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Development and validation of New Media Literacy Scale (NMLS) for university students

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ABSTRACT

Along with the emergence of new media technologies, individuals are now expected not only to consume but also produce, share and criticize digital contents. Being new media literate, they also need to know socio-cultural and emotional aspects of new media beyond its technical characteristics. New media literacy (NML) involves a series of crucial skills needed for living and working in the mediated and participatory society of 21st century. Although there has been a growing interest in the conceptualization of NML, the literature lacks a measuring instrument to operationalize NML. This study attempts to fill this gap by developing and validating a NML scale (NMLS) for university students. The sample included 1226 students at a state university in Turkey. Both exploratory and confirmatory factor analyses as well as item analyses including internal consistency coefficients, item-total correlations, and item discrimination powers were conducted to determine construct validity and reliability. Consistent with the adopted theoretical framework, the 35-item NMLS comprised four factors: Functional Consumption, Critical Consumption, Functional Prosumption, and Critical Prosumption. Potential applications of NMLS for measuring students' new media competencies were discussed within the pedagogical and research contexts.

1. Introduction

The proliferation of advanced technologies in today's digital era has facilitated rapid access to new information and delivery of media messages to crowd of people. However, just the ownership of technological devices or the ability to use them is not sufficient for reaching valid and reliable information as well as active participation in digital media. Individuals need to have a variety of media or digital literacy skills in order to both consume and (re) produce functional media content. Such skills are required to survive in the digital era. In his revised holistic model of digital literacy, Eshet (2012) defined digital literacy as a multidimensional concept that comprised technical, cognitive, motoric, sociological, and emotional aspects. According to Eshet (2012), a digitally-literate person should have photo-visual skills (understanding graphical/visual messages), reproduction skills (creating meaningful media content), branching skills (constructing knowledge from complex and flexible hypermedia domains), information skills (judging the accuracy and quality of media content), socio-emotional skills (communicating and working with others in the cyberspace) and real-time thinking (multi-tasking or processing different kinds of multimedia stimuli). Known as a survival kit for the 21st century, media literacy involves similar skills such as accessing, decoding, analyzing, evaluating and producing both written and electronic media content such as text, image, audio, video, and so on (Hobbs & Jensen, 2009; Zhang, Zhu, & Sang, 2014). It helps people consciously use media, distinguish and evaluate media content, critically examine media types, investigate media effects, and develop alternative media content (Kellner & Share, 2007). In addition to such skills, it includes the knowledge of how messages are created, commercialized, and diffused all around the world (Thoman & Jolls, 2004).

1.1. New media literacy (NML)

The emergence of Internet technologies and mobile communication tools has transformed old media and introduced the concept of "new media". Printed text and analog broadcasting have been

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superseded, if not completely suppressed, by online publication and digital video. Now, not only authorities (e.g., website owners, directors) but also ordinary users can (co)create digital media content to represent their social values, ideologies, politics and so on. This has blurred the boundaries between the sender and receiver of information (Oberhelman, 2007) and created a convergence culture in which old and new media intersect and the powers of media producers and consumers interact in order to achieve collective intelligence (Jenkins, 2006). Therefore, by the term new media, we refer to all technology-based socio-cultural platforms in which any messages are digitally coded and distributed by any users. This new media is characterized by digital interactivity, creative and collective participation, networkability, data manipulation, modularity, hybridity, and virtuality (Chen, Wu, & Wang, 2011; Lin, Li, Deng, & Lee, 2013). Moreover, it has the feature of ubiquitous computing environment through which digital messages can be accessible anywhere and anytime on any digital devices (e.g., tablets, smart phones).

In today's world, the most prevalent forms of new media are Web 2.0 tools. Web 2.0 refers to new version of World Wide Web platforms that allow for user-generated content, dynamic and light programming, active contribution, folksonomy (i.e., social tagging), collective intelligence, and many-to-many web communication (Butler, 2012; O'Reilly, 2005; Selwyn, 2007). Social networking sites (e.g., Facebook, Twitter), image and video sharing sites (e.g., YouTube, Instagram), blogs, wikis, mash-ups, 3D virtual worlds (e.g., Second Life) are common examples of these tools. In contrast to Web 1.0 environments with centralized web sites distributing information to passive visitors, Web 2.0 platforms promote proactive participation and contribution, social networks, and diverse interactions (Maloney, 2007; McLoughlin & Lee, 2007; Selwyn, 2007). A user can create media messages individually or collaboratively in the digital form of text, image, video or hybridity of these and share them with other users, who can also edit or refine these messages by adding their own touches or tag them by assigning keywords for useful classification and retrieval purposes. Such a tagging mechanism makes massive digital resources easily searchable and sharable for all users, which in turn, enhances collective knowledge acquisition (Held & Cress, 2009).

The rise of new media has demanded new kind of literacy, which is called "new media literacy" (NML). Traditionally, media literacy was viewed as teaching students about media and how to access and understand its contents (i.e., consuming media). Since the beginning of the 21st century, new media technologies have expanded this notion of literacy to include (re)creating media contents and sharing them with others (i.e., producing media). Today's individuals have perpetual contact with information and each other through both consuming and producing media messages. Therefore, the new focus in NML is on collective creation of innovative media content over static content delivery, social interaction over isolated surfing, and active participation and engagement over passive reception (Jenkins, 2006; Maloney, 2007). Furthermore, being able to read and write media needs to be accompanied by critical and expressive thinking about the politics of representation (Kellner, 2010). Individuals are now expected to question potential biases, consequences and power of mediated messages they create or receive within the various channels of new media. In contrast to traditional forms of media literacy, NML addresses some specific limitations or problems (e.g., Poe's Law, Streisand Effect). While communicating virtually, individuals should look for contextual or intentional indicators in order to be conscious of ironic expressions, parodies or satires and be able to distinguish them from truthful ones. They need to know that any digital message may rapidly spread to large group of people on the cyberspace. In fact, it might be unintentionally publicized to larger masses when it is tried to be hidden or censored.

