

Developing an Academic Hub with Data Synchronization, Altmetrics Display and Added Value Information for Promoting Scholarly Communication Performance

Ming-Yueh Tsay

Distinguished Professor & University Librarian, Graduate Institute of Library, Information and Archival Studies, National Chengchi University, Taipei City, Taiwan, China
mytsay@nccu.edu.tw

Chih-Ming Chen

Distinguished Professor & Associate University Librarian, Graduate Institute of Library, Information and Archival Studies, Taipei City, Taiwan, China
chencm@nccu.edu.tw



Copyright © 2017 by Ming-Yueh Tsay and Chih-Ming Chen. This work is made available under the terms of the Creative Commons Attribution 4.0 International License:

<http://creativecommons.org/licenses/by/4.0>

Abstract:

This study investigates the origin and development of altmetrics, focusing on the features, data indicators and types of altmetrics. The data sources and analytical tools of altmetrics are further described. And an example on developing an Academic Hub with the application of altmetric display is illustrated. Unlike the article-based Institutional Repository (IR) system developed by DSpace, the Academic Hub (AH) is an author centered academic service provider that offers integrated and rich author-based information for scholars. Coping with the expanding web social media, altmetrics is emerging as an alternative methodology for evaluating research impact. National Chengchi University (NCCU) Libraries in Taiwan has developed a novel AH that provides data synchronization mechanism with Open Researcher and Contributor ID (ORCID) website via ORCID APIs, altmetrics display, and academic added value information. The latter is based on modification and expanding the functions of open source IR system –DSpace for the promotion of scholarly communication performance since NCCU became an ORCID premium member in 2016.

Keywords: Altmetrics, Institutional Repository, Academic Hub, ORCID

Introduction

Advancements in the Internet and information communication technology have motivated researchers to frequently seek and use online information. In addition, the diverse development of social network has substantially changed the methods of scholarly communication. Therefore, in the current digital age, the use of the traditional citation-based academic evaluation can no longer reflect the true academic influences. Consequently, conventional and innovative metrics have been combined to create new academic evaluation indicators, recently. Under the impact of open sources, digital publishing, and big data, measurement studies of the

various types of social media evolve into a new area of webometrics and novel indicators for scholarly assessment and communication in the Web 2.0 named “altmetrics” has been emerged. In the present study, we explore the origin and development of altmetrics, focusing on the features, data indicators and types of altmetrics. Moreover, we describe data sources and analytical tools of altmetrics and give an example on developing an Academic Hub with data synchronization, altmetrics display and Added Value Information for Promoting Scholarly Communication Performance in the National Chengchi University (NCCU) Libraries in Taiwan.

The Origin and Development of Altmetrics

Looking back at altmetrics history, one must first understand the differences between article-level metrics (ALMs) and altmetrics. The former uses data from traditional (cited frequency) to measure the impact of single articles, while altmetrics integrates a variety of new data sources to measure the impact of single articles, single journals or single scholars (Tananbaum, 2013). Altmetrics includes the features of ALMs and provides more applications. In 2010, Priem first used the term “altmetrics” on his Twitter to make up for the limitation of article-level metrics, and it was the beginning of the development of altmetrics. Priem, Taraborelli, Groth and Neylon (2010) and others officially addressed the term altmetrics by publishing the statement “Altmetrics: A Manifesto” on Altmetrics website (<http://altmetrics.org>). Altmetrics is an acronym for alternative metrics. Originally it was alt-metrics, and then the hyphen was removed for simplicity, and “altmetrics” is now widely used. After its release, the idea of altmetrics attracted the attention of scientific researchers. Piwowar (2013a) commented on *Nature* that the evaluation of research findings by National Science Foundation were based on the results of a study, not limited to documents, and the recognized research output must be citable and available. Apart from documents, data set, software programs, patent and copy rights were also included. Piwowar’s altmetrics opened a new vision for academic impact, drawing supports from institutions such as Public Library of Science (PLoS) and Elsevier.

The Association for Computing Machinery (ACM) held altmetrics professional workshops in 2011, 2012 and 2014 with ACM Web Science Conference. Among these workshops, in 2011, *Altmetrics11* provided an in-depth analysis of the academic impact of social media websites. In 2012, *Altmetrics12* discussed topics related to social media metric methods, online science communication patterns, traditional metrics and their correlation to altmetrics and data collection, analysis and dissemination tools of altmetrics. *Altmetrics14* explored how to expand the impact and measurement methods of altmetrics. From 2015 to 2017, *Altmetrics 15-Altmetrics 17* were held in conjunction with the *Altmetrics Conference*. For *Altmetrics 17*, the workshop will take place on 26 September 2017, focusing on the dependencies of altmetrics, including the role of data providers and aggregators and the technical affordances of underlying platforms (altmetrics.org, 2017). The *Altmetrics Conference* is an annual conference. Since *1:AM*, took place in 2014, the conference has provided to be a platform for active discussions and exchange among researchers and practitioners to reflect upon current and future challenges of altmetrics. This September, *4:AM*, the *Altmetrics Conference*, will focus on the latest developments, applications and opportunities offered by alternative metrics (4:AM, 2017).

