context, vol. 18. Springer Science & Business Media (2006)
10. Józsa, E., Köles, M., Komlodi, A., Hercegf, K., Chu, P.: Evaluation of search quality differences and the impact of personality styles in native and foreign language searching tasks. In: *IiX'12*. pp. 310–313. ACM (2012)
11. Kelly, D., Arguello, J., Edwards, A., Wu, W.: Development and evaluation of search tasks for iir experiments using a cognitive complexity framework. In: *ICTIR'15*. pp. 101–110. ACM (September 2015)
12. Lloyd, A., Kennan, M.A., Thompson, K.M., Qayyum, A.: Connecting with new information landscapes: information literacy practices of refugees. *Journal of Documentation* 69(1), 121–144 (2013)
13. Marlow, J., Clough, P., Recuero, J., Artiles, J.: Exploring the effects of language skills on multilingual web search. In: *Advances in Information Retrieval*. pp. 249–252. Springer, Berlin Heidelberg (March 2008)
14. Rózsa, G., Komlodi, A., Chu, P.: Online searching in english as a foreign language. In: *WWW'15 Companion*. pp. 875–880 (2015)
15. Vinson, T.: The origins, meaning, definition and economic implications of the concept social inclusion/exclusion: incorporating the core indicators developed by the european union and other illustrative indicators that could identify and monitor social exclusion in australia. Canberra: Department of Education, Employment and Workplace Relations (2009)