1.2. Theoretical framework of NML

Chen et al. (2011) proposed a promising theoretical model to unpack the notion of NML based on their analysis of historical evolution of literacy and technical and socio-cultural characteristics of new media. This was the first attempt to conceptualize NML in the relevant literature. Basically, they identified NML as two continuums: (a) from consuming to prosuming media literacy, and (b) from functional to critical media literacy. Consuming media literacy refers to competencies to access media messages and employ media at various levels while prosuming media literacy, on top of consuming abilities, regards to competencies to produce media contents and participate in media environments. Using Toffler's (1981) concept of prosumer, Chen et al. (2011) argue that a media prosumer is both a producer and a consumer because he/she usually produces customized contents through using preexisting media artifacts, ideas, and benefits of technological tools. In other words, prosuming aspect is essentially grounded on the consuming one. On the other hand, expanding Buckingham's (2003) notion of functional and critical literacy, Chen et al. (2011) define functional media literacy as competencies to operate media tools in order to access and create media messages and understand them at the textual level whereas they view critical media literacy as abilities to analyze and judge media messages and understand them at various contextual levels. As is the case with the first continuum, functional aspect is integrated as a basis in the critical one. That is, one should already be familiar with technical or operational characteristics of new media in order to have a good comprehension of its socio-cultural contexts.

Combining these continuums mentioned above, Chen et al. (2011) proposed four components of NML: (1) functional consuming, (2) critical consuming, (3) functional prosuming, and (4) critical prosuming. A functional consumer is able to access produced media content and understand its textual meaning. A critical consumer is able to analyze and interpret socio-cultural, economic, and political consequences of media content. Hence, he/she has the ability of questioning media messages in terms of their purposes, underlying ideologies, social values, and representations of power. A functional prosumer is able to participate in production of new media content in various media platforms whereas a critical prosumer can also convey his/her own beliefs, negotiate with others' ideas, and consider expected impacts during media construction and participation. Chen et al. (2011) associate functional consuming and prosuming with computer literacy and critical consuming and prosuming with information literacy, and argue that NML is a convergence of all these four components with critical prosuming being the most crucial in the 21st century.

A couple of years later, Lin et al. (2013) refined the theoretical framework developed by Chen et al. (2011) so that it could provide more comprehensive explanation of NML and put more emphasis on distinguishing characteristics of Web 2.0 technologies. Essentially, Lin et al. (2013) kept four components of NML same as before, but proposed ten fine-grained indicators to further elaborate these components.

In the refined framework by Lin et al. (2013), functional consuming literacy is further represented by *consuming skill* and *understanding* indicators. The consuming skill involves a number of technical abilities in order to operate different hardware and software for accessing various media content whereas the understanding indicator refers to the ability to grasp literal meaning of media messages. For example, a functional consumer knows how to use computers and Internet search engines to locate information in any form of media and he/she can capture and interpret others'

ideas submitted to discussion boards, chat rooms or social networks.

Critical consuming literacy is identified by *analysis*, *synthesis*, and *evaluation* indicators. The analysis indicator refers to individuals' ability to deconstruct media messages in terms of their authorships, formats, audiences, and purposes. It highlights the recognition of media messages as subjective rather than simply perceiving them as neutral. The synthesis indicator involves the competency of sampling, remixing, and comparing media content from different sources. On top of analysis and synthesis, the evaluation indicator includes the ability to examine the reliability and credibility of media content. It helps to reach true, relevant and unbiased information. For example, a critical consumer can identify manipulative or biased news spreading on the Internet by examining its construction process and verifying it from multiple sources. As can be seen, such an inquiry requires individuals to exercise higher order thinking skills in order to critically engage with mediated messages.

Lin et al. (2013) characterize functional prosuming literacy based on three indicators: *prosuming skill*, *distribution*, and *production*. Similar to consuming skill, the prosuming skill refers to a number of technical skills in order to use various technologies for creating digital artifacts. The distribution indicator involves individuals' activities to share their own feelings, ideas and digital artifacts with others in new media platforms. Therefore, it relates to the process of information dissemination and belongs to Web 2.0 technologies exclusively. The production indicator indicates the competency of duplicating, rearranging, or combining text, audio and video pieces into digital media formats. For example, a functional prosumer can open a new Facebook profile or Twitter account, create a slideshow or video clip by mixing his/her pictures, and share this with friends.

As the last but the most complex and crucial media literacy, critical prosuming is represented by *participation* and *creation* indicators (Lin et al., 2013). The former refers to individuals' interactive and critical participation in new media platforms. This indicator is exclusively related to active contribution and collective intelligence characterized by Web 2.0 technologies. Therefore, it requires individuals to own social skills to achieve digital communication and collaboration with others. A critical prosumer in a discussion forum, for instance, can identify deception, improve others' comments or go into a negotiation with others by presenting his/her ideas as well as being respectful for diverse values and ideologies. The latter indicator involves individuals' initiations to create original media contents in which their own socio-cultural values and ideologies embedded or to combine preexisting media content to create new meanings. For example, a critical prosumer can develop a new website or open a new blog in order to promote awareness about a topic of interest or to start discussion on a matter of opinion.