The Association for Information Science and Technology issued a special edition in the *Bulletin of the ASIST*, entitled the “Altmetrics: What, Why and Where?” in April /May 2013. It included eight topics about basic introduction of altmetrics, the importance of altmetrics to a researcher’s resume, open access to altmetrics, and how developing countries use altmetrics, and the challenges it would face. *Information Standard Quarterly*, published by the National Information Standards Organization (NISO), also released a special issue for altmetrics in the

summer of 2013, to explore how altmetrics could expand academic and influential perspectives and to analyze how institutional collections, academic libraries make use of altmetrics. The complete standards and application specifications for altmetrics, entitled *Outputs of the NISO Alternative Assessment Metrics Project* was published in 2016 (National Information Standards Organization, 2016).

Over the years, academic literature of altmetrics have been dominated by the altmetrics seminar and the altmetrics articles published by *PLoS ONE*. For academic libraries and librarians, more and more scholars have published studies of altmetrics-related topics in the academic journals. Among them, “Altmetrics: Rethinking the Way We Measure” by Galligan and Dyas-Correia (2013) in *Serial Review* is a comprehensive beginner’s guide to altmetrics, listing 17 questions and answers related to altmetrics and provided a clear and brief description. The *White Paper on Altmetrics* (National Information Standards Organization, 2014), states that “Libraries and librarians have the necessary qualification to train and disseminate the appropriate use of altmetrics to promote the global academic community, the impact, the attention and the value of the research produced in their institutions”. Every other year, the Association of College and Research Libraries (ACRL, 2016) reports top trends in academic libraries. Altmetrics was reviewed, both in 2014 and 2016, as one of the big category of the top trends.

Features, Data Indicators and Types of Altmetrics

Piwowar (2013b) indicates that altmetrics has the following four potential advantages:

- (1) It has a more in-depth and detailed analysis of academic impact, to help its users to know how academic writings are read, discussed, stored and commented.
- (2) It provides real-time information, showing the academic impact by day, instead of the old method measured by year.
- (3) It gives insight into web-native academic output, such as blog posts, data sets, videos, software and so on.
- (4) It helps to understand influence from different users, including scholars, practitioners, clinicians, educators and the general public.

Altmetrics has very diversified data indicators development. Classification systems used by Cave (2012), Konkiel (2013) and PLoS (2014) are listed as Table 1.

Table 1. Data indicator classification systems of altmetrics

	Cave	Konkiel	PLoS
Altmetrics Classification of data indicators	Usage Capture Mention Social Media Citation	Shares Saves Reviews Adaptation Social Media Usage	Usage Blog and Medias Social Network Citation PLoS
Altmetrics Analysis tools for this classification system	PlumX		PLoS Article Level Metrics

Table 1 demonstrates the comparison of three altmetrics data indicator classification systems, and if one looks into the table contents one will find altmetrics, despite its development so far, lacks a consistent data indicator classification system, and doesn’t have detailed regulations for

defining the scope of data source websites or data attributes. As a result, altmetrics tools based on the development of different taxonomic systems (e.g. PlumX uses altmetrics data classification system proposed by Cave, but PLoS article level metrics uses PLoS classification system) provide different data contents and their analysis results cannot be compared to each other on the same benchmarks, causing dilemma and confusion in altmetrics development. Take altmetrics classification system proposed by Cave (2012) as an example. Altmetrics data indicators can be divided into five categories: usage, capture, mention, social media and citation. Under each category, the indicators are divided into various types, as described below:

(1) Usage

Common types of use are PDF / XML Downloads, HTML Views and Book Holdings.

(2) Capture

Capture includes Favorites, Bookmarks, Saves, Readers, Watchers and Groups.

(3) Mention

Generally it includes Blog Posts, News Stories, Wikipedia Articles, Comments and Reviews.

(4) Social Media

Social media includes Tweets, Likes, Shares, Ratings on social media websites such as Facebook, Twitter and Google+.

(5) Citation

Common types of citation are database websites such as Web of Science, Scopus, CrossRef, PubMed Central, and Microsoft Academic Search.

Altmetrics has a wide range of sources and covers many different types of commercial and nonprofit sites, each of which does not use exactly the same altmetric indicator type. It is important to clarify and understand the contexts and definitions of different altmetric data sources. What is the correlation between traditional metrics of academic impact indicators and the emerging altmetrics when two meet each other? According to Konkiel (2013, p.14), studies have shown altmetric's various sources of data correlate with traditional assessment of academic impact. Whether it is discussed on Twitter, viewed on Facebook walls, bookmarked on Mendeley and CiteUlike, recommended by F1000, or cited by Wikipedia, are all related to the impact of numbers of citations, and blog posting by experts has even more correlations to highly cited articles and journal impact factor.

Altmetric Data Sources and Analytic Tools

To know altmetrics data sources and analytic tools is a great help for understanding its trends and applications. Altmetrics.org (<http://altmetrics.org>) is the best reference site for the altmetrics. It is a free website with free access, created by Jason Priem and Heather Piwowar, outstanding scholars in the field of bibliometrics, with the most prominent feature of altmetric declaration that altmetrics can improve existing academic filtering mechanism. The site includes information of altmetrics meetings and workshops. As the center of altmetrics campaign, it is the best introductory resource websites for altmetrics topics.

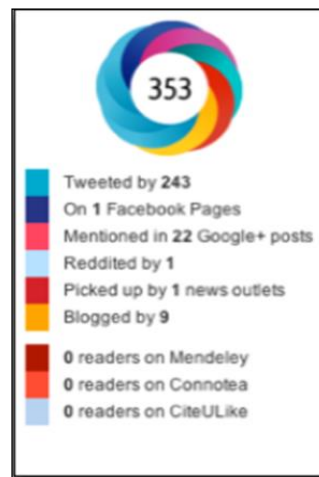
Altmetric.com, Impactstory, PLoS and PlumX have altmetric capabilities to converge various data sources and are the most important altmetrics integration analysis tools. The followings are further introductions of two popular commercial provider for altmetrics.

1. Altmetric.com (<http://www.altmetric.com>)

Altmetric.com is a commercial company that provides Article Level Metrics service. Its present customers include institutions, libraries, publishers and various businesses. Altmetric.com's special feature is colorful donut-like altmetric badges, a visualization of

altmetric impact. Each data source is represented by a specific color, and the more colors of a badge includes, the more altmetric data sources the article has. The middle of the badge is the altmetric Score, which is the score given by Altmetric.com's own article rating mechanism. Higher score means greater impact of the article (as shown in Figure 1.)

Figure 1. Altmetric badge of analysis results from Altmetric.com
Source: Altmetric, n.d.

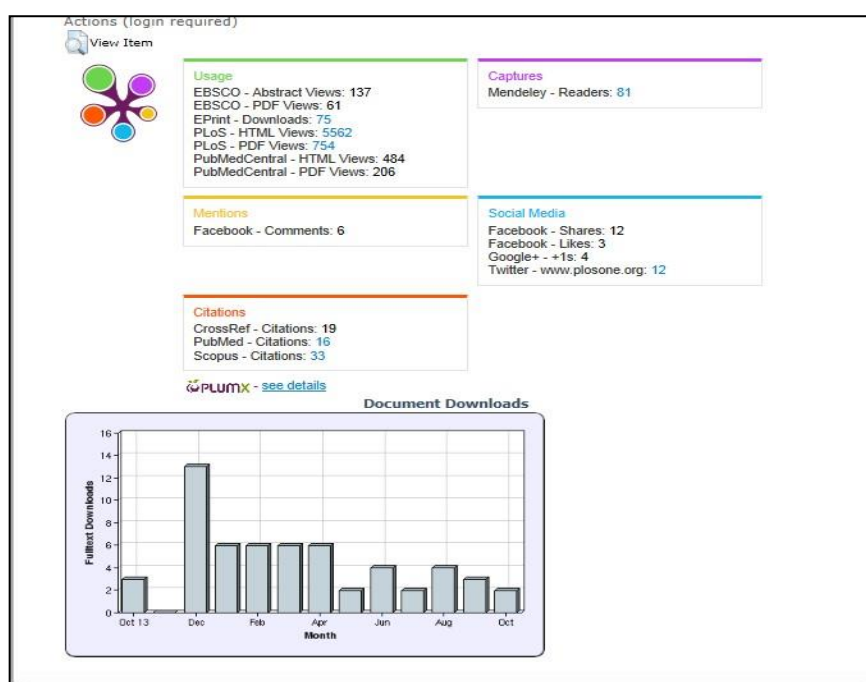


2. PlumX (<http://plu.mx>)

In 2012 Andrea Michalek and Mike Buschman founded Plum Analytics, and launched PlumX service in 2013. Plum Analytics was acquired by EBSCO in January 2014, and it was transited to Elsevier in February 2017. PlumX uses the altmetric indicator classification system proposed by Cave (2012) and its five circles (Plum Print) that look like plum pedals represent five altmetric data indicators: usage, capture, mention, social media and citation (as shown in Figure 2.) The size of five circles visualizes the impact of different types of data. The larger the circle is, the more data sources that type has.