1.3. Purpose of the study

As can be seen from the explanations above, NML is a new concept and involves a series of crucial skills needed for living and working in the mediated and participatory culture of 21st century. Educational institutions take it as one of the top priority issues in their curriculums because new media environments revolutionize learning and teaching. Media education activities help students develop adequate self-confidence, intellectual curiosity and critical thinking in order to make judgments about media messages that they might come across in their future lives (Hobbs, 2011). Although theoretical conceptualizations of NML may inform teaching or building new media competencies, operational definition is needed to diagnose both the capacity of students and the effectiveness of educational practices related to NML. In this study, we aimed to develop and validate a comprehensive scale for measuring NML based on the theoretical framework of Lin et al. (2013) explained earlier. Our literature review revealed that existing instruments focused only consuming or information-seeking skills germane to conventional media and thus they failed to cover prosuming skills related to unique affordances of new media. Therefore, to our best knowledge at the beginning of this study, no instrument has ever been particularly developed to measure young adults' NML inclusively. In this regard, our study makes a unique contribution to the kickoff and development of systematic investigation of this emerging concept.

2. Methodology

2.1. Item development

The quantification of NML was accomplished based on qualitative exploration of NML concepts and outcomes. We conducted an item generation process for NML scale (NMLS) with the guidance of adopted theoretical framework of NML (Lin et al., 2013), literature review of previous measures and research on media and digital literacy (Arke & Primack, 2009; Eshet, 2012; Inan & Temur, 2012; Karaman & Karatas, 2009) and our focus group discussions. Each item was constituted in three steps. Firstly, we examined theoretical explanations of different dimensions of NML and their fine-grained indicators to get a conceptual understanding of NML construct. Secondly, we discussed and articulated potential items that could represent those literacy indicators. In this step, previous scales were also inspected to find out if they had adaptable items. Most items related to critical and prosuming dimensions of NML framework were developed based on our focus group discussions because they were not covered by traditional media literacy scales. After reaching consensus on item wording, we finally wrote candidate statements. The initial list of statements was carefully reviewed to eliminate complex and illogical expressions, recurrences, and typos. Finally, the item pool was made up of 45 positive items measured on a 5-point Likert-type scale with "1 = strongly disagree" and "5 = strongly agree". Sample items include "I know how to use searching tools to get information needed in the media", "I can compare news and information across different media environments", "I am able to use software necessary for developing media contents (text, image, video, etc.)", and "I can collaborate and interact with diverse media users towards a common purpose".

2.2. Expert review

Writing adequate number of items from all aspects of concept domain is crucial for content validity during scale development. Content validity refers to the systematic examination of the scale content to determine whether it covers a representative sample of the behavior domain to be measured (Anastasi & Urbina, 1997). It depends on a theoretical basis and is largely a matter of judgment. A usual approach to establishing content validity is to consult with experts. We utilized two-stage process, as described by Lynn (1986), to determine content validity of NMLS. In the first stage (i.e., development stage), we initially identified the content domain and conceptualized NML by adopting theoretical framework of Lin et al. (2013). In this framework, NML is defined by four dimensions with a total of ten indicators: functional consuming (*consuming skill* and *understanding*), critical consuming (*analysis*, *synthesis* and *evaluation*), functional prosuming (*prosuming skill*, *distribution* and *production*) and critical prosuming (*participation* and *creation*). The definition and sample competencies of these dimensions and

indicators were already given in section 1.2 above. Next, we generated potential items and formulated the scale based on this theoretical framework, existing measures and focus group interviews. Detailed information about these actions was also given in the preceding section 2.1.

The second stage (i.e., judgment-quantification stage) involved expert assessment for the relevance of scale's content. Lynn (1986) recommended at least three experts but stated that more than 10 were probably unnecessary. Accordingly, we worked with four academicians from those fields related to our research scope and methodology such as computer education and instructional technologies, communication studies, and psychometrics. These experts were given the definition of NML dimensions and indicators as well as a list of 45 items. As advised by Lynn (1986), they were asked to write their comments and rate the relevancy of each item to given definitions on a 4-point ordinal scale in which 1 = not relevant, 2 = somewhat relevant, 3 = quite relevant and 4 = highly relevant. We also urged them to reword items as needed to make them more clear and concise and add new ones relevant to NML concepts. After gathering feedback and rating data from the experts, we computed content validity index for each item (I-CVI) as the number of experts giving a rating of either 3 or 4 divided by the total number of experts. Lynn (1986) developed criteria for item relevancy by incorporating the standard error of the proportion. She recommended that the I-CVI should be 1 for three to five experts and a minimum of 0.78 for six to ten experts. Results of the analysis of expert ratings and I-CVIs for the 45 items revealed that 26 items met the criteria whereas 19 items had the I-CVI values less than 1. Of these 19 items, eight items with no advice for revision were eliminated and eleven items were rewritten based on the experts' recommendations. Three new items that experts thought to be consistent with NML conceptual domain were also added to the scale. The second round of expert review acknowledged these revisions. As a result, this content validation process modified the number of items in the pool to 40.

2.3. Pilot testing

Another crucial step in scale development is to ensure that prospective respondents understand item statements. For this purpose, we conducted focus group interviews with 15 volunteer college students to pilot the revised 40 items. Students responded the items in a questionnaire form at an empty classroom. We observed students during this process and at the end hold discussions about how they perceived and understood each item. They were requested to make judgments about item wording, clarity of the statements, and logical organization of the items. Such judgments are based less on the technical elements of content validity and more on what looks valid (i.e., face validity) (Anastasi & Urbina, 1997). Participants of this pilot-testing found the items and uniform 5-point Likert scale acceptable and easy to understand. The analysis of their feedback revealed that all items demonstrated good clarity in language and face validity from the perspectives of target audience.