The altmetric data source for PlumX is tracking all forms of research results. In addition to the database usage statistics, it also includes the number of library collections displayed by WorldCat. As for mention category, it includes book reviews from Amazon online bookstore. In the citation category, besides traditional citation databases such as PubMed Central and Scopus, patent references are also included. Altmetric impact analysis currently provided by PlumX is not limited to a single article. It also applies to institution collection system and provides altmetric analysis for researchers, faculties, schools, institutions or single journal/periodical.

Figure 2. Altmetric annalistic results provided by PlumX
Source: D-Scholarship@Pitt, n.d.



Developing an Academic Hub with the Application of Altmetric Display

The following section aims to introduce the development process, promotion outcome, and future development of NCCU AH, which is developed based on IR and presents “author” centered academic information.

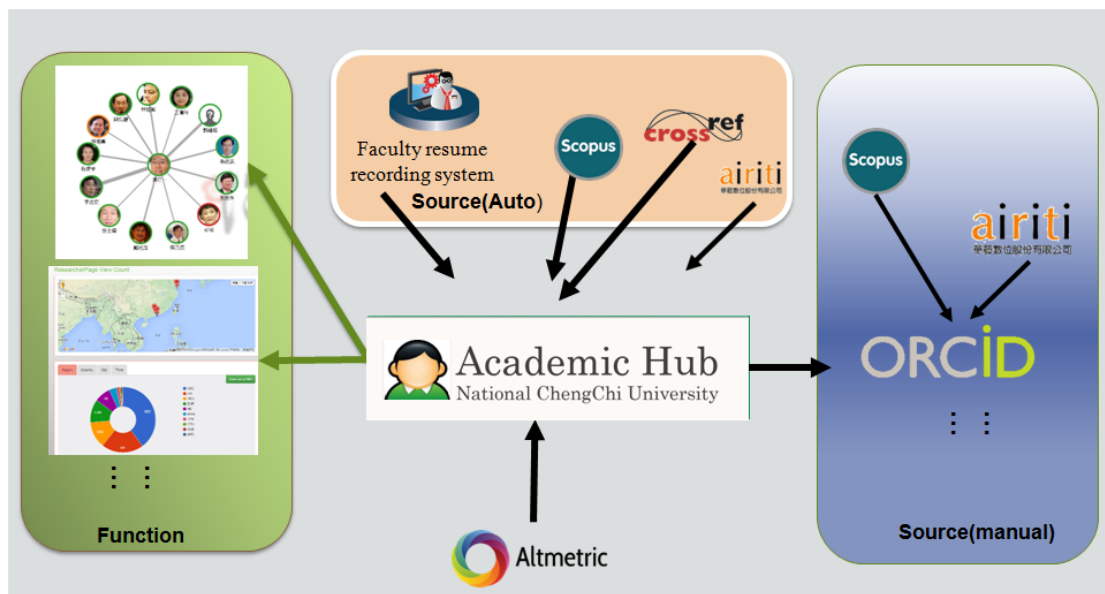
The Development Process of NCCU Academic Hub (AH)

In comparison with article-based Institutional Repository (IR) systems, author- based AH provides the users with rich author information and research articles that it has gradually become the major system in universities to present academic research outcomes. NCCU AH, employing a free open source software, i.e. DSpace-CRIS, based on DSpace IR system and the requirements for NCCU scholarly communication, is a tailored academic energy gathering and scholarly communication benefit promotion system. NCCU AH was put into formal use in 2017. The development experience in NCCU AH and the effective user promotion are demonstrated as following.

1. Establishment of NCCU AH

In consideration of the development trend of using AH to promote scholarly communication, National Chengchi University decided to transform the original IR system into an AH system in 2016. After referring to the advantages and disadvantages and the structure of AH in various universities, the major structure of NCCU AH covers four parts of Faculty Resume Recording System, API interfacing between AH and ORCID (Open Researcher and Contributors Identification), Value-added information module, and AH system. The system architecture is shown in Figure 3. The development details of such four parts are explained as below.