2.4. Participants

The revised version of 40-item NMLS emerged from the aforementioned scale development processes was administered to 1311 volunteer university students at a large state university in Turkey. We inspected returned questionnaires thoroughly and eliminated those that were simply blank, considerably incomplete or negligently responded. Consequently, the final sample included 1226 students. Participants were drawn from nine different colleges including Arts and Sciences (26%), Forestry (15%), Agriculture (12%), Theology (12%), Economics and Administrative Sciences (11%), Engineering (10%), Education (5%), Technology (5%), and Law (4%). Almost half of the students (49%) were freshman, 13% were sophomore, 20% were junior, and 18% were senior. Of the sample, 55% were female and 45% were male students and their age ranged from 18 to 30 with a mean age of 21.05 (SD = 1.96).

We contacted college administrations to obtain necessary permission for data collection by writing a petition explaining the scope and aim of our research. The questionnaires were conducted in students' lecture halls either before or after their lessons. Students were initially asked to give their written consent and informed that any information they provided would be voluntary, confidential, and used only for research purposes. Those students who had volunteered to participate were informed about how they fill out the questionnaire form.

3. Results

3.1. Construct validity phase

The construct validity of the NMLS was judged via exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Using the function of SPSS software for selecting cases, we randomly split the sample into two halves: (a) development subsample (n = 613) and (b) cross-validation subsample (n = 613). We firstly employed EFA on the former to identify the factorial structure of the items, and then CFA on the latter to cross-validate and refine the emerged measurement model from the EFA.

3.1.1. Exploring factorial structure of the NMLS

Prior to performing EFA, the suitability of the data in the development subsample for the factor analysis was assessed. There were several missing values randomly distributed within the items and they were estimated using series mean method. The inspection of Boxplots indicated four to seven univariate outliers in several items. Because the sample was quite large and the differences between 5% trimmed mean and overall mean of the related items were very small, we decided that these cases could not have a distorting effect on the distribution and thus retained them in the data set. The normality assumption was also supported by absolute values of skewness and kurtosis less than 1 and normal probability plots representing reasonably straight lines. The presence of possible multivariate outliers was checked by calculating Mahalanobis distance values. Those cases whose Mahalanobis values exceeding the critical Chi-square value of 80.08 (df = 39, alpha = 0.001) were considered as outliers and removed from the analysis (Pallant, 2007; Tabachnick & Fidell, 2007). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.95, exceeding the recommended value of 0.60 and Barlett's Test of Sphericity was statistically significant (χ^2 = 12,227.16, df = 780, $p < 0.01$), indicating highly acceptable factorability of the data and correlation matrix (Pallant, 2007). The development subsample size of the study (n = 613) was more than adequate because the number of cases from 100 to 400 can be regarded as suitable for factor analysis (Hair, Black, Babin, & Anderson, 2010).

In the EFA, all 40 items were subjected to principal component analysis with varimax orthogonal rotation using SPSS 20. The initial solution revealed seven factors with eigenvalues over 1. However, those after the fourth factor had eigenvalues and percentages of explained variances that were relatively small and close to each other. An inspection of Catell's (1966) scree test showed a clear break after the fourth factor in the screeplot (Fig. 1). Furthermore, we performed a parallel analysis through Monte Carlo PCA software (Watkins, 2000) and found that only four factors had eigenvalues greater than the corresponding criterion values for 100 randomly

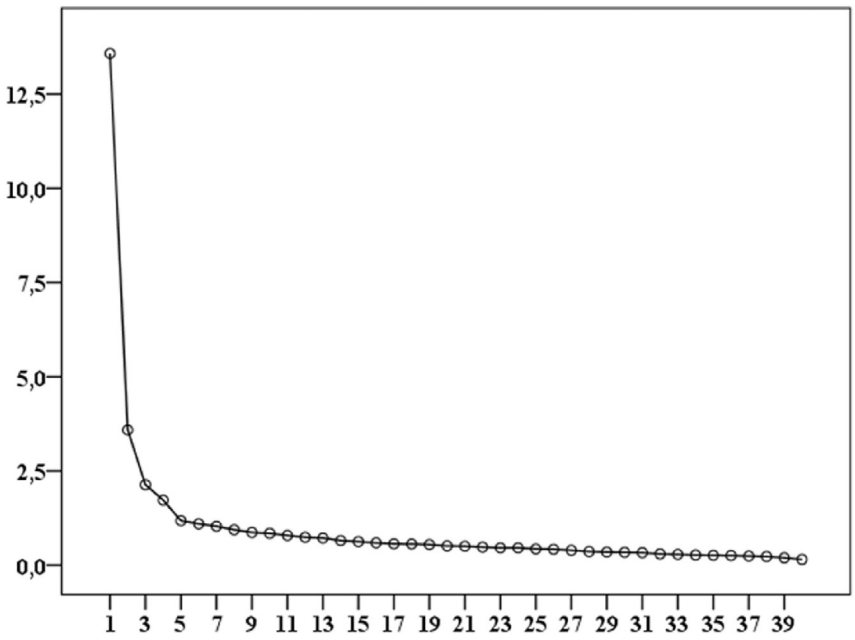

Fig. 1. Scree plot for exploratory factor analysis of the NMLS.

generated data matrix of the same size as our real sample. Based on these findings, we decided to retain four factors for further investigation.

The replication of EFA with four-factor solution indicated that five items had factor loadings less than recommended value of 0.50 (Hair et al., 2010) or similar cross loadings whose differences were less than 0.10. After removal of these items, the final four-factor model with the remaining 35 items accounted for 55% of the total variance, which is an acceptable rate in social sciences. Examining items' meanings and coherency in accordance with the adopted theoretical framework of NML (Lin et al., 2013), we labeled factors as functional consumption (FC, 7 items), critical consumption (CC, 11 items), functional prosumption (FP, 7 items), and critical prosumption (CP, 10 items) respectively. Item wordings, factor loadings, eigenvalue, variance explained, and Cronbach's alfa for each factor are given in Table 1. The factor loadings ranged from 0.50 to 0.85, suggesting that all items were good measures of their respective factors (Hair et al., 2010). As indicated by Cronbach's alphas (0.85, 0.87, 0.89, and 0.93) well above the threshold value of 0.70, all factors were internally consistent and well defined by their items (DeVellis, 2003).

3.1.2. *Confirming factorial structure of the NMLS*

The four-factor measurement model extracted from EFA was subjected to CFA using the cross-validation subsample and LISREL 8.80 software. Like in the EFA, we initially checked the assumptions of CFA. There were four to seven univariate outliers observed in the Boxplots of several items. We decided to retain these cases since the sample was quite large and their %5 trimmed means were not as much different than overall means. In fact, none of the items had absolute values of skewness and kurtosis larger than 1, suggesting that the data could be treated as univariately normally distributed (Kline, 2005). This was also supported by visual examination of normal probability plots, which showed reasonably straight lines. Mahalanobis distance values were calculated for the inspection of multivariate outliers. The cases with Mahalanobis values greater than critical Chi-square value of 65.25 (df = 34, alpha = 0.001) were treated as outliers and thus removed from the analysis (Pallant, 2007; Tabachnick & Fidell, 2007).

Because our data met normality assumptions, we employed maximum likelihood estimation, which is the most widely used estimation technique in structural equation modeling (SEM). The measurement model comprised of factors as latent constructs and items as observed variables (Fig. 2). In accordance with the NML theoretical framework, all constructs were allowed to correlate with others. Chi-square goodness of fit test, which is the fundamental measure of model fit in SEM analysis, was found to be statistically significant ($\chi^2 = 1279.25$, df = 544, $p < 0.01$). However, χ^2 is known to be biased towards large samples and complex models. Thus χ^2/df ratio is recommended to sufficiently evaluate model fit and values less than 3 indicate a good model fit (Kline, 2005). This ratio was found to be 2.35 in our analysis. Moreover, we used alternative model fit indices based on residuals and independent model including Standardized Root Mean Square Residuals (SRMR), Root Mean Square of Error of Approximation (RMSEA), Goodness of Fit Index (GFI), Comparative Fit Index (CFI), and Normative Fit Index (NFI). The SRMR and RMSEA values equal or less than 0.05 signify perfect fitness and the GFI, CFI and NFI values greater than 0.90 indicate good fitness (Brown, 2006; Hair et al., 2010). We found these index values as follows: SRMR = 0.050, RMSEA = 0.049, GFI = 0.89, CFI = 0.98 and NFI = 0.97. As shown in Fig. 2, standardized parameter estimates for all items were statistically significant ($p < 0.01$) and not less than recommended value of 0.50 (Hair et al., 2010), ranging from 0.62 to 0.72 for FC, 0.50 to 0.68 for CC, 0.64 to 0.82 for FP, and 0.64 to 0.82 for CP factor. Since each item was loaded only on its respective factor in the model, the standardized parameter estimates can be regarded as indicators of item-factor correlations (Kline, 2005). Therefore, relatively large and significant estimates provide evidence for convergent validity which refers to the degree to which theoretically similar measures are in fact related to each other (Maruyama, 1998). All estimates for each factor in our model were significant and relatively large (0.50 and above) and hence supported convergent validity. Collectively, these results suggest that four-factor 35-item measurement model of NMLS fits well with the observed data and exhibits adequate construct validity.

Table 1
Results of exploratory factor analysis of the NMLS.