Figure 3. NCCU AH architecture



(1) Faculty Resume Recording System

Faculty Resume Recording System, developed by NCCU Computer Center, completely records a researcher's educational background, on/off campus experiences, and awards & achievements. Since the recorded information is large and complicated, necessary information is selected after several times of discussion and classified into five categories, including basic information, academic publication, teaching achievement, off-campus qualification, and project subsidy. Such information are provided from NCCU Computer Center API interfacing, transferred to the library database, and eventually input to AH and presented on corresponding pages. National Chengchi University became a premium member of ORCID, an independent, non-profit, community oriented, and interdisciplinary institution, in 2016. The advantage of applying for ORCID, for researchers, is to avoid name confusion so that the academic research outcomes could be correctly attributed, cited, and measured. Meanwhile, the academic energy of the university could be correctly gathered and calculated and exposed to the ORCID website. It could enhance the international visibility of instructors' articles. An ORCID column is therefore added in Faculty Resume Recording System to correspond with the instructor's ORCID application number.

(2) API interfacing between AH and ORCID

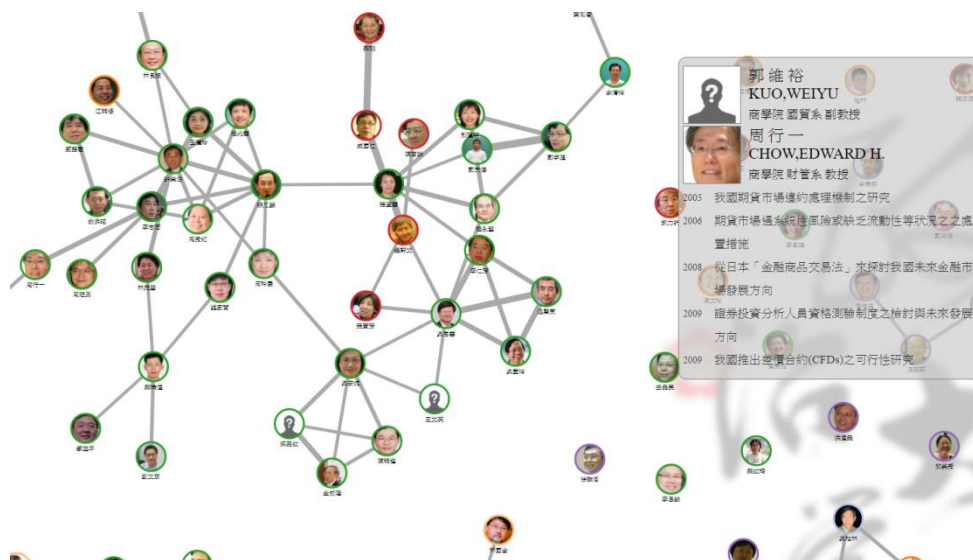
The AH data are acquired from Faculty Resume Recording System and Dissertation Table Maintenance System. The former provides researchers' resume, which is transferred to AH through API interfacing; and, the latter provides the information of instructors' articles. The librarians, after referring such information, would further refer to off-campus database (e.g. Scopus, Airiti) and establish on AH after correctly organizing such information. Meanwhile, authority control is established on AH, and the contents offered by AH are uploaded to the ORCID website through API offered by ORCID. After establishing and integrating such mechanisms, the data on ORCID could be formally utilized through API interfacing after the official auditing and certification of ORCID.

(3) Value-added information

In addition to articles and the basic information of researchers, NCCU AH also provides value-added information. In regard to articles, citation information functions of Altmetric, Web of

Science, and Scopus are introduced in the AH. Relevant citation information could be displayed on the AH webpage through the official API interfacing so that the users could understand the influence of such articles. Regarding researchers, the social network visualization function is currently planned and designed. The system could display the on-campus cooperation of researchers, observe the interaction between the studies, and understand the results of the combination among research topics (Figure 4).

Figure 4. Social network visualization function



(4) NCCU AH system

Based on NCCU IR, the first version of NCCU AH (<https://nccuir.lib.nccu.edu.tw/academicbeta/>) went live in April, 2017. NCCU AH is established with DSpace system, which was the open source IR system co-developed by the US Massachusetts Institute of Technology and Hewlett-Packard. By revising the source code, the system could be self-developed tailored functions. DSpace could preserve various types of data, including texts, images, and sound, and is spread to the world through the Internet. The system could establish index for archives as well as allows the users searching for archives through search engines. In addition to permanently preserving archives, more importantly, it provides various professional methods to manage the research data in the archives and enhance the visibility of such data so that the users could easily access. A lot of institutions around the world have currently utilized DSpace for the archive systems.

In addition to the original archive function, it also integrates instructors' educational background and experiences, teaching information, research projects, academic publication, and value-added information to be completely presented on the AH. Meanwhile, aiming at citation information embedded in articles (e.g. Altmetric, Web of Science, and Scopus), the influence of such articles is also presented. NCCU AH is organized and presented on three principal axes, including academic publication, researcher, and department.