Factor/item	Factor loading	Eigenvalue	Variance explained	Cronbach's alpha
Functional consumption (FC)		3.73	10.65%	0.85
FC1: Know how to use searching tools to get information needed in the media.	0.50			
FC2: Catch up with the changes in the media.	0.62			
FC3: Make use of various media environments to reach information.	0.60			
FC4: Realize explicit and implicit media messages.	0.67			
FC5: Notice media contents containing mobbing and violence.	0.71			
FC6: Understand political, economical and social dimensions of media contents.	0.70			
FC7: Perceive different opinions and thoughts in the media.	0.62			
Critical consumption (CC)		5.02	14.35%	0.87
CC1: Distinguish different functions of media (communication, entertainment, etc.).	0.54			
CC2: Determine whether or not media contents have commercial messages.	0.59			
CC3: Classify media messages based on their producers, types, purposes and so on.	0.59			
CC4: Compare news and information across different media environments.	0.55			
CC5: Combine media messages with own opinions.	0.59			
CC6: Consider media rating symbols to choose which media contents to use.	0.53			
CC7: Make decision about the accuracy of media messages.	0.71			
CC8: Analyze positive and negative effects of media contents on individuals.	0.67			
CC9: Evaluate media in terms of legal and ethical rules (copyright, human rights, etc.)	0.68			
CC10: Assess media in terms of credibility, reliability, objectivity and currency.	0.64			
CC11: Fend against the risks and consequences caused by media contents.	0.54			
Functional prosumption (FP)		4.20	12.01%	0.89
FP1: Create user accounts and profiles in media environments.	0.68			
FP2: Use hardware necessary for developing media contents (text, image, video, etc.).	0.69			
FP3: Use software necessary for developing media contents (text, image, video, etc.).	0.69			
FP4: Use basic operating tools (button, hyperlinks, file transfer etc) in the media.	0.70			
FP5: Share digital media contents and messages on the Internet.	0.74			
FP6: Make contribution or comments to media contents shared by others.	0.67			
FP7: Rate or review media contents based on personal interests and liking.	0.64			
Critical prosumption (CP)		6.19	17.67%	0.93
CP1: Influence others' opinions by participating to social media environments.	0.73			
CP2: Make contribution to media by reviewing current matters from different perspectives (social, economical, ideological etc.).	0.71			
CP3: Collaborate and interact with diverse media users towards a common purpose.	0.72			
CP4: Construct online identity consistent with real personal characteristics.	0.55			
CP5: Make discussions and comments to inform or direct people in the media.	0.70			
CP6: Design media contents that reflect critical thinking of certain matters.	0.82			
CP7: Produce opposite or alternative media contents.	0.85			
CP8: Produce media contents respectful to people's different ideas and private lives.	0.73			
CP9: Create media contents that comply with legal and ethical rules.	0.74			
CP10: Develop original visual and textual media contents (video clips, web page, etc.)	0.68			

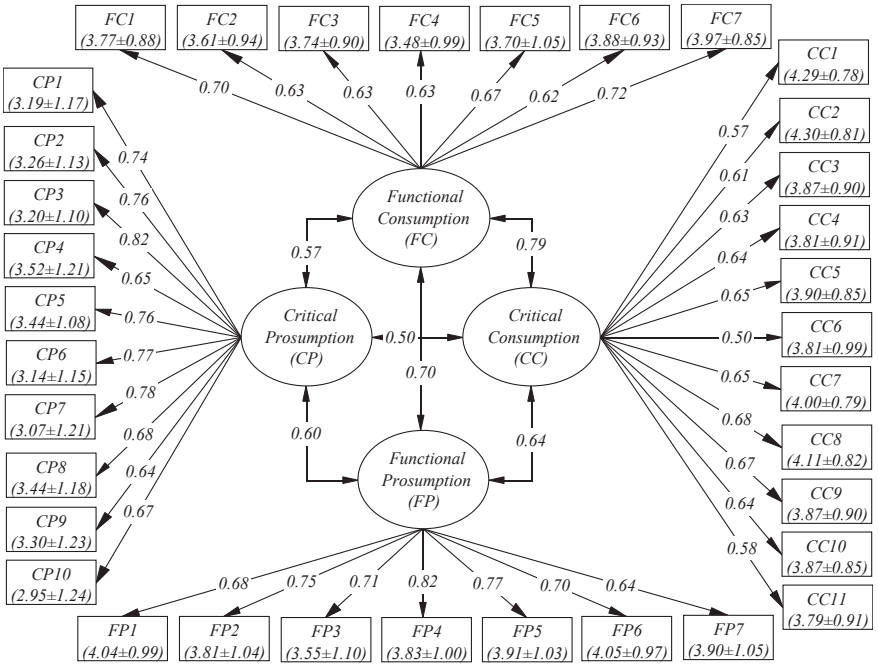

Fig. 2. Results of confirmatory factor analysis of the four-factor model of NMLS. The numbers in parentheses represent item mean scores and standard deviations (Mean ± SD).

3.1.3. Second-order confirmatory factor analysis

After verifying the four-factor measurement model of NMLS, we also developed a second-order model in order to investigate if four factors can be explained by a single higher-order factor. This one-factor model assumed that the relationships among four constructs emerged from the first-order model (FC, CC, FP, and CP) can be exclusively accounted for a broader latent construct (NML). Therefore, it did not allow four constructs to be correlated with each other but rather loaded them onto the NML construct with unidirectional connections. We tested this model by running CFA in the cross-validation subsample. Similar to the first-order model, the results showed a good model fit (χ^2/df = 2.36, SRMR = 0.054, RMSEA = 0.049, GFI = 0.88, CFI = 0.98, NFI = 0.97). The standardized parameter estimates between the second-order factor of NML and the first-order factors of FC, CC, FP, and CP (i.e., structural loadings) were 0.91, 0.83, 0.79, and 0.65 respectively and statistically significant ($p < 0.01$). Besides, those between the first-order factors and observed items (i.e., measurement loadings) were statistically significant ($p < 0.01$) and not less than recommended value of 0.50 (Hair et al., 2010), ranging from 0.63 to 0.71 for FC, 0.50 to 0.68 for CC, 0.64 to 0.82 for FP, and 0.64 to 0.82 for CP factor. Similar to first-order model, all standardized estimates in the second-order model were significant and relatively large, which provided evidence for convergent validity (Maruyama, 1998). These findings as a whole suggest that NML can also be considered as an underlying unidimensional construct.

3.2. Construct reliability and item analysis phase

3.2.1. Internal consistency level

Both factor and entire reliability analyses of four-factor model of NMLS were carried out by calculating Cronbach alpha internal consistency coefficients on the whole sample. The subscale coefficient values for each factor were as follows: 0.85 for FC, 0.87 for CC, 0.89 for FP, and 0.93 for CP. Moreover, the coefficient value for the whole NMLS was found to be 0.95. These findings exceed the acceptable Cronbach's alpha level of 0.70 for scale development (DeVellis, 2003; Nunnally & Bernstein, 1994), and thus indicate a good convergence or internal consistency.