(1) Academic publication

Academic publication derives from the original NCCU IR functions, mainly preserving on-campus academic publication. In terms of the academic publication list, the required article

could be found through browse, search, or filter. When a user clicks into an article, the simple metadata and the detailed metadata could be viewed on the right, while the functions of article view, reference export, citation information, and social media community share on the left derive from the original IR functions to accelerate the article spread. Regarding citation information, Altmetrics, Web of Science, and Scopus are included in the AH to choose the required pattern through API offered by the manufacturer or the organization and embed the corresponding source code in the webpage to present the citation information of an article. Figure 5 shows the academic publication interface function.

Figure 5. Academic publication interface function

The screenshot displays the 'ACADEMIC HUB' interface. At the top, there is a header with the title '學術集成 ACADEMIC HUB' and a building illustration. Below the header is a breadcrumb trail: '文學院 / 圖書資訊與檔案學研究所 / 期刊論文 / Item'. The main content area is divided into two columns. The left column contains links for 'View/Open', 'Export' (with options for Endnote RIS and Bibtex formats), 'CITATION INFORMATION' (including an Altmeter of 5 and 'Times Cited in Web of Science : 5'), and '社群 sharing' (social media icons). The right column has tabs for '> Simple Record' and '> Full Record'. Below these tabs is a table of DC metadata.

DC欄位	值
dc.contributor (貢獻者)	政大圖檔所
dc.creator (作者)	Tsay, Ming-Yueh
dc.creator (作者)	蔡明月
dc.date (日期)	2011
dc.date.accessioned	2013-03-28 16:39:43
dc.date.available	2013-03-28 16:39:43
dc.date.issued (上傳時間)	2013-03-28 16:39:43

(2) Researcher

Researcher page is the core of the AH, where researchers entitled NCCU professors are presented and classified with colleges and departments. The administration system API is utilized for acquiring and filtering data. For the users' convenience to acquaint the researchers, the photo uploading function is added on the back-end so that the users could see the researcher's photo while browsing the webpage.

After accessing to the personal page of a researcher, detailed data of the educational background and experiences, research projects, supervised theses, and academic publication could be viewed. The personal page would also present the researcher registration on ORCID so that the user could completely acquaint the researcher on the page. The data are also acquired from the administration system API. Figure 6 shows the researcher interface function.

Figure 6. Researcher interface function

<div> <div></div> <div>研究者 / 文學系 / 圖檔所 / 蔡明月</div> </div>	<div> <div>研究者</div> <div>學系</div> <div>學術產出</div> </div>																		
<div> <div>  </div> <div> <div>蔡明月</div> <div> <div>Tel:(02)29393091#88038</div> <div> <div>0000-0001-5484-1313</div> <div> <div>個人資料</div> <div>基本資料</div> <div>學歷</div> <div>榮譽事蹟(校內)</div> <div>榮譽事蹟(校外)</div> <div>經歷</div> </div> </div> <div>學術產出</div> <div>教學成果</div> </div> </div> </div>	<div> <div>基本資料</div> <table> <tr> <td>職稱</td><td>教授</td></tr> <tr> <td>隸屬系所</td><td>圖檔所</td></tr> <tr> <td>隸屬學院</td><td>文學院</td></tr> <tr> <td>研究專長</td><td>資訊計量學、圖書館與資訊科學、資訊檢索、參考資源與服務</td></tr> <tr> <td>e-mail</td><td>mysay@nccu.edu.tw</td></tr> <tr> <td>連絡電話</td><td>(02)29393091#88038</td></tr> </table> </div>	職稱	教授	隸屬系所	圖檔所	隸屬學院	文學院	研究專長	資訊計量學、圖書館與資訊科學、資訊檢索、參考資源與服務	e-mail	mysay@nccu.edu.tw	連絡電話	(02)29393091#88038						
職稱	教授																		
隸屬系所	圖檔所																		
隸屬學院	文學院																		
研究專長	資訊計量學、圖書館與資訊科學、資訊檢索、參考資源與服務																		
e-mail	mysay@nccu.edu.tw																		
連絡電話	(02)29393091#88038																		
	<div> <div>學歷</div> <table> <tr> <td>國別/學校名稱</td><td>系所名稱</td><td>教育程度</td></tr> <tr> <td>美國</td><td>伊利諾大學香檳校區</td><td>博士</td></tr> <tr> <td>美國</td><td>伊利諾大學香檳校區</td><td>碩士</td></tr> <tr> <td>台灣、中華民國</td><td>私立淡江大學</td><td>學士</td></tr> </table> <div> <div>榮譽事蹟(校內)</div> <table> <tr> <td>得獎年度</td><td>獎項名稱</td><td>頒獎單位</td></tr> <tr> <td>106</td><td>學術研究成果國際化優良研究獎</td><td>國立政治大學</td></tr> </table> </div> </div>	國別/學校名稱	系所名稱	教育程度	美國	伊利諾大學香檳校區	博士	美國	伊利諾大學香檳校區	碩士	台灣、中華民國	私立淡江大學	學士	得獎年度	獎項名稱	頒獎單位	106	學術研究成果國際化優良研究獎	國立政治大學
國別/學校名稱	系所名稱	教育程度																	
美國	伊利諾大學香檳校區	博士																	
美國	伊利諾大學香檳校區	碩士																	
台灣、中華民國	私立淡江大學	學士																	
得獎年度	獎項名稱	頒獎單位																	
106	學術研究成果國際化優良研究獎	國立政治大學																	

The Promotion of NCCU Academic Hub (AH)

Being a part of NCCU AH architecture, IR is transformed into NCCU AH, and the ORCID registration wizard has been integrated into the NCCU administration system for researchers registering ORCID (Figure 7). Meanwhile, it also allows the librarians grasping the registered researcher list and actively explaining the importance and necessity of registering ORCID to the instructors in library affairs meetings, college affairs meetings, and department affairs meeting as well as inviting the instructors to register ORCID. Three illustration meetings were held before the official presentation of NCCU AH to explain to the instructors about joining in ORCID and the advantage of developing NCCU AH over the scholarly communication of instructors' articles. So far, about a half of NCCU professors have registered ORCID; the development of NCCU AH intensifies the benefit.

Figure 7. Integrating ORCID to the administration system

ORCID說明

Figure 7: Integrating ORCID into the administration system

id http://orcid.org/0000-0003-1381-8058 ☐ 尚未設定代理人

- 如有任何問題，請聯絡 中正圖書館推廣服務組 蔡雯雯 分機6202、商學院圖書分館 粘雅玲 分機84006、綜合院館圖書分館 張瑋婷 分機50107
- 關於ORCID與設定代理人的說明資訊，請參考[政大圖書館ORCID說明](#)。
- [重設ORCID](#)

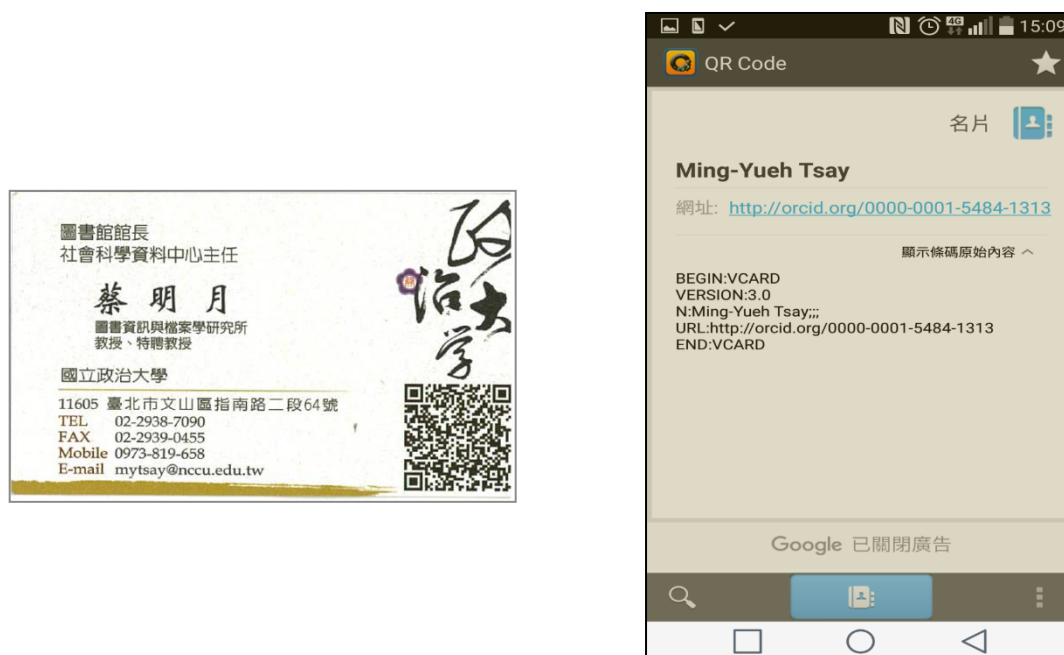
請按照以下步驟設定ORCID代理人

1. 請點選右邊圖示  進行機構典藏授權
授權是給予機構典藏權限能夠將校務系統以及機構典藏的資料推播到教師的ORCID帳號
授權範圍包含1.讀取全部範圍的"受信任的人"等級以上權限2.新增、修改以即刪除biography區塊3.新增修改、修改以即刪除activities區塊
2. 確認Google Chrome的書籤列已經開啟，或參考[顯示書籤列的說明](#)