3.2.2. Item-total correlations

As an important phase of item analysis, the corrected item-factor total correlations were also examined to determine the coherency of items within the same factor (i.e., level of serving the purpose of factor). All item-factor total correlations were much greater than threshold value of 0.30 (Pallant, 2007), ranging from 0.55 to 0.66 for FC, 0.47 to 0.64 for CC, 0.62 to 0.73 for FP, and 0.59 to 0.80 for CP factor. Furthermore, the corrected factor-scale total correlations were also above 0.30, ranging from 0.45 to 0.65. These findings suggest that NMLS has significant item-factor and factor-scale relationships. In other words, each item within the same factor serves the general purpose of that factor as well as the general purpose of the NMLS.

3.2.3. Item discrimination power

Another important step in item analysis is to determine how well the four-factor model of NMLS discriminates between individuals with high competency and those with low competency in terms of NMLS. In order to accomplish this, we observed the differentiation between the lowest 27% and highest 27% of the participants in the whole sample. For this reason, we ranked the raw scores from the highest to the lowest and then identified the first 27% of them as the higher group ($n = 331$) and the last 27% of them as the lowest group ($n = 331$) for each item, factor, and the whole scale. This was followed by conducting independent sample *t*-test to statistically test the difference between the mean scores of the two groups. The *t*-test values for all item scores were statistically significant ($p < 0.01$), ranging from 49.12 to 72.58 in FC, 40.87 to 74.75 in CC, 62.83 to 66.45 in FP, and 57.92 to 84.59 in CP factor. The *t*-test values for the total scores were also statistically significant ($p < 0.01$), 65.78 for FC factor, 66.84 for CC factor, 69.12 for FP factor, 80.91 for CP factor, and 76.01 for the whole NMLS. These results suggest that each item, factor and the whole scale have adequate power to distinguish individuals in terms of their levels of regarding NML competency. Moreover, as shown in Table 2, the inter-correlations between the factors were moderately small enough (varied between 0.44 and 0.63) and did not exceed 0.70, suggesting that the four factors were adequately distinct and thus the scale demonstrated discriminant validity (Ping, 2004).

4. Discussion and conclusion

Consistent with the adopted theoretical framework of NML (Lin et al., 2013), our study produced a four-factor NMLS comprising FC, CC, FP, and CP as seemingly distinct but related factors, each of which is measured by multiple Likert type items. This finding empirically suggests that NML can be operationalized in the future studies by employing the four-factor NMLS (Appendix). In addition to measuring this first-order model, we also developed and tested the second-order model to measure overall general NML ability. This is a natural next step in scale development. After a researcher discovers multidimensional structure of the data and forms subscales, he/she also investigates whether it is possible to develop a generalized or total scale by combining these subscales. In fact, it is recommended to test alternative models for comparison of various conceptualizations of factorial structure of the instrument to be developed (Noar, 2003). Our second-order one-factor model represents the hypothesis that whether FC, CC, FP, and CP factors extracted from the first-order four-factor model can load on one common or unidimensional underlying construct (i.e., overall NML ability). However, we found that both fit indices and χ^2/df ratio were almost identical for both models though the second-order model produced two extra degrees of freedom. These results provide evidence that both models are statistically equivalent and applicable for measuring NML. The only difference between them is that the second-order model is a special case of the first-order model and provides an alternative account of the association between the first-order factors. The decision on which model to be used depends ultimately on what theory suggests (Byrne, 2001). Since we take the four dimensional theoretical model of NML as a reference in our scale development, the first-order four-factor model can be safely utilized in measuring NML.

On the other hand, the second-order model analysis also provided evidence for unidimensional usage of NMLS. Researchers can administer the scale and generate a composite variable by summing up the scores of all items (i.e., total score) rather than producing four variables with subscale scores. The relevant literature recommends that second-order models can offer several advantages over the first-order models in some research contexts. For example, they can allow researchers to test whether the total score actually account for the relationships between the subscores, explain the covariance in a more parsimonious way with fewer parameters, separate variance owing to specific factors from the measurement error, and interpret complex research structures such as multitrait-multimethod models or latent state-trait models in a more simple and useful manner (Chen, Sousa, & West, 2005). Using second-order model might be particularly beneficial when researchers are interested in exploring if first-order factors can predict a criterion variable. Therefore, the choice of which model of the scale to be used belongs to researchers and their research

Table 2
Descriptive statistics and correlation coefficients for NMLS factors.

Factor	Min-Max	Mean	SD	Skewness	Kurtosis	Correlation coefficient		
						CC	FP	CP
Functional consumption (FC)	7–35	25.85	4.93	−0.39	0.18	0.63*	0.56*	0.45*
Critical consumption (CC)	16–55	43.11	6.51	−0.47	0.06		0.56*	0.44*
Functional prosumption (FP)	7–35	26.72	5.73	−0.63	0.01			0.51*
Critical prosumption (CP)	10–50	32.22	8.97	−0.36	−0.43			

*$p < 0.01$.

purposes. Future studies are needed to compare both models in different samples and research contexts for further cross-validation of the items.

From the theoretical aspect, our findings empirically validate the preliminary work of Chen et al. (2011) and continuing efforts of Lin et al. (2013) in which they conceptualize NML as four types of literacy comprising two continuums from consumption to prosumption and from functionality to criticality. The study also corroborates the technical and socio-cultural characteristics of new media as the scale involves relevant items. One of the most important practical implications of our study is to promote research studies on NML from conceptual level to empirical one and thus to stimulate more research on new media and competencies needed to live with it. Recently, there has been a growing interest in conceptual discussion about the new media emerged with the advancements in information and communication technologies. However, the relevant literature lacks an operational tool to measure individuals' new media competencies especially producing and criticizing digital media contents. The NMLS developed in the present study can fill this gap and be utilized in the data collection phases of descriptive and experimental research contexts. This enables researchers to explore a variety of variables with which NML is associated.

The descriptive statistics for NML factors show that participants have good levels of FC, CC and FP whereas they have average level of CP. This is expected because CP is the most complex and crucial part of NML. The results suggest that current generation of students should be supported in critical and active participation in new media platforms and creation of original media contents that convey their own socio-cultural values and ideologies. School education should put more focus on how to produce and criticize media contents than how to access and understand them. NML impacts current generation's performance in school and business. It is regarded as both learning and job skill. Students and employees are expected to learn new media skills in the 21st century. Therefore, the validated NMLS can be readily utilized within a school or business to promote awareness about new media and its competencies. Furthermore, it can be employed as a diagnostic or needs assessment tool to access students' level of NML so that teachers can develop and implement suitable curricular activities to improve new media usage and test their educational effectiveness. The data collected through the NMLS can be used for pedagogical decision making in technology-enhanced learning in the schools. Teachers might use the NMLS to understand how their students interact with new media in learning. Kong et al. (2014) foresee that the goals of education in digital classrooms include the development of 21st century skills beyond learning domain knowledge, and indicate the development of tools for assessment of these skills as a critical research issue in the coming ten years. This study can contribute in this regard by providing a measuring tool for NML. The NMLS can also aid employers to assess their employees' performance gaps with regard to new media competencies and then design and implement need-based professional development programs.

In conclusion, our study produced a reliable and psychometrically valid scale for the assessment of NML. Along with the emerging new media and digital technologies, individuals are expected to actively participate in new media by producing, sharing and questioning digital contents beyond merely consuming them. Being new media literate, they also need to know social, emotional and cultural aspects of new media as well as its technical features. The NMLS involves such newest and complex media literacy competencies that emerged in the last decades. Its availability can stimulate to conduct future research studies and thus add to the growing body of literature on NML. The present study is limited to content and construct validity analysis including convergent and discriminant validity. Future studies may check additional validities such as criterion and nomological ones by taking the account of several variables related to NML. Another limitation of this study is germane to the sample. We worked with college students only because our scale targets this generation's new media competencies. However, the recruitment of participants was based on convenient sampling and could not be representative for all college students. This may decrease the potentiality of our study for generalizing results to larger populations (i.e., hindering external validity). Fortunately, the sample is quite cosmopolite (including students from different colleges) and large in size ($n = 1226$) and thus the power of the statistical techniques used in the study is rather high. Future studies may focus on different combination of college students to corroborate our findings or adaptation of NMLS to younger generation such as primary and secondary school students.

Appendix. New Media Literacy Scale (NMLS)

Directions: The term "media" used in the following items, unless otherwise specified, refers to current digital technology platforms including but not limited to web sites, online forums, social networks, video sharing sites and virtual worlds in which anyone can share any digital content. Please indicate how you feel about your knowledge and skills for each of the following statements.

1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree.

Functional consumption (FC)

1 I know how to use searching tools to get information needed in the media.
2 I am good at catching up with the changes in the media.
3 It is easy for me to make use of various media environments to reach information.
4 I realize explicit and implicit media messages.
5 I notice media contents containing mobbing and violence.
6 I understand political, economical and social dimensions of media contents.
7 I perceive different opinions and thoughts in the media.

Critical consumption (CC)

8 I can distinguish different functions of media (communication, entertainment, etc.).
9 I am able to determine whether or not media contents have commercial messages.
10 I manage to classify media messages based on their producers, types, purposes and so on.
11 I can compare news and information across different media environments.
12 I can combine media messages with my own opinions.
13 I consider media rating symbols to choose which media contents to use.
14 It is easy for me to make decision about the accuracy of media messages.
15 I am able to analyze positive and negative effects of media contents on individuals.
16 I can evaluate media in terms of legal and ethical rules (copyright, human rights, etc.).
17 I can assess media in terms of credibility, reliability, objectivity and currency.
18 I manage to fend myself from the risks and consequences caused by media contents.

Functional prosumption (FP)

19 It is easy for me to create user accounts and profiles in media environments.
20 I can use hardware necessary for developing media contents (text, image, video, etc.).
21 I am able to use software necessary for developing media contents (text, image, video, etc.).
22 I can use basic operating tools (button, hyperlinks, file transfer etc) in the media.
23 I am good at sharing digital media contents and messages on the Internet.
24 I can make contribution or comments to media contents shared by others.
25 I am able to rate or review media contents based on my personal interests and liking.

Critical prosumption (CP)

26 I manage to influence others' opinions by participating to social media environments.
27 I can make contribution to media by reviewing current matters from different perspectives (social, economical, ideological etc.).
28 I am able to collaborate and interact with diverse media users towards a common purpose.
29 It is easy for me to construct online identity consistent with real personal characteristics.
30 I can make discussions and comments to inform or direct people in the media.
31 I am skilled at designing media contents that reflect critical thinking of certain matters.
32 I am good at producing opposite or alternative media contents.
33 I produce media contents respectful to people's different ideas and private lives.
34 It is important for me to create media contents that comply with legal and ethical rules.
35 I am able to develop original visual and textual media contents (video clips, web page, etc.)

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