3. 請拖曳右方圖示  到書籤列


Furthermore, printing QRCode on instructors' business cards is also offered in order to enhance the exchange with other researchers. By scanning QRCode on an instructor's business card with a mobile device, the research experiences could be immediately browsed to further enhance the academic cooperation and exchange. Figure 8 shows the business card and the presented information after scanning.

Figure 8. Business card and the presented information



Conclusions and Future Work

The promotion of NCCU AH is appreciated by many instructors. The introduction of Faculty Resume Recording System allows the users understanding the complete experience of an instructor. The introduction of ORCID allows a researcher being correctly identified so that the name could achieve authority control to rapidly, correctly, and completely organize and present the academic publication. The combination with ORCID API function allows AH synchronously displaying an instructor and the articles on the ORCID official website. It is expected that the promotion of NCCU AH could effectively enhance the scholarly communication of instructors' articles, promote the international visibility of on-campus researchers' academic research outcomes, and to further enhance the international cooperation and exchange.

NCCU AH would be continuously reinforced the functions, such as social network analysis of co-researchers, statistical information visualization of instructors' articles, automatic communication of instructors' articles to academic community websites, and location distribution of instructors' articles being concerned. In addition, SicVal and PlumX would also be introduced to reinforce the presentation of the instructors' articles being cited and discussed on NCCU AH. However, the data quality from providers, the use of persistent identifiers and the transparent methods for calculating specific output types are essential issues should be concerned in using altmetrics data for the NCCU AH visualization display. Meanwhile, xAPI (Tin Can API, 2015) would be introduced to record and analyze the users' behaviors on NCCU AH to develop personalized service as well as be the reference for improving the user interface

and information structure of the system so as to continuously develop NCCU AH system better meeting the users' needs and presenting the benefit of academic information communication.

References

- 4:AM. (2017). Retrieved from <http://altmetricsconference.com/category/1am-london>
- ACRL Research Planning and Review Committee. (June 2016). 2016 top trends in academic libraries. *C&RL News*, 274-281.
- Altmetric. (n.d.). Retrieved from <http://www.altmetric.com/badges.php>
- Altmetric.org (2017). Retrieved from <http://www.altmetric.org/altmetrics17/>
- Cave, R. (2012). *Overview of the altmetrics landscape*. In *Proceedings of the Charleston Library Conference* (pp. 349-356). West Lafayette, IN: Purdue University Press. doi:10.5703/1288284315124
- D-Scholarship@Pitt. (n.d.). Retrieved from <http://d-scholarship.pitt.edu/17829/>
- Galligan, F., & Dyas-Correia, S. (2013). Altmetrics: Rethinking the way we measure. *Serials Review*, 39(1), 56-61. doi:10.1016/j.serrev.2013.01.003
- Konkiel, S. (2013). Altmetrics: A 21st-century solution to determining research quality. *Online Searcher*, 37(4), 11-15.
- National Information Standards Organization. (2014). *White Paper on Altmetrics*. Retrieved from http://www.niso.org/apps/group_public/download.php/13295/niso_altmetrics_white_paper_draft_v4.pdf
- National Information Standards Organization. (2016). *Outputs of the NISO Alternative Assessment Metrics Project*. Retrieved from <http://www.niso.org/publications/rp/rp-25-2016/>
- Piowar, H. (2013a). Altmetrics: Value all research products. *Nature*, 493(7431), 159. doi:10.1038/493159a
- Piowar, H. (2013b). Introduction altmetrics: What, why and where? *Bulletin of the American Society for Information Science and Technology*, 39(4), 8-9. doi:10.1002/bult.2013.1720390404
- PLoS. (2014). Overview: Article-level metrics measure the dissemination and reach of published research articles. Retrieved from <http://article-level-metrics.plos.org/alm-info/>
- Priem, J., Taraborelli, D., Groth, P., & Neylon, C.(2010). *Altmetrics: A manifesto*. Retrieved from <http://altmetrics.org/manifesto>
- Tananbaum, G. (2013). *Article-level metrics: A SPARC primer*. Retrieved from <http://www.sparc.arl.org/resource/sparc-article-level-metrics-primer>
- Tin Can API. (2015). *What is the Tin Can API?* Retrieved June 13, 2017, from <https://tincanapi.com/overview